A Guide to Outcomes-based Criteria

For Visiting Team-Chairs and Program Visitors

Canadian Engineering Accreditation Board

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Table of Contents

Abbreviations

AB	Accreditation Board
CI	Continual Improvement
CIS	Course Information Sheet
GA	Graduate Attribute
HEI	Higher Education Institution
PV	Program Visitor
VT	Visiting Team
WA	Washington Accord

Background

In May-June 2015, the CEAB will make the first round of decisions incorporating two new outcomes-based high-level criteria. It should be emphasized that these "new" criteria are additional to the existing criteria and do not in any way replace or weaken those criteria. The criteria have been developed to facilitate assessment of the following aspects of engineering programs:

3.1 Graduate attributes
The higher education institution must demonstrate that the graduates of a program possess the attributes under twelve 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.

3.2 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.

3.3 Students
Accredited programs must have functional policies and procedures that deal with quality, admission, counselling, promotion and graduation of students.

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 program.

3.5 Program Environment
The Accreditation Board considers the overall environment in which an engineering program is delivered.

3.6 Accreditation procedures and application
These criteria provide a broad definition of the scope and limitations of engineering programs in Canada that can be considered for accreditation

Purpose

The purpose of this guide is to provide information to visiting teams (VT) and program visitors (PV) to assist them in gathering appropriate evidence for the Accreditation Board (AB), with particular reference to the outcome-based criteria.

The essence of the graduate attribute (GA) criterion is that the program demonstrates that performance levels have been assessed against program expectations for the twelve attributes.

The essence of the continual improvement (CI) criterion is that the program has developed a procedure for program review, with consultation of appropriate stakeholders, leading to appropriate actions, based on measured performance relative to expectations.

The role of the visiting team and program visitors is thus to provide the Board with their assessment of the completeness, quality and reliability of the information that they have gathered and reviewed.

Although the Board makes all decisions on the granting or denial of accreditation to a program, the Board relies on the documentary evidence submitted by the programs and the reports of the visiting teams.

This guide is intended to provide a consistent framework for reporting on the outcomes-based criteria. It is not intended to add to any criteria or documentary requirements for the higher education institutions (HEI). The guide is organized as a series of questions relating to the standardized questionnaire tables (3.1.1 and 3.1.2) documenting the outcomes-based criteria. After each question, a number of actions are suggested to assist the PV/VT in providing answers for their report to the AB. There is no requirement or expectation that the PV/VT answer each question for each attribute.

Exhibit 1, appended to the 2015 questionnaire, provides a structure for the discussion of responses for CEAB criteria 3.1 (graduate attributes) and 3.2 (continual improvement).

If insufficient evidence was provided in the standard documentation the program should be requested to make supplementary information available, preferably before the visit, but no later than at the time of the document review on the first day of the visit (usually Sunday afternoon).

If excessive amounts of information were provided and the information was not transferred to the questionnaire standardized forms, the team chair should request immediate resubmission of the questionnaire (and in extreme cases may consider rescheduling the visit).

Course Information Sheets

CIS are intended to provide PV/VT with a brief summary of the content and characteristics of the learning activities (usually, but not restricted to, courses) in a program.

Course Information Sheets Instructions:
To be completed for **all** **courses** that appear in table 4.5a (compulsory courses) and table 4.5b (elective courses) in the questionnaire.

Notes on content-level codes for instructional level
Programs are asked to classify the instructional level of content relating to one or more graduate attribute in each learning activity (usually a course). It is important that the visiting team verify that course information sheets (CIS) are accurate, complete and current.

The content level codes specified for use in course information sheets are:

I	introduced	D	developed	A	applied

It is assumed that learning activities associated with delivering attributes are organized in a progression from **introductory** through **development** to **application** level. These terms classifying instructional level require contextual definition with reference to engineering course content. Over the four years of an engineering program:

1. The depth and the complexity of the material increases
2. The way the material is covered changes
3. Expectations for success change
4. How a student uses the material changes

At the ***introductory*** level the students learn the working vocabulary of the area of content, along with some of the major underlying concepts. Many of the terms need defining and the ideas are often presented in a somewhat simplified way.

At the intermediate ***development*** level the students use their working vocabulary and major fundamental concepts to begin to probe more deeply, to read the literature, and to deepen their exploration into concepts. At this level, students can begin to appreciate that any field of study is a complex mixture of sub-disciplines with many different levels of organization and analysis.

At the advanced ***application*** level the students approach mastery in the area of content. They explore deeply into the discipline and experience the controversies, debate and uncertainties that characterize the leading edges of any field. An advanced student can be expected to be able to relate course material across different courses, to begin to synthesize and integrate and achieve fresh insights. Students at this level are working with the knowledge very differently, perhaps even creating new knowledge through independent investigation.

Definitions and Terminology

A number of terms and phases used in the guide are assumed by the AB to have a specific interpretation. It is essential for consistency that all PV/VT and AB use and interpret these terms in the same way.

Graduate Attributes

Generic characteristics, specified by the Accreditation Board, expected to be exhibited by graduates of accredited Canadian engineering programs at the time of graduation.

Attribute Indicators

Descriptors of what students must do to be considered competent in the attribute; the measurable and pre-determined standards used to evaluate learning (i.e. measureable characteristics of attributes or components of attributes).

Assessment Tools

Measurement devices (metrics) used to develop sources of data on student learning (e.g. tests, quizzes, examinations, rubrics, etc.)

Performance Descriptors

Scales of descriptors of the performance levels students have achieved for a specific assessment indicator (e.g. [A/B/C/D/F]; [>80%/70-79%/60-69%/50-59%/<50%]; [innovates/applies/comprehends/knows]; [acceptable/marginal/unacceptable]; [students have mastered…./students can apply…./students can describe…./students know….]).

