Report on the 2020 consultation of the Engineering Design Task Force

Contents

1. Introduction

1.1. The current use of the term 'engineering design' in the CEAB criteria

Engineering Design is a nebulous term to define and use. The CEAB uses the terms in both inputs (AUs) and outcomes (GAs):

- CEAB Criterion 3.1.4 defines "Design" as *"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."*[1]
- CEAB Criterion 3.4.4.5 defines "Engineering Design" as *"Engineering design integrates mathematics, natural sciences, engineering sciences, and complementary studies in order to develop elements, systems, and processes to meet specific needs. It is a creative, iterative, and open-ended process, subject to constraints which may be governed by standards or legislation to varying degrees depending upon the discipline. These constraints may also relate to economic, health, safety, environmental, societal or other interdisciplinary factors."*[2]

HEIs, Program Visitors and CEAB members potentially have differing subjective interpretations of the term.

1.2. The 'Definition of Engineering Design' Task Force

To address the issues stemming from having two functional definitions of engineering design, the CEAB struck the Engineering Design Task Force, composed of Jeff Pieper (Chair), Emily Cheung and Suzanne Kresta. The Task Force was mandated to explore the challenges stakeholder groups face given the existence of the two definitions of engineering design and to establish a consistent interpretation and application of the definitions of "design" in the context of the CEAB. The goal is to have a single, accurate and comprehensive definition and interpretive statement on "Engineering Design". This will enable HEIs to better deliver quality education and prepare for CEAB visits. It will also aid CEAB visiting teams to provide consistent and reasoned assessments for eventual use in making accreditation decisions.

The primary outcome of the Engineering Design Task Force is to produce a draft revised definition of Engineering Design for Criteria 3.1.4 and 3.4.4.5 and relevant interpretive statement(s) for consideration by all stakeholders of the accreditation process. Both of these elements are presented below.

[1] CEAB Accreditation Criteria and Procedures 2020
[2] CEAB Accreditation Criteria and Procedures 2020

2. 2020 Consultation scope and methodology

2.1. Consultation objectives

The primary objectives of the consultation on the proposed new definition of Engineering Design and the accompanying interpretive statement were to:

1. Inform stakeholders of an alternate definition of engineering design (and therefore revisions to the Design Graduate Attribute, Criterion 3.4.4.5, and development of a new interpretive statement on engineering design) is being considered.
2. Investigate stakeholder reaction to the report recommendations.
3. Consolidate and synthesize stakeholder feedback with the objective of putting forward a list of recommendations for implementation.
4. Identify barriers to change if the report recommendations are adopted.
5. Develop a reasonable implementation plan that accommodates the diverse viewpoints of stakeholders.

The consultation process had four guiding principles:

1. Be inclusive of all relevant stakeholder groups.
2. Be transparent.
3. Be procedurally fair.
4. Encourage feedback (both positive and constructive).

2.2. Consultation approach

At their June 1-2, 2019 meeting, the CEAB instructed the Definition of Engineering Design Task Force to consult with stakeholders on the recommendations made in the document, "Engineering Design Task Force Report" (Appendix 1). In keeping with Engineers Canada's consultation process (Appendix 2), the consultation team used a virtual focus group methodology accompanied by a general call for comments. Focus groups allowed the consultation team to focus on the specific questions of interest with targeted stakeholders of accreditation.

To standardize the consultation meetings as much as possible, the planning team developed the following materials:

- An invitation to participate which describes the process by which stakeholder feedback will be collected and how it will be used, and explains that feedback will be summarized and made available to stakeholders (Appendix 3).
- A presentation slide deck which will be used at every consultation (Appendix 4).
- Engineers Canada web content to inform readers about the consultation process and outcomes.

The "Engineering Design Task Force Report" was also used to provide an overview of the recommendations to those participating in the consultation.

Stakeholders were made aware of the consultation process through the Engineers Canada bi-weekly newsletter and the weekly update email from Engineers Canada's CEO. Additionally, a web page dedicated to the consultation was hosted on the Engineers Canada website.

The consultation period opened on October 1, 2020 and closed December 2, 2020. All stakeholders were invited to participate in two introductory webinars, which were recorded and shared on the Engineers Canada website and were publicly accessible. The webinars provided:

- background on the Task Force's creation and purpose,
- an overview of the recommendations; and
- the ways by which each stakeholder group would be consulted.

The English introductory webinar was held on October 15, 2020 with 45 participants, and the French introductory webinar was held on October 16, 2020 with four participants.

All stakeholders were then invited to:

1. Request a 1-hour webinar or in-person meeting to provide feedback on the recommendations.
2. Submit written feedback.

2.3. Website statistics

Page/Item	Unique page views	Average time spent	Number of downloads
Canadian Engineering Accreditation Board's 2020 engineering design task force report webpage	220	3:50	n/a
Rapport 2020 du Groupe de travail sur la conception en ingénierie - Bureau canadien d'agrément des programmes de génie webpage	44	4:10	n/a
Engineering Design Task Force Report	n/a	n/a	61 unique (63 total)
Rapport du Groupe de travail sur la conception en ingénierie	n/a	n/a	13 unique (13 total)

2.4. Stakeholders

The following stakeholders were invited to participate in the consultation:

- Regulators
  - CEO Group
  - National Admissions Officers Group
- Engineering Deans Canada (EDC)
  - Higher education institutions
- Engineers Canada
  - Engineers Canada Board
  - Accreditation Board
  - Qualifications Board
- Canadian Federation of Engineering Students

- The Natural Sciences and Engineering Research Council (NSERC) Design Chairs
- The Canadian Engineering Education Association

Given the diverse structure of each stakeholder group, the primary contact within each organization was invited to request a meeting with members of the Task Force for a tailored consultation focus group. Consequently, members of the Task Force attended a meeting with Engineering Deans Canada to discuss the recommendations in the report.

2.5. Key questions asked of each stakeholder

Each stakeholder was asked to respond to the following questions:

1. Is the definition of the "Engineering Design" broad enough to apply to Criteria 3.1.4 *and* Criteria 3.4.4.5 yet specific enough to support consistent application of the definition in the context of the CEAB? If not, what is missing, inconsistent or inaccurate?
2. What is missing or unclear in the interpretive statement on engineering design that could offer more guidance to visiting teams and HEIs on how to apply and assess 'design' in the context of the CEAB?
3. What are the ramifications, both positive and negative, of implementing the proposed definition and interpretive statement? What risks will be incurred by this implementation? How can these risks be mitigated?

3. Findings

3.1 List of stakeholders that provided feedback

Table 1 lists the stakeholders that provided feedback, the method by which feedback was provided, and the date it was received.

Table 1: List of stakeholders that provided feedback

Stakeholder	Feedback method	Date received
Rob LeBlanc *Chair, Canadian Engineers Qualification Board*	Letter	December 8, 2019
Canadian Engineers Accreditation Board *February 8, 2020 meeting*	Meeting discussion notes	February 8, 2020
Waguih ElMaraghy *CEAB member*	Email	February 9, 2020
Roydon Fraser *CEQB member*	Email	March 9, 2020
Jason Carey and Fraser Forbes *University of Alberta*	Email	October 13, 2020
W. Ramahi *Not identified*	Webinar comment	October 15, 2020
Tim Joseph *Engineers Canada Board/Director appointee to the CEAB*	Webinar comment	October 15, 2020
Rick Sellens *Not identified*	Webinar comment	October 15, 2020
Cliff Knox *Professional Engineers Ontario*	Webinar comment	October 15, 2020
Suzelle Barrington *CEAB member*	Webinar comment	October 15, 2020
Mahmoud Mahmoud *CEQB Chair*	Webinar comment	October 15, 2020
Denis Peters *Memorial University*	Webinar comment	October 15, 2020
Christine Moresoli *University of Waterloo*	Webinar comment	October 15, 2020
Changiz Sadr *Engineers Canada Board*	Webinar comment Email	October 15, 2020 October 20, 2020
Carol Jaeger *University of British Columbia*	Webinar comment	October 15, 2020
Amy Hsiao *University of Prince Edward Island/CEQB member*	Webinar comment	October 15, 2020
Dwight Aplevich *University of Waterloo*	Webinar comment Email	October 15, 2020 October 16, 2020
Suzanne Kresta *CEAB member*	Email	October 15, 2020

Stakeholder	Feedback method	Date received
Claude Laguë *University of Ottawa*	Email	October 26, 2020
Matt Borland *University of Waterloo*	Email	November 9, 2020
Sharon Sankar *Chair, National Admissions Officials Group*	Letter	November 11, 2020
Engineering Deans Canada *November 19, 2020 meeting*	Meeting discussion notes	November 19, 2020
Waguih ElMaraghy *CEAB member*	Emails	November 25 & 26, 2020
J. Christopher Bouwmeester *University of Toronto*	Email	November 26, 2020
Department of Civil Engineering, University of British Columbia *Submitted by Carol Jaeger*	Email	November 26, 2020
Marie-José Nollet École de technologie supérieure	Email	December 1, 2020
Paul Henshaw *University of Windsor*	Email	December 2, 2020
Michel Couturier *University of New Brunswick*	Email	December 2, 2020
University of British Columbia – Vancouver *Submitted by Carol Jaeger*	Email	December 3, 2020
Minha Ha *York University*	Email	December 4, 2020
Grant McSorley *University of Prince Edward Island*	Letter	December 4, 2020
Pierre Bourque *CEAB member*	Email	December 4, 2020
Paula Klink *CEAB member*	Email	December 4, 2020
Jason Foster *University of Toronto*	Email	December 4, 2020
Roni Khazaka *Faculty of Engineering at McGill University*	Email	December 4, 2020
Christine Moresoli *Faculty of Engineering at the University of Waterloo*	Email	December 5, 2020
Kevin Deluzio *Faculty of Engineering at Queen’s University*	Email	December 7, 2020
Russ Kinghorn *Previous Engineers Canada President*	Email	December 7, 2020
Roch Lefebver *Université de Sherbrooke*	Email	December 8, 2020
Sierra Sparks *Canadian Federation of Engineering Students*	Email	December 9, 2020

Stakeholder	Feedback method	Date received
Alfred Inacio *Business Technology Consultant*	Email	January 4, 2021
John Newhook *Dalhousie University*	Email	January 5, 2021
Jerome Talim *Carleton University*	Email	January 8, 2021

In all, the Task Force received 43 pieces of feedback. Input was received from individuals, HEIs, organizations and regulatory bodies representing both academia and industry. A total of approximately 90 pages of materials were generated via the consultation process.

3.2 Feedback themes

A variety of feedback was received throughout the consultation period. There was a range of opinions on the Task Force's two recommendations: a new definition of engineering design to be applied to all criteria, and an interpretive statement to help HEIs and visiting team members assess engineering design activities.

Recommendation 1: Adopt the proposed revised definition of engineering design

The majority of the feedback received was supportive of having one definition of engineering design within the accreditation system. Stakeholders made recommendations on elements that should be included or removed from the proposed definition; the Task Force assessed each suggestion to determine if it strengthened the proposed definition, if it was a duplicate idea, or if it would dilute or expand the scope of the definition. Many suggestions for the proposed definition also informed the proposed interpretive statement by highlighting where clarifications and/or alignments were required.

Recommendation 2: Adopt the proposed interpretive statement

The proposed interpretive statement generated many comments with recommendations for elements that should either be included or removed for greater clarity. The language of the proposed interpretive statement was revised to remove proscriptive language (such as 'must' and 'should') in favour of language which provides suggestions (such as 'typically' and 'could').

Common point of feedback between the proposed definition and interpretive statement

Many stakeholders provided comments on the discipline-specific nature of engineering design; in response, the Task Force assessed both the proposed definition and proposed interpretive statement with the goal of ensuring that both were sufficiently broad to be applicable to a range of engineering disciplines. In order to provide additional clarity, multiple illustrative examples were added to the proposed interpretive statement.

4. Recommendations to CEAB

In light of the feedback received through the 2020 consultation on the definition of engineering design, the Task Force recommends that the CEAB adopt the following definition and interpretive statement:

Definition

Engineering design is a process of making informed decisions to creatively devise products, systems, components, or processes to meet specified goals based on engineering analysis and judgement. The process is often characterized as complex, open-ended, iterative, and multidisciplinary. Solutions incorporate natural sciences, mathematics, and engineering science, using systematic and current best practices to satisfy defined objectives within identified requirements, criteria and constraints. Constraints to be considered may include (but are not limited to): health and safety, sustainability, environmental, ethical, security, economic, aesthetics and human factors, feasibility and compliance with regulatory aspects, along with universal design issues such as societal, cultural and diversification facets.

Interpretive Statement

The Accreditation Board develops interpretive statements to clarify the intent underlying certain key expectations which generate inquiries that are not otherwise covered by the Accreditation board criteria. The following Interpretive Statement on Engineering Design offers clarity on the definition as it relates to criteria 3.1.4 and 3.4.4.5, and Graduate Attribute 4.

It is recognized that the process, skills, and competencies associated with design are fundamental to the practice of engineering. A key feature of good engineering design education is the instilling of a mindset of creative exploration of a range of approaches to problems framed as complex, open-ended, iterative, and multidisciplinary. The process of making decisions in engineering design requires the use of well-founded skills, competencies and knowledge.

Design education relates to the development of students who approach the design process with goals related to exploring the range of possibilities to meet objectives as set out in problems they face. Design engineers will consider sets of constraints, engineering, computational and scientific tools that can be brought to bear, and the requirements of the problem in arriving at solutions. These solutions are evaluated for their fit in meeting the objectives and also, but of no less importance, their societal, economic, health and safety, as well as regulatory factors as appropriate.

In order to aid Higher Education Institutions (HEIs) and program visitors in consistently assessing the presence of engineering design, a statement of the limitations or what may be excluded from the activity of design can be useful.

What engineering design is not

Engineering design is not being effectively accomplished if the following characteristics are present:

- immediate or clear solutions
- a single, correct answer

- solutions relating directly to component specification or sizing.

As noted above, component specification and sizing exemplify a key feature that distinguishes design. If a student encounters a problem with accomplishing a task and needs to explore ways to achieve the goals within constraints, then the development and assessment of a solution can be considered as design. On the other hand, if the problem requires a student to specify a size or particular component to accomplish a task, then the design aspect is significantly diminished. Notably, problems that involve the specification and sizing based on standard tables and pre-engineered-type products may be considered more as analysis than design. It is also recognized that different disciplines may have different approaches to engineering design. If a learning activity is framed appropriately for the level of design, then this type of analysis may be considered introductory design. In engineering disciplines, where design relies heavily on codes and standards, some flexibility in decision-making must be included at all levels.

What engineering design includes

Conversely, effective engineering design brings together a variety of skills related to design activity and may also involve skills specific to a technical discipline or multiple disciplines as needed. While practitioners bring varied approaches to design as applied to problems within their fields, some overarching characteristics of appropriate design include, but are not limited to:

- development or fostering of creativity
- inclusion of open-ended problems
- development and use of modern design theory and methods
- needs or scope identification
- consideration of constraints such as:
    - health and safety,
    - sustainability,
    - environmental,
    - ethical,
    - security,
    - economic,
    - compliance with regulatory aspects,
    - universal design issues (including societal, cultural and diversification facets)
    - aesthetics and human factors
- formulation of problem statements and specifications
- consideