June 24, 2016

Larry Staples, FEC, P.Eng.
Chair, Consultation Group on Engineering Education and Accreditation

Dear Mr. Staples

Subsequent to our February 1, 2016 submission to the Consultation Group, a copy of which is attached for your reference, we have been following developments on the Consultation Group website, and with particular interest Alternatives A and B of the document "Engineering Instruction and Accreditation – Consultation on Advances in Accreditation", March 2016 and the proposed changes to curriculum content analysis to be considered by the Forum on Accreditation, August 17 - 18, 2016. This is further to your request for submissions from interested parties. We recognize that the responsibility and authority for setting criteria for accreditation lies with Engineers Canada.

The current CEAB criterion 3.4 that defines the AU as a measurement unit was developed by the CEAB and, in particular, André Biron, as a result of requests made in 1990 by the NCDEAS specifically to move away from proportional measurement, which is induced by the use of years as units of measure. The definition is also intended to ensure that the same rigorous measurement is made for every program under accreditation evaluation. Further explanation of this is provided in the attached paper by André Biron.

It is understood that the two alternatives under consideration, namely Alternative A and Alternative B, are proposed on the basis of reducing the workload, including outcomes assessment in the accreditation process, and introducing increased flexibility. In our collective opinion, neither proposal will result in a decreased workload; in fact, the opposite may prove to be true. In addition, in our experience, the current system using the well-established AU system, with particular attention to criterion 3.4.1.4, provides significant flexibility; the need for further flexibility is not clear. We note that for the 275 currently accredited engineering programs in Canada, there are 74 distinct program titles, not counting differences due purely to the use of English or French. This is concrete evidence of considerable flexibility in curriculum design but, in addition, there are wide differences in program goals and delivery across the country.

We are concerned that the proposed Alternatives A and B carry with them risks that may result in unintended consequences; primarily a reintroduction of the ambiguity and lack of rigorous curriculum content analysis that was of great concern to the NCDEAS and which was the impetus for the development of the current AU system. Certainly we consider that Alternative B is wrong and that Alternative A is suspect.

In addition to our comments on Alternatives A and B, we wish to mention, relative to the proposed change in the draft accreditation criteria for the 2017-2018 cycle, that, to our knowledge, there has never been a credible measurement of years for the real duration of studies in engineering programs in Canada. Specifically, criterion 3.4.2 states: *"The program must have a minimum of four years of full-time (or equivalent) appropriate content at a university level."* In the interpretive statement on proposed criterion 3.4.6 (the number has changed) contained in the May 19 note from Kim Allen to the stakeholders, it is stated (page 5): *"The Accreditation Board accepts the following methods to quantify four years of program content:*

- *a. The continued use of accreditation units with a minimum total of 1950 AU*

- *b. The use of the HEI's equivalent institutional academic credits"*

Option a. corresponds to the current AU system, which we support. Option b. is not clear to us. A detailed calculation would be helpful. In addition, again, we do not foresee a reduction in workload; and expect there would be an increase.

We note the request for input to the August 17-18, 2016 Forum on Accreditation in a recent Engineers Canada Newsletter and we urge you to seek extensive consultation, specifically with André Biron who is the most knowledgeable person with respect to the AU system and who has an intimate and detailed understanding of its development, history, and the risks attached to the proposed Alternatives A and B. You may reach him by e-mail at andre.biron@sympatico.ca or by phone at 514-484-1480.

As we noted in our first submission, we are five Past-CEAB Chairs who collectively:
- represent 38 years of CEAB experience,
- have worked within the system both prior and subsequent to the adoption of the AU system,
- have participated in dozens of visits as general visitors, program visitors and chairs,
- have attended every CEAB September meeting in various capacities since 1982 up to and including 2014,
- have participated in many exchange meetings and accreditation visits with our counterparts in the USA,
- have led or participated in several international accreditation visits, and
- have maintained an on-going interest in the CEAB and its very important and valuable work.

We are re-stating our offer to engage with the Consultation Group by e-mail or by teleconference should you wish to discuss further any of the points made in this submission. For ease of communication, we have agreed that Genanne Beck will act as a single point of contact for our group. You may reach her by e-mail at beckg@ns.sympatico.ca and by phone at 902-423-8744.

Yours very truly,

Les Russell, FEC, P.Eng., Chair 1995-96
Dwight Aplevich, FEC, P.Eng., Chair 1993-94
Ron Biggs, FEC, P.Eng., Chair 1992-93
André Biron, FIC, ing., Chair 1990-91
Genanne Beck, FEC, P.Eng., Chair 1988-89

CC: Georges Lozano, Kim Allen

Attachments:
February 1, 2016 Submission
June 7, 2016 André Biron Paper

Submission to Consultation Committee on Engineering Education and Accreditation
February 2016

Introduction:
Several CEAB past chairs have become aware of current discussions regarding program assessment. We believe past experience to be relevant and we submit the following for consideration.

Definitions:
For clarity, we distinguish between the following, principally with respect to CEAB criterion 3.1 (Graduate attributes) and 3.4.1 (Approach and methodologies for quantifying curriculum content):

- Pre-1995 criteria: CEAB criteria and procedures prior to 1995.
- 1995 criteria: CEAB criteria and procedures introduced in 1995, in force to 2013.
- 2014 criteria: criteria and procedures published in 2008 to take effect with the June 2014 CEAB decisions.
- Proposed criteria: Contained in Consultation Document, November 23, 2015

Workload:
Other than workload and, perhaps, the desire for increased flexibility and innovation in curriculum development, it is not clear what problems with the 2014 criteria the proposed changes are meant to address. Nor is it clear how the proposed changes address workload issues, especially since the AU system in criterion 3.4.1 will remain, although modified somewhat, if the proposed changes are implemented.

For your consideration, we offer the following breakdown of workload associated with program content analysis. The bulk of this workload can be found by analyzing the criteria and visit documents, roughly as follows:

Comparison	**Criterion 3.1**	**Criterion 3.4.1**
Focus	Student outcomes (attributes, indicators)	Program inputs (learning hours)
Principal accreditation impact	Teaching improvement, non-minimal path analysis	Accountability, minimal path analysis
Tables	Numerical, performance numbers aided by rubrics	Numerical, counts of AU and distribution of content
Methodology	Measuring the knowledge, skills, and character of graduates	Counting of credit hours and equivalent, with approximate distribution of curriculum content
Periodicity	Requires continual effort to gather and analyze data	Changes only required following curriculum changes

Although visit experience suggests that the work associated with both criteria could be reduced, criterion 3.1 requires ongoing work involving considerable judgment; criterion 3.4.1 requires occasional work that consists mainly of counting. We suggest that to reduce workload, consideration might be given to where most of it occurs. One could argue that criterion 3.1 was introduced without adequate consideration of the impact it would have on workload; hence, the current concerns have resulted.

Balance in accreditation decisions:
The long-standing accreditation challenges of separating and balancing prescription and flexibility, quantity and quality assessment, objective and subjective assessment, and now both input and output assessment remain with the proposed criteria changes.

Change of units:
The consultation document states: "…the total program requirement of 1800 AU (1950 effective 2014) is removed but the concept of a minimum 16 years total education is retained." This statement ignores the difficulties often encountered in the pre-1995 criteria in defining a year. Curriculum content was defined in years and fractions of years, but there was considerable difficulty: programs varied from about 105 to 165 credits and semesters varied from 12 to 17 weeks in length. The AU was defined, at the request of and in consultation with the NCDEAS, precisely to avoid these and related difficulties.

The 80 % maximum in one proposal is a bit of a mystery since that maximum is already guaranteed in the existing system.

It seems the proposed changes will result in a type of mixed-unit assessment of curriculum content, partly through AUs and partly through a yet to be developed interpretive statement based on assessing university credits, academic terms, or years. Does this not introduce an element of subjectivity into a quantitative assessment?

Concerns:
We share the concerns expressed by Dr. Isaacson in his letter dated December 14, 2015. However, we unanimously disagree with his recommendation 1A. This is discussed in detail in the attached appendix by André Biron (in addition, not all engineering programs in Canada use a credit system).

We consider the "simpler definition of AU's" recommendation to be a serious concern because it re-introduces problems the 1995 criteria were designed to avoid. If this were to be approved by the Board, it would set the CEAB back to the pre-1995 criteria based on years and force a return to relative values, but in a worse format since the recommendation suggests that the AU be defined in two different ways (one for the set limits such as 225 AUs, and one for the actual values for a given program).

The consultation timeline is rather severe, which limits the possibility of full discussion.

The intended benefits of the proposed changes have not been articulated or explained.

It is not clear how the proposed changes will address the perceived curriculum analysis workload issues. No comparison of workloads has been given, for example.

The proposed changes have the potential to result in a flawed process that may force some relatively heavy programs to add courses in a category that is adequately covered.

Recommendations:

- Consider fully the context in which the current system was developed in order to avoid re-introducing problems of the past.

- Consider other measures that could contribute to alleviating the workload attached to accreditation.

- Articulate, assess and consider the risks and potential impacts of proposed changes.

- Extend the consultation process timeline and broaden the consultation in order to engage a larger selection of stakeholders. One might consider page 6 of the presentation prepared for the Fall 2015 Webinar as identifying a broad range of stakeholders with vested interests in the outcomes of the work of the Consultation Group.

In spite of our disagreement with his recommendation 1A, we believe Dr. Isaacson's letter and the Appendix in this submission together provide a thoughtful summary and analysis that is a starting point for further consultation and discussion.

Respectfully submitted by:

Les Russell, FEC, P.Eng., Chair 1995-96
Dwight Aplevich, FEC, P.Eng., Chair 1993-94
Ron Biggs, P. Eng., Chair 1992-93
André Biron, FIC, ing., Chair 1990-91
Genanne Beck, FEC, P.Eng., Chair 1988-89

Appendix: Comments on Proposed "Simpler" Definition of AU's

by André Biron, ing. (CEAB Chair 1990-1991)

A letter by Dr. Michael Isaacson to the Consultation Group on Accreditation Matters, dated December 14, 2015, has been brought to my attention. The letter contains, in particular, a recommendation (1A) entitled "Replacement of the Proposal", which states, in part:

I propose that AU's are retained as at present, but that a much simpler definition is used – by taking these as proportional to the numbers of academic credits at the institution…This would preclude the need to calculate the number of hours of lectures, tutorials and laboratories comprising a course, nor would there be any need to rely on complex K-factor calculations…This approach relies solely on a suitably defined proportionality constant between AU's and academic credits, and nothing else…

I do not support this recommendation for reasons detailed in this text.

HISTORICAL BACKGROUND OF CURRICULUM CONTENT MEASUREMENT

As many of us know, the Canadian Engineering Accreditation Board (CEAB) was created in 1965. I believe that it was in 1975 that a curriculum content process was established which can be briefly described as follows.

The process established requirements in terms of "years" for each of the following five categories: Mathematical Foundations (later Mathematics), Basic Sciences (later Natural Sciences), Engineering Science, Engineering Design, and Humanities, Social Sciences and Administrative Studies (later Complementary Studies). For a model program of four years, the total requirements for the five categories was 3.5 years, thus leaving one half-year (12.5%) not prescribed.

The main point about this process, for a typical four-year program, was that all calculations were based on the equivalence between the total of academic credits at the institution and four years. Thus, for example, a "half-year" requirement meant exactly 12.5% of that total of academic credits.

This process remained mandatory from 1975 to 1995, when it was replaced by the "AU Approach".

The reason for this replacement was increasing doubt, among several Board Members, about the real significance of the requirement in terms of percentages. For example, a program which barely satisfied the half-year requirement in, say, Mathematics, could be penalized if it added a course in another category, such as engineering design.

This discomfort culminated in the 1990-1991 period, when I was CEAB Chair, in particular in the fall of 1990 when the CEAB received the annual NCDEAS report with several recommendations (Ross Peters, CEAB Chair 2007-2009, later told me that he was the main author of that report). The first recommendation, and I believe that it was considered the most important by the

NCDEAS, was (here I am using my own words, from memory) that the CEAB should stop measuring curriculum content with relative values, and start measuring it in absolute terms.

It turned out that I was in total agreement with that recommendation, and work began soon after on the design of the AU Approach.

The philosophy for that approach was related to the fact that the contents of a year were not known (other that it consisted of 26 weeks), nor were the contents of a week, or even a day, known. However, the contents of an hour of instruction were known. And thus, the hour became the basis for the approach.

The approach was also designed to remain as close as possible to the current situation: programs that had been accredited using the old system should also be accredited with the new approach.

The core of the new approach was the definition of the AU in terms of hours, with additional means to take into consideration program activities not measurable on an hourly basis (hence the optional tool of the K-factor). It is precisely this core that recommendation 1A quoted above intends to eliminate.

VARIATIONS BETWEEN ENGINEERING PROGRAMS IN CANADA

Another feature that was discovered while developing the AU approach was that the total of AU's in engineering programs in Canada varied considerably.

During the summer of 1991, with the help of two students, I examined the contents of one program in each of the 32 engineering institutions in Canada. Electrical Engineering was the choice for 26 institutions, and another program was chosen at random for the other six institutions that did not have an Electrical Engineering program.

To give an idea of the variations, here are the totals for AU's, in an increasing order, for 25 four-year programs in 1991:

1799/1838/1853/1937/1950/1951/1954/1976/1980/1984/1991/2047/2133/2162/2170/2203/2216/2243/2253/2259/2270/2310/2373/2381/2806

The underlined values are for programs other than Electrical Engineering.

The highest value (2806) is for RMC, which was expected for a military program.

The high variations underline even further the limited significance of relative numbers. For example, an arbitrary selection of the fourth lightest (1937) and the fourth heaviest (2310) programs reveals that 0. 5 year for the median program (2133) contains the same number of AU's as 0.55 year for the light program and 0.46 year for the heavy program.

REASONS FOR NOT SUPPORTING RECOMMENDATION 1A

There are few details given for recommendation 1A. My understanding is that the number of credits at the institution would be set equal to a certain number of AU's. Let us assume, for the

sake of discussion, that a 120-credit program would correspond to 1950 AU's (this would automatically satisfy the requirements for at least 20% non-prescribed components), and that this program contains 14 credits of Complementary Studies.

I also assume that the requirements for each category would be retained: thus, for example, the Complementary Studies requirement would be 225 AU's.

The Complementary Studies analysis would then be: 14 x 1950/120 = 227.5, thus satisfying the 225 requirement for AU's.

Now if this same program adds an Engineering Design course and an Engineering Science course, each of 3 credits, for the following accreditation visit, and if nothing else is changed, the numbers would then be:

- Credits: 126
- The number of years would still be 4 years for the program
- The constant value of AU's would still be 1950.

Then the Complementary Studies analysis would be: 14 x 1950/126 = 216.7, thus not satisfying the 225 requirement for AU's. This failure is only due to the addition of a couple of courses in the program.

This is precisely the main objection that the NCDEAS had in 1990.

I support the concern expressed by the NCDEAS which is still valid today. And thus, I consider that the proportionality definition proposed is not acceptable.

I should also note that the use of the AU in this recommendation is not justified. That concept was needed to relate to an absolute value (the hour). In recommendation 1A, it would be simpler to use an entity that everyone can understand, such as the duration of the program in years.

In other words, this would be a return to the process used from 1975 to 1995 that the Board wanted to eliminate.

Montreal, January 9, 2016

A COMMENT ON THE PROPOSED FLEXIBILITY FOR THE DEFINITION OF ONE TUTORIAL OR LABORATORY HOUR IN ALTERNATIVES A AND B

DOCUMENT "ENGINEERING INSTRUCTION AND ACCREDITATION" (MARCH2016)

by André Biron, FIC, ing., CEAB Chair 1990-1991

Alternatives A and B (described on pages 39 to 41) introduce, among other features, a significant change compared to the current AU approach: each institution would have the discretion to define equivalent instructional hours for laboratories and tutorials as it considers appropriate, whereas the current AU approach states that one hour of laboratory or scheduled tutorial must be counted as one half of the value of one hour of lecture.

In my opinion, a consequence of this change is that numerical minimum values in absolute form, mentioned for alternative B (such as 225), and also included as a guide for alternative A, are no longer valid. The reason is that the totals of instructional hours for a given program are now dependent upon the discretion of the institution. Hence I consider that alternative B is unacceptable. In addition, I consider that alternative A may provide results that have limited significance.

HISTORICAL BACKGROUND

In November 1990, the Accreditation Board received the annual NCDEAS report which included, as was customary, several recommendations. In particular, Recommendation 2 a) read as follows:

"A better explanation of the CEAB's intention regarding minimum content should be included on the policy statement. Specifically, it is suggested that the following sentence be added to clause 2.2.8. "In all cases the requirements are to be met in terms of the absolute amount of instruction, not the proportion of a particular curriculum".

It was this recommendation, coupled with increasing doubts among some Board members at the time about the real significance of the curriculum content measurement in "years" which had been used in Canada since at least 1975, that provided the impetus for the development of what is now known as the AU approach. The Board agreed with Recommendation 2 a).

The AU approach, mandatory in Canada since 1996, has been based on the results of a detailed study of the contents of one program for each of the 32 engineering institutions in Canada in the summer of 1991 (25 of those programs were four-year programs). That study was carried out by two industrial engineering students under my direction (Reference 1). A copy of that report (in French) was given to the Board in 2007.

Several combinations were considered in the report and, in particular, two indices were calculated for each program examined:

- The (1 – ½) index, where one laboratory or tutorial hour was assumed equivalent to one half lecture hour.

- The (1 – 1) index, where one laboratory or tutorial hour was assumed equivalent to one lecture hour.

At the end, the (1 – ½) index was retained. The (1 – 1) index was therefore dropped.

However, the information related to the (1 – 1) index is still available, and considering the proposed features for alternatives A and B, this can be useful in order to estimate how much a given variation in the value of one laboratory or tutorial hour influences the total number of equivalent hours (or AU's in the current approach).

For the sake of simplicity, I have restricted my computations to the 25 four-year programs of 1991 (Reference 1, Appendix F, Graphs 11 and 14). The result is that, if the equivalence of one laboratory or tutorial hour is increased from 0.5 lecture hour to 1 lecture hour, then the total AU's are increased by **at least 15%** (the median increase was 20%).

This means that, if the higher value had been selected in 1991 for laboratory or tutorial hours, corresponding to the (1 – 1) index, then the major equivalence of the entire approach (with the minimum increase of 15%) would probably have been:

4 years = 1800 x 1.15 = 2070 (instead of 1800)

Then the minimum value corresponding to the old half-year would have been about **260** (instead of 225). And so on.

ANALYSIS OF ALTERNATIVES A AND B

The major conclusion from the preceding comments is that, for a given program, any variation in the counting of a laboratory or tutorial hour, relative to the value of a lecture hour, leads to a variation in the total of instruction hours for that program that is significant (at least 15%, for example, if the variation for tutorial or laboratory hours is 100%). Consequently, all numerical minimum values in absolute form mentioned on page 41 for alternative B (at least 420, 900, 225…) would need to be modified in accordance with the values given by each institution to tutorial or laboratory hours (such as 530, 1035, 260… for an increase of 100% for tutorial or laboratory hours). The same comment applies to the guideline given for alternative A on page 40 for the definition of a full-time semester.

If the numbers used in alternative B remain unchanged, and if one hour of tutorial is worth anything other than 0.5 lecture hour, then not only are those numbers irrelevant, they also lead, in the case of an increase for the value of one tutorial or laboratory hour (a likely event), to lower standards for curriculum content.

Thus the only "acceptable" form of numerical limits would be alternative A (ignoring the guideline for the measurement of a full-time semester on page 40), where the minimum values are given as percentages (which should be calculated on the basis of the internal units of an institution, such as credits; the proposed definition of an "instruction hour" is not needed). This, however, would correspond to a major policy reversal relative to the 1990 NCDEAS recommendation 2 a) quoted above. In addition, those minimum percentages (23%, 45%, 12%) would have limited significance because, as noted on page 39, "longer programs can be unfairly constrained". That quote in the text applies only to programs "that [are] longer than four years." But it should also apply to all programs because it can be shown in Reference 1 that there are significant differences in terms of equivalent hours between programs that have the same nominal duration. Without going to extremes, it was easy to find differences of more than 10% between two four-year programs in the sample of 1991.

CONCLUSION

The current AU approach is considered, as mentioned on page 24, as "rigorous" and "robust". It measures curriculum content accurately in absolute terms. It is therefore a major challenge to introduce modifications to the approach in order to increase flexibility and/or to reduce workload without paying a price, i.e. without losing the precision that currently exists.

The two alternatives A and B illustrate how difficult that challenge is. By allowing institutions to establish a value deemed appropriate for tutorial and laboratory hours, the main purpose of the AU approach, namely normalization, is lost. And the overall result, in my judgment, is that in its current form, alternative B is unacceptable, and that alternative A is a return to the system that existed from 1975 to 1995 in Canada and that the CEAB wanted to replace because the significance of the results was not clear.

I have some difficulty understanding the fact that Deans have been raising issues regarding the constraints put upon educational innovation by the current system (page 4). Section 3.4.1.4 of the Criteria reads as follows:

The Accreditation Board can give consideration to departures from this approach and these methodologies în any case in which it receives convincing documentation that well-considered innovation in engineering education is in progress.

There have been some cases (probably rare) where this has happened.

As far as reduction of workload is concerned, I have sympathy for that issue considering the additional requirements for graduate attributes. But the proposed

changes I have seen, so far, have not provided convincing evidence that they would lead to such a reduction. In fact, in some cases, I see an increase of workload (for example with the need to measure years).

My overall conclusion is that, if curriculum content is relevant to the quality of engineering programs, then the current AU approach should be retained, without any change.

Reference 1

« Étude comparative des heures d'enseignement et de laboratoire dans les universités canadiennes offrant des programmes d'ingénierie », by Luce Paquet and Chantale St-Arneault, November 1991

Montreal, June 7, 2016