Performance descriptors should have an “action verb” (apply, comprehend…) and a description of content but either of these components can be implicit or abbreviated in a particular context. (e.g. >80% means “students have mastered introductory chemistry”; <50% means “students have insufficient knowledge of introductory chemistry”)

Curriculum Map

A plotted representation (often in the form of a table) that shows the relationship between learning experiences (e.g. courses, co-ops, co-curricular activities), instructional and assessment methods, and intended learning for each aspect of a given program so that the relationships and connections among all the elements are easily seen.

In–Depth Knowledge

In-depth knowledge means knowledge gained from courses/learning activities beyond the introductory instructional level described on p. 6.

Complex Engineering Problems

In 2012, the CEAB adopted the definition of complex problem used in the Washington Accord (WA) graduate attribute exemplar. A defining characteristic of professional engineering is the ability to work with complexity and uncertainty since no real engineering project or assignment is exactly the same as any other. Accordingly, the attributes place as central the notions of complex engineering problems and complex problem solving.

A complex engineering problem is defined by the following characteristics:

1. It must require the application of *in-depth knowledge*
2. It must satisfy at least one of the following additional characteristics:
    - involves wide-ranging or conflicting Issues
    - has no obvious solution such that originality is required
    - involves infrequently encountered issues
    - is outside accepted standards and codes
    - involves diverse stakeholders and needs
    - is posed at a high-level with many components or sub-problems

First Principles

First principles are the fundamental concepts or assumptions on which a theory, system, or method is based. In engineering, first principles start directly at the level of established laws of chemistry, physics and mathematics and do not argue by analogy or make use of any empirical formulae or assumptions.

Resea*r*ch

Primary research involves experiments, investigations, or tests carried out to acquire data first-hand. Research in the context of this guide is used more broadly to include data gathered from appropriate technical and non-technical sources, including but not restricted to the peer-reviewed engineering literature, specifications, standards, codes, and reports.

Curriculum Mapping

Table 3.1.1 Curriculum map

Curriculum map instructions:

List all learning activities (courses etc.) that relate to specific graduate attributes. Highlight those activities where student achievement has been, or is planned to be, assessed (measured).

Questions for visiting teams to consider

Were the instructions followed in filling in the table?

Comment on the accuracy and completeness of the map
Identify any apparent errors in the map

Does the curriculum map align with the course information sheets?

Identify any inconsistencies between the curriculum map and the CIS
Comment the impact of any changes in mapping as a result of PV/VT reviews of the CIS

Are any learning activities supporting only one graduate attribute?

Identify activities that are well-aligned with a single attribute

Are graduate attributes dependent on a single (or limited number) of learning activities?

Identify activities where opportunities for assessment are scarce

Are assessments reasonably distributed over time?

Identify opportunities to track group/cohort performance through the program for specific attributes in the assessment scheme

Are assessments reasonably distributed over graduate attributes?

Identify attributes that might be “over-sampled” in the assessment scheme
Identify attributes that might be “under-sampled” in the assessment scheme
Identify attributes that are not sampled in the assessment scheme

Is there too much dependence on a single learning activity for assessment?

Identify activities that are associated with more than three attributes

Are there better aligned learning activities where measurements could be made?

Identify activities that are not assessed where alignment with attributes appears better

Are there better times in the program where measurements could be made?

Identify sequencing and timing issues with the mapping
Identify sequencing and timing issues with the assessment scheme

Are there too many assessment points?

Comment on the sustainability of the assessment scheme within the resources of the program/HEI
Identify any apparent redundancies within the assessment scheme

Are there too few assessment points?

Identify any apparent gaps within the assessment scheme

Attribute Indicators

<u>Table 3.1.2 Attribute indicators</u>

Attribute indicators instructions:

List the indicators associated with each attribute together with the learning activities where the indicator has been used to assess performance of students (as highlighted in Table 3.1.1). Rows are provided but there is no expectation that they will all be used for any particular attribute. If more rows are needed, add rows as required.

The information requested in the standardized questionnaire is a sample. The program/HEI are free to include additional documents <u>but must complete the standardized tables</u>. The PV/VT may also consider requesting supplementary data either <u>before</u> or at the time of the on-site visit. It is recommended that such requests target specific issues.

<u>Questions for visiting teams to consider</u>

Were the instructions followed in filling in the table?

Identify any attributes where a set of indicators were not provided

Identify any inconsistencies between Table 3.1.1 highlighting and Table 3.1.2 selections

Are the indicators aligned with (directly relevant to) the attributes?

Identify any indicators that are not well-aligned (specific and relevant) with an attribute or an attribute component

Identify any indicators that address multiple components of an attribute (non specific)

Are there enough indicators for each attribute?

Identify any significant components of an attribute that are not addressed by an indicator (gaps in coverage of indicators relative to the attribute description)

Are there too many indicators for any attributes?

Identify any overlap between indicators (redundancy? or valuable cross-check?)

Comment on the sustainability of the assessment schedule for the program/HEI

Are the indicators measureable?

Identify any indicates where measurement is likely to be a challenge

Provide a rationale for your issue with the measurability of any indicators

Are the assessment points in the curriculum well chosen?

Identify indicators that may be inappropriate for the instructional level

Identify any unnecessary assessment points and redundancies

Assessment Tools

Table 3.1.3 Assessment tools

Assessment tools instructions:

Provide examples of the assessment tools (rubric or other) used to comparatively evaluate performance for any 12 indicators listed in Table 3.1.2. At least one indicator for each of the 12 attributes must be included. Change column headings as required. Add or delete columns as required. Provide performance descriptors that exactly correspond to those used in assessment. A complete set of all assessment tools should be available to the visiting team at the time of the visit.

The information requested in the standardized questionnaire is a sample. The program/HEI are free to include additional documents but must complete the standardized tables. The PV/VT may also consider requesting supplementary data either before or at the time of the on-site visit. It is recommended that such requests target specific issues.

Questions for visiting teams to consider

Were the instructions followed in filling in the table?

Identify any attributes where too many sample indicators are provided (adding more examples doesn't add value)?

Identify any attributes where too few indicators are provided (perhaps where different performance level metrics are used?)

Are the performance descriptors well aligned with the graduate attributes?

Identify cases where performance descriptors are generic and not attribute-specific

Are there enough performance descriptors (levels)?

Identify cases where there may be too few descriptors (<3?)

Discuss rationale with program/HEI and comment in the report

Are there too many performance descriptors (levels)?

Identify cases where there may be too many descriptors (>5?)

Discuss rationale with program/HEI and comment in the report

Are the performance descriptors distinct and unambiguous?

Identify cases where performance level descriptors are indistinct or ambiguous

Discuss with instructors/students and comment in the report

Do the instructors/students have a common understanding of the performance descriptors?

Identify any inconsistencies between instructor and student understanding of descriptors

Document any procedural or ad-hoc consultations/discussions of performance descriptors that have taken place between instructors/students

What are the consequences if an individual fails to meet expectations?

Identify any consequences of falling below expectations

No action/consequence? Repeat assessment? Cross-check in other assessments?

Are individual student-performance-levels monitored?

Determine where or not performance records of individuals in respect of attributes are maintained and monitored

Assessment Results

Table 3.1.4 Assessment results

Assessment results instructions:

Provide examples of the assessment results for the 12 indicators listed in Table 3.1.3. If possible, provide data for multiple assessments collected at different times for the same learning activity, and multiple assessments using the same tool in different learning activities. A complete set and summary of all results should be available to the visiting team at the time of the visit.

The information requested in the standardized questionnaire is a sample. The program/HEI are free to include additional documents but must complete the standardized tables. The PV/VT may also consider requesting supplementary data either before or at the time of the on-site visit. It is recommended that such requests target specific issues.

Questions for visiting teams to consider

Were the instructions followed in filling in the table?

- Identify cases where no summary was provided on the first day
  - Request the summary and report any discussions
- Identify cases where no histograms were provided
- Identify cases where multiple assessments were made at different times in the program
- Identify cases where the same tool (rubric?) was applied to multiple activities (courses?)

Are the results reasonable considering the sample (class or group) size?

- Identify cases where small numbers of students create problems with data
- Discuss finding larger groups or combining groups/cohorts
- Identify cases where large numbers of students result in "noisy" data
- Discuss validity/calibration/verification of assessment tool

Are there too many "fails" considering the sample (cohort or group) size?

- Identify possible changes in performance descriptor scale (range and threshold)

Are there too few "fails" performances considering the sample (cohort or group) size?

- Identify possible changes in performance descriptor scale (range and threshold)

Is the threshold between success and failure reasonable and objective?

- Identify any cases where the threshold is indistinct or unclear to instructors/students
- Discuss with students/instructors

Is the time-progression of results reasonable?

- Identify trends over stages in programs
- Identify cases where change/variability in assessment tools limits the potential for trend analysis
- Discuss rationale for variations with program/HEI and report discussions

Continual Improvement

Table 3.2.1 Continual improvement
Questions for visiting teams to consider

Discuss the specific results from Table 3.1.4 with respect to future program expectations. What conclusions do you draw from the specific data presented?
Is the interpretation of the data reasonable (over-interpreted or under-interpreted)? *Is the data meaningful or expected to become meaningful over time?* *Is there sufficient support from the data to justify action?* *How many cycles of data collection might be need to justify action?*
Who are the stakeholders consulted (or to be consulted) in the program revision process? How will (or have) the consultations take place?
Are the students consulted? How? *Are the alumni consulted? How?* *Are service-course providers and representatives of the HEI outside engineering consulted? How?* *Are representative groups of employers/industry consulted? How?* *Are stakeholders representing the profession consulted? How?* *Are stakeholders representing the public (non-technical) consulted? How?* *How are stakeholder representatives selected?* *How is continuity in stakeholder representatives to be maintained?*
How are the results from data collection and analysis being used (or are planned to be used) in support of program improvement?
Who decides whether the data supports a decision for change? *Can actions be implemented without supporting data?* *Can stakeholder groups mandate change?* *Can the program-faculty as a whole or individuals veto change?* *Where does the final decision-making authority lie (program/HEI/stakeholders)?*
What specific actions have been planned or implemented as a result of the data collection and analysis with respect to expectations for and achievement of graduate attributes?
How many specific actions have been implemented as a result of the CI process? *How many specific actions are planned as a result of the CI process?* *Is there a process to monitor the results of actions?* *Is any such process sustainable and transparent?*

Review of Graduate Attributes

The PV and/or VT are tasked with assembling evidence that the program has demonstrated measured student-performance (as a group or cohort) in respect of each attribute. Such evidence may be drawn both from the documentation provided by the program and from interviews and observations during the site visit. Please refer to the guidance on instructional level (introduction, development, application) for courses (p. 7).

This guide provides a framework for the PV/VT as a series of questions to consider and possible sources of information where answers might be found. A summary of the specific evidence accumulated from the documentation review and site visit for each attribute should be reported to the AB by the PV/VT to support the decision-making process (and will be disclosed to the HEI for correction of factual errors).

This section suggests some questions relating to specific attributes to help the PV/VT provide the AB with evidence supporting how well the indicators, assessment instruments and data analysis align with the attribute descriptors. It will be up to the AB to maintain consistency across programs within the same HEI and across HEI. Using the questions of this guide as a framework for reporting is intended to help promote consistency in the evaluation of the outcomes-based criteria.

There is no requirement or expectation that all programs address all content at all levels or that programs measure performance for every attribute component in every course/learning activity. However, the PV/VT are in the best position to comment on the extent to which the sample of activities chosen for assessment by the program/HEI are reasonably representative.

The PV/VT are not expected to provide answers to all the questions posed. The questions are provided to guide the visitors in framing the information that they provide to the AB. The final section of this guides provides examples of the kind of narrative that the AB expect to help them in the decision making process. Reports should report observations – formative comments can be provided by the PV/VT but provision of summative analysis is the role of the AB at the decision meeting.

Knowledge base

Demonstrated competence in university-level mathematics, natural sciences, engineering fundamentals, and specialized engineering knowledge appropriate to the program.

Criterion 3.3 “Curriculum content and quality” specifies minimum input content requirements for mathematics (MATH), natural sciences (NS) and engineering sciences (ES). For this attribute criterion 3.1.1, the program must demonstrate that an appropriate level of student performance has been achieved for this content. There are four explicit sub-components of this attribute that require comment: mathematics, natural sciences, engineering fundamentals, and specialized engineering knowledge.

The primary source of information for PV/VT is probably the CIS, backed up by on-site review of more detailed course information (if necessary). Only where courses are well-aligned with specific components of the attribute will examination results may be an appropriate performance measure.

<u>Questions for visiting teams to consider specific to courses/learning activities identified with the knowledge base in Table 3.1.1</u>

What evidence <u>demonstrates graduate performance</u> relative to program expectations for the knowledge base?

Identify assessment tools, results and analysis

How many activities address mathematics (at each of the I-D-A levels)?
How many activities address natural sciences (at each of the I-D-A levels)?
How many activities address engineering fundamentals (at each of the I-D-A levels)?
How many activities address program-specific engineering (at each of the I-D-A levels)?
How many activities identified address *complex engineering problems*?

In each case, identify and list the activities

Are the courses/learning activities selected for assessment representative?
Are the indicators used for the knowledge base attribute well-aligned with the attribute-descriptor?

Identify any issues with indicator alignment

Are there gaps in the indicators used relative to the attribute-descriptor?

Identify any gaps or inconsistencies between indicators and the descriptor

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.

The primary source of documentation for PV/VT information is probably CIS, assignments, project reports supplemented by on-site interviews with students/faculty. Assessment tools are likely to be rubrics applied to assignments and project reports. Please refer to p.7 for the contextual definitions of *in-depth knowledge*, *complex engineering problem, first-principles,* and *research.*

Questions for visiting teams to consider specific to courses/learning activities identified with problem analysis in Table 3.1.1

What evidence demonstrates graduate performance relative to program expectations for problem analysis?
Identify assessment tools, results and analysis

How many activities identified address *complex engineering problems*?
How many activities identified require the use of *in-depth knowledge* of mathematics, natural sciences, or engineering fundamentals*?*
How many activities require the use of *in-depth knowledge* of discipline-specific engineering*?*
How many activities require the development of solutions from *first-principles*?
How many activities require *research* for the development of solutions?
How many activities require students to substantiate/validate their solutions and conclusions?

In each case, identify and list the activities

Are the courses/learning activities selected for assessment representative?
Are the indicators used for the problem-analysis attribute well-aligned with the attribute-descriptor?

Identify any issues with indicator alignment

Are there gaps in the indicators used relative to the attribute-descriptor?

Identify any gaps or inconsistencies between indicators and the descriptor

Problem 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.

The primary source of documentation for PV/VT information is probably CIS, assignments, laboratory reports, project reports supplemented by on-site interviews with students/faculty. Assessment tools are likely to be rubrics applied to assignments, laboratory reports and project reports. Please refer to p.7 for the contextual definitions of *in-depth knowledge*, *complex engineering problem, first-principles,* and *research.*

Questions for visiting teams to consider specific to courses/learning activities identified with problem investigation in Table 3.1.1

What evidence demonstrates graduate performance relative to program expectations for problem investigation?

Identify assessment tools, results and analysis

How many activities identified address *complex engineering problems*?
How many activities identified require the use of *in-depth knowledge* of mathematics, natural sciences, engineering fundamentals *or* discipline-specific engineering*?*
How many activities require application of the principles of experimental design?
How many activities require *research* as an investigative tool?
How many activities require critical analysis of data sources and data interpretation?
How many activities require compilation and synthesis of information from multiple data sources?
How many activities require students to substantiate/validate their solutions and conclusions?

In each case, identify and list the activities

Are the courses/learning activities selected for assessment representative?
Are the indicators used for the problem-investigation attribute well-aligned with the attribute-descriptor?

Identify any issues with indicator alignment

Are there gaps in the indicators used relative to the attribute-descriptor?

Identify any gaps or inconsistencies between indicators and the descriptor

Engineering 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.

The primary source of documentation for PV/VT information is probably CIS, assignments, project reports supplemented by on-site interviews with students/faculty. Assessment tools are likely to be rubrics applied to assignments, logbooks and project reports. Please refer to p.7 for the contextual definitions of *in-depth knowledge*, *complex engineering problem, first-principles,* and *research.*

Questions for visiting teams to consider specific to courses/learning activities identified with engineering design in Table 3.1.1

What evidence demonstrates graduate performance relative to program expectations for engineering design?

Identify assessment tools, results and analysis

How many activities identified address *complex engineering problems*?
How many activities identified require the use of *in-depth knowledge* of mathematics, natural sciences, engineering fundamentals *or* discipline-specific engineering*?*
How many activities identified address open-ended problems?
How many activities identified address health and safety considerations in design?
How many activities identified used applicable engineering standards and codes?
How many activities identified address economic, environmental, cultural and societal considerations in design?

In each case, identify and list the activities

Are the courses/learning activities selected for assessment representative?
Are the indicators used for the design attribute well-aligned with the attribute-descriptor?

Identify any issues with indicator alignment

Are there gaps in the indicators used relative to the attribute-descriptor?

Identify any gaps or inconsistencies between indicators and the descriptor

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.

The primary source of documentation for PV/VT information is probably CIS, assignments, laboratory reports, project reports supplemented by on-site interviews with students/faculty. Assessment tools are likely to be rubrics applied to assignments, logbooks and project reports. Please refer to p.7 for the contextual definitions of *in-depth knowledge*, *complex engineering problem, first-principles,* and *research.*

Questions for visiting teams to consider specific to courses/learning activities identified with use of engineering tools in Table 3.1.1

What evidence demonstrates graduate performance relative to program expectations for use of engineering tools?

Identify assessment tools, results and analysis

How many activities involve *complex engineering activities*?
How many activities use computer-based tools (software and hardware)?
How many activities involve "hands-on" use of modern engineering equipment?
How many activities involve application of modern techniques and methodologies?
How many activities involve understanding and/or assessment of limitations?

In each case, identify and list the activities

Are the courses/learning activities selected for assessment representative?
Are the indicators used for the use of engineering tools attribute well-aligned with the attribute-descriptor?

Identify any issues with indicator alignment

Are there gaps in the indicators used relative to the attribute-descriptor?

Identify any gaps or inconsistencies between indicators and the descriptor

Individual and team work

An ability to work effectively as a member and leader in teams, preferably in a multi-disciplinary setting.

The primary source of documentation for PV/VT information is probably CIS, assignments, laboratory reports, project reports supplemented by on-site interviews with students/faculty. Assessment tools are likely to be rubrics applied to assignments, logbooks and project reports.

Questions for visiting teams to consider specific to courses/learning activities identified with use of engineering tools in Table 3.1.1

What evidence demonstrates graduate performance relative to program expectations for individual and teamwork?

Identify assessment tools, results and analysis

How many activities demonstrate performance of individuals working independently?
How many activities demonstrate performance as team members or team leaders in diverse teams?
How many activities demonstrate team experience in multi-disciplinary settings?

In each case, identify and list the activities

Are the courses/learning activities selected for assessment representative?
Are the indicators used for the use of engineering tools attribute well-aligned with the attribute-descriptor?

Identify any issues with indicator alignment

Are there gaps in the indicators used relative to the attribute-descriptor?

Identify any gaps or inconsistencies between indicators and the descriptor

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.

The primary source of documentation for PV/VT information is probably CIS, assignments, laboratory reports, project reports supplemented by on-site interviews with students/faculty. Assessment tools are likely to be rubrics applied to formal and informal presentations and written essays and reports. Please refer to p.7 for the contextual definitions of *in-depth knowledge*, *complex engineering problem, first-principles,* and *research.*

Questions for visiting teams to consider specific to courses/learning activities identified with communication skills in Table 3.1.1

What evidence demonstrates graduate performance relative to program expectations for communication skills?
  Identify assessment tools, results and analysis

How many activities involve communication of *complex engineering concepts*?
How many activities target a professional/technical audience?
How many activities target a public/non-technical audience?
How many activities target reading, comprehension and listening skills?
How many activities involve written formal and informal reports?
How many activities involve formal and informal presentations?
How many activities target design and structuring of documentation?
How many activities involve giving and responding to verbal or written instructions?
  In each case, identify and list the activities

Are the courses/learning activities selected for assessment representative?
Are the indicators used for the communication skills attribute well-aligned with the attribute-descriptor?
  Identify any issues with indicator alignment
Are there gaps in the indicators used relative to the attribute-descriptor?
  Identify any gaps or inconsistencies between indicators and the descriptors

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.

The isolation of professionalism as an attribute is unique to the Canadian accreditation system. The primary source of documentation for PV/VT information is probably CIS, assignments and on-site interviews with students/faculty. Assessment tools are likely to be rubrics applied to assignments, essays, debates and role-playing exercises.

<u>**Questions for visiting teams to consider specific to courses/learning activities identified with professionalism in Table 3.1.1**</u>

What evidence <u>demonstrates graduate performance</u> relative to program expectations for professionalism?

Identify assessment tools, results and analysis

How many activities address an understanding of the role of the P.Eng.?
How many activities address an understanding of the responsibilities of the P.Eng.?
How many activities address protection of the public and the public interest?
How many activities address the professional code of ethics?
How many activities discuss engineering failures?
How many activities discuss legal liability of engineers?
How many activities discuss integrity issues for engineers?
How many informal or formal opportunities do students have to meet practicing engineers (outside the academic environment)?

In each case, identify and list the activities

How many instructors are licensed to practice engineering in Canada?
How many instructors serve as volunteers for learned and professional societies?

Are the courses/learning activities selected for assessment representative?
Are the indicators used for the professionalism attribute well-aligned with the attribute-descriptor?

Identify any issues with indicator alignment

Are there gaps in the indicators used relative to the attribute-descriptor?

Identify any gaps or inconsistencies between indicators and the descriptors

Impact on society and the environment

An ability to analyze social 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.

The primary source of documentation for PV/VT information is probably CIS, assignments, and project reports. Assessment tools are likely to be rubrics applied to assignments, essays, debates and role-playing exercises.

<u>Questions for visiting teams to consider specific to courses/learning activities identified with the impact on society and the environment attribute in Table 3.1.1</u>

What evidence <u>demonstrates graduate performance</u> relative to program expectations for impact on society and the environment?

Identify assessment tools, results and analysis

How many activities address concepts of sustainable design and development?
How many activities address concepts of environmental stewardship?
How many activities address understanding of interactions with economic issues?
How many activities address understanding of interactions with legal issues?
How many activities address understanding of interactions with cultural and social issues?
How many activities address understanding of interactions with health and safety issues?
How many activities address understanding and analysis of uncertainties in prediction?

In each case, identify and list the activities

Are the courses/learning activities selected for assessment representative?
Are the indicators used for the impact on society and the environment attribute well-aligned with the attribute-descriptor?

Identify any issues with indicator alignment

Are there gaps in the indicators used relative to the attribute-descriptor?

Identify any gaps or inconsistencies between indicators and the descriptors

Ethics and equity

An ability to apply professional ethics, accountability, and equity.

The primary source of documentation for PV/VT information is probably CIS, assignments, project reports and interviews with students and instructors. Assessment tools are likely to be rubrics applied to assignments, essays, debates and role-playing exercises.

Questions for visiting teams to consider specific to courses/learning activities identified with the ethics and equity attribute in Table 3.1.1

What evidence demonstrates graduate performance relative to program expectations for ethics and equity?

Identify assessment tools, results and analysis

How many activities provide opportunity to develop, discuss or demonstrate an ability to apply principles of professional ethics?
How many activities provide opportunity to develop, discuss or demonstrate an ability to apply principles of professional accountability?
How many activities provide opportunity to develop, discuss or demonstrate an ability to apply principles of equity in the workplace?

In each case, identify and list the activities

Are the courses/learning activities selected for assessment representative?
Are the indicators used for the ethics and equity attribute well-aligned with the attribute-descriptor?

Identify any issues with indicator alignment

Are there gaps in the indicators used relative to the attribute-descriptor?

Identify any gaps or inconsistencies between indicators and the descriptors

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.

The primary source of documentation for PV/VT information is probably CIS, assignments, project reports and interviews with students and instructors. Assessment tools are likely to be rubrics applied to assignments, essays, debates and role-playing exercises.

Questions for visiting teams to consider specific to courses/learning activities identified with the economics and project management attribute in Table 3.1.1

What evidence demonstrates graduate performance relative to program expectations for economics and project management?

Identify assessment tools, results and analysis

How many activities provide opportunity to incorporate aspects of business practices in an engineering context?
How many activities provide opportunity to incorporate aspects of project management in an engineering context?
How many activities provide opportunity to incorporate aspects of risk management in an engineering context?
How many activities provide opportunity to incorporate aspects of change management in an engineering context?
How many activities provide opportunity to develop an understanding of the limitations of economic analysis in an engineering context?
How many activities provide opportunity to develop an understanding of the limitations of engineering management techniques?

In each case, identify and list the activities

Are the courses/learning activities selected for assessment representative?
Are the indicators used for the economics and project management attribute well-aligned with the attribute-descriptor?

Identify any issues with indicator alignment

Are there gaps in the indicators used relative to the attribute-descriptor?

Identify any gaps or inconsistencies between indicators and the descriptors

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 primary source of documentation for PV/VT information is probably CIS, assignments, project reports and interviews with students and instructors. Assessment tools are likely to be rubrics applied to assignments, essays, debates and role-playing exercises.

<u>**Questions for visiting teams to consider specific to courses/learning activities identified with the lifelong learning attribute in Table 3.1.1**</u>

What evidence <u>demonstrates graduate performance</u> relative to program expectations for lifelong learning?

Identify assessment tools, results and analysis

How many activities provide opportunity to reflect on individual current educational needs?
How many activities provide opportunity to reflect on individual future educational needs?
How many activities provide opportunity to reflect on issues of local, national and global change?
How many activities provide opportunity for in-depth individual research of an engineering topic outside the scope of formal coursework?

In each case, identify and list the activities

Are the courses/learning activities selected for assessment representative?
Are the indicators used for the lifelong learning attribute well-aligned with the attribute-descriptor?

Identify any issues with indicator alignment

Are there gaps in the indicators used relative to the attribute-descriptor?

Identify any gaps or inconsistencies between indicators and the descriptors

Examples of Reporting

It is important that the role of the PV/VT as objective observers gathering information is maintained and that the AB, with the experience gained from reports on many programs, continue to act as decision-makers.

In this section, examples are provided to illustrate the kind of feedback suggested for the PV/VT report. In each case, the suggested questions are answered for specific attributes for a **hypothetical program** and an appropriate report-response framed. The suggested framework for reporting consists of a summary of observations with optional formative commentary.

Purple text is used to indicate information collected and verified by PV/VT.

Problem analysis report

Observations

What evidence demonstrates graduate performance relative to program expectations for problem analysis?

Assessed activities expect 75% to exceed level 3 on 4 point scale.

Only one assessment cycle has been completed. Both direct and indirect assessments are used.

	#	Introduced	Developed	Applied
Identified	8	ENGR103; DSPE201, 302, 303	DSPE302, 303, 305, 306	DESX401, 403
Assessed	4	ENGR103; DSPE201	DSPE302	DESX401
Performance	4	77; 76	74	71

How many activities identified address complex engineering problems? 2(DESX401, 403)

How many activities identified require the use of in-depth knowledge of mathematics, natural sciences, or engineering fundamentals? 6(DSPE302, 303, 305, 306, DESX401, 403)

How many activities require the use of in-depth knowledge of discipline-specific engineering? 6(DSPE302, 303, 305, 306, DESX401, 403)

How many activities require the development of solutions from first-principles? No evidence

How many activities require research for the development of solutions? 2(DESX401, 403)

How many activities require students to substantiate/validate their solutions and conclusions? 4(DSPE303, 306, DESX401, 403)

Are the courses/learning activities selected for assessment representative? Yes.

Are the indicators used for the problem-analysis attribute well-aligned with the attribute-descriptor? Not fully. No indicator aligns with use of first-principles or research requirement. Indicators do not resolve components of in-depth knowledge.

Are there gaps in the indicators used relative to the attribute-descriptor? Yes. No indicator aligns with use of “first-principles” or “research”.

Report on attribute

The program has measured performance for 4 activities in four different semesters. The sample (4 of 8) is reasonably representative. Performance levels have been measured for only one cycle. Both direct and indirect assessment methods have been applied. Measured performance levels either exceed or are close to program expectations. Generic indicators are reasonably well-aligned but do not resolve components of in-depth knowledge and no indicators align with use of “first-principles” and “research”.

Formative comments

Consider linking performance expectations to instruction-levels (I-D-A).

Consider revision of indicators to improve alignment with attribute-descriptor.

Use of engineering tools report

Observations

What evidence demonstrates graduate performance relative to program expectations for use of engineering tools?

Assessed activities expect 75% to exceed level 3 on 4 point scale.

Only one assessment cycle has been completed. Only direct assessments are used.

No assessment is undertaken for this attribute at the application (advanced) level.

	#	Introduced	Developed	Applied
Identified	8	ENGR102; CMPT102; DSPE301	DSPE301, 401; CO-OPS	CO-OPS; DESX401, 403
Assessed	3	ENGR102	DSPE301, 401	
Performance	4	78	75, 76	

How many activities involve complex engineering activities? 4 (CO-OPS, DESX401, 403) Note: CO-OP experiences are highly variable.

How many activities use computer-based tools (software and hardware)? 3(CMPT102, DSPE301, DSPE401)

How many activities involve "hands-on" use of modern engineering equipment? 4(CO-OPS; DESX401, 403) Note: CO-OP experiences are highly variable.

How many activities involve application of modern techniques and methodologies? 4(CO-OPS; DESX401, 403) Note: CO-OP experiences are highly variable.

How many activities involve understanding and/or assessment of limitations? 1(DESX403). Only evidence is brief section in final design reports.

Are the courses/learning activities selected for assessment representative? No. ENGR102 involves old equipment and routine analysis.

Are the indicators used for the use of engineering tools attribute well-aligned with the attribute-descriptor? Yes but they are generic rather than specific in character.

Are there gaps in the indicators used relative to the attribute-descriptor? Yes. Indicators do not resolve computer tools, equipment, and methodologies/techniques.

Report on attribute

The program has measured performance for 3 activities in three different semesters. The sample (3 of 8) is not fully representative. Performance levels have been measured for only one cycle. Only direct assessment methods have been applied. Measured performance levels either exceed or are close to program expectations. Generic indicators are reasonably well-aligned but do not resolve components of use of tools (computers/equipment/methodologies).

Formative comments

Consider replacing ENGR102 as an assessment target.

Consider revising indicators to be more specific relative to the attribute-descriptor.

Consider placing more emphasis understanding/assessment of limitations.

Consider employer feedback for indirect assessment of CO-OPS.

Individual and team work report

Observations

What evidence <u>demonstrates graduate performance</u> relative to program expectations for individual and teamwork?

Assessed activities expect 75% to exceed level 3 on 4 point scale.

The assessment cycle is incomplete. Only one partial assessment cycle completed.

Only indirect assessment tools are used.

No assessment is undertaken for this attribute in a multidisciplinary context.

	#	Individual	Member/Leader	Multi Team
Identified	8	DESX101,102, 301, 302, 401, 402, 403, 404; CO-OPS	DESX101,102, 301, 302, 401, 402, 403, 404; CO-OPS	CO-OPS
Assessed	2	DESX102, 302	DESX102, 302	None
Planned	1	DESX404	DESX404	None
Performance	2	70, 75	70, 75	None

How many activities demonstrate performance of individuals working independently? 10(DESX101, 102, 301, 302, 401, 402, 403, 404; CO-OPS)

How many activities demonstrate performance as team members or team leaders in diverse teams? 10(DESX101, 102, 301, 302, 401, 402, 403, 404; CO-OPS). Limited diversity.

How many activities demonstrate team experience in multi-disciplinary settings? 2(CO-OPS) Note: CO-OP experiences are highly variable.

Are the courses/learning activities selected for assessment representative? Yes, but all activities are similar in character (design projects).

Are the indicators used for the use of engineering tools attribute well-aligned with the attribute-descriptor? Yes, but relying on self-assessment and peer-assessment can be criticized both as inconsistent and subjective.

Are there gaps in the indicators used relative to the attribute-descriptor? Yes. There is no process to ensure that all students experience tem-member, team-leader, and multidisciplinary-team roles.

Report on attribute

The program has measured performance for 3 activities in three different semesters. The sample (3 of 12) is representative but the activities show limited diversity (all design projects). Indicators do not assess characteristics of multidisciplinary teams. Performance levels have not been measured for a full cycle. Only indirect assessment methods have been applied. Measured performance levels either exceed or are close to program expectations.

Formative comments

Consider possibilities for multidisciplinary teams.

Consider developing a direct assessment tool for this attribute.

Consider employer feedback for indirect assessment of CO-OPS.

Impact on society and the environment

Observations

What evidence <u>*demonstrates graduate performance*</u> *relative to program expectations for impact on society and the environment?*

Assessed activities expect 75% to exceed level 3 on 4 point scale.

Only one assessment cycle has been completed.

Both direct and indirect assessment tools are used.

	#	Introduced	Developed	Applied
Identified	9	ENCS102	DESX301; ENCS301; DESX401, 403;	ENCS401; CO-OPS; SOCIETIES
Assessed	3	ENCS102	ENCS301	ENCS401
Performance	3	75	80	79

How many activities address concepts of sustainable design and development? 2(ENCS102, 301; SOCIETIES)

How many activities address concepts of environmental stewardship? 2(ENCS102, 301; SOCIETIES)

How many activities address understanding of interactions with economic issues? 3(ENCS401; DESX401, 403)

How many activities address understanding of interactions with legal issues? No evidence. Considered under professionalism and project management.

How many activities address understanding of interactions with cultural and social issues? 5(ENCS102, 301; CO-OP; SOCIETIES)

How many activities address understanding of interactions with health and safety issues? 3(ENCS102; CO-OPS)

How many activities address understanding and analysis of uncertainties in prediction? 2(ENCS301, 401)

Are the courses/learning activities selected for assessment representative? Yes.

Are the indicators used for the impact on society and the environment attribute well-aligned with the attribute-descriptor? Yes.

Are there gaps in the indicators used relative to the attribute-descriptor? No. This is a program-strength.

Report on attribute

The program has measured performance for 3 activities in three different semesters. The sample (3 of 9) is reasonably representative. Performance levels have been measured for only one cycle. Both direct and indirect assessment methods have been applied. Indicators are specific and well-aligned. Measured performance levels exceed program expectations.

Formative comments

None.

Ethics and equity report

Observations

What evidence demonstrates graduate performance relative to program expectations for ethics and equity?

Assessed activities expect 75% to exceed level 3 on 4 point scale.

No assessment cycle has been completed. Only partial assessment available.

Only indirect assessment tools are used.

	#	Introduced	Developed	Applied
Identified	5	ENCS102, 202, 302	CO-OPS	None
Assessed	1	ENCS102	None	None
Planned	1	ENCS302	None	None
Performance	1	66	None	None

How many activities provide opportunity to develop, discuss or demonstrate an ability to apply principles of professional ethics? 5(ENCS102, 202, 302; CO-OPS) Limited opportunities.

How many activities provide opportunity to develop, discuss or demonstrate an ability to apply principles of professional accountability? 5(ENCS102, 202, 302; CO-OPS) Limited opportunities.

How many activities provide opportunity to develop, discuss or demonstrate an ability to apply principles of equity in the workplace? 2(CO-OPS) Note: CO-OP experiences are highly variable.

Are the courses/learning activities selected for assessment representative? Yes, but always consists of single assignment based on introductory-level content.

Are the indicators used for the ethics and equity attribute well-aligned with the attribute-descriptor? No. Ethics indicators are duplicates of those applied to professionalism and not all align with ethics. Equity is not addressed by any indicator.

Are there gaps in the indicators used relative to the attribute-descriptor? No. Equity is not addressed by the assessment tools.

Report on attribute

The program has measured performance for 2 activities in two different semesters. The sample (2 of 5) is reasonably representative. Performance levels have not been measured for a full cycle. Both direct and indirect assessment methods have been applied. Indicators are not well-aligned and fail to address equity. Measured performance levels fall below program expectations.

Formative comments

Consider revision and expansion of the current minimal “embedded” coverage of this attribute.

Consider a subset of focused indicators from those applied to professionalism.

Consider including specific indictors to address equity.

Life-long learning report

Observations

What evidence demonstrates graduate performance relative to program expectations for lifelong learning?

Assessed activities expect 75% to exceed level 3 on 4 point scale.

Only one assessment cycle has been completed.

Both direct and indirect assessment tools are used.

	#	Introduced	Developed	Applied
Identified	4	DSPE201	DSPE301	DSPE404; SOCIETIES
Assessed	3	DSPE201	DSPE301	DSPE404
Performance	1	72	75	80

How many activities provide opportunity to reflect on individual current educational needs? 1(DSPE201)

How many activities provide opportunity to reflect on individual future educational needs? 1(DSPE301)

How many activities provide opportunity to reflect on issues of local, national and global change? 2(DSPE201, 301)

How many activities provide opportunity for in-depth individual research of an engineering topic outside the scope of formal coursework? 2(DSPE301, 404)

Are the courses/learning activities selected for assessment representative? Yes

Are the indicators used for the lifelong learning attribute well-aligned with the attribute-descriptor? Yes

Are there gaps in the indicators used relative to the attribute-descriptor? No. Specific courses to cover program planning and research methodologies (DSPE201) plus a senior research elective including discussion of requirements for future graduate studies form a strong foundation in preparation for lifelong learning.

Report on attribute

The program has measured performance for 3 activities in three different semesters. The sample (3 of 4) is fully representative. Performance levels have been measured for only one cycle. Both direct and indirect assessment methods have been applied. Indicators are specific and well-aligned. Measured performance levels either exceed or come close to program expectations.

Formative comments

Consider making the research elective a core component of the program.

Summative Evaluation

The following summative evaluations are based on the preceding **hypothetical report-examples**. In the early stages of outcomes-based assessment this will be the role of the AB to better ensure consistency but as PV/VT gain experience and AB expectations are more clearly articulated, this role may be assumed by the PV/VT.

Attribute	A	M	U	Rationale
Problem analysis	x			
Use of engineering tools		x		Not fully aligned with attribute-descriptor. Too focused on computers.
Individual and team work			x	Not fully aligned with attribute-descriptor. No indicator(s) for multidisciplinary team experience. Assessment cycle incomplete. No direct assessment tools.
Impact on society and the environment	x			Program strength.
Ethics and equity			x	Not fully aligned with attribute-descriptor. Equity not addressed by any indicator. Performance falls below expectations. Content is embedded in broad activities addressing many attributes. CO-OP experience is not assessed.
Lifelong learning	x			Program strength

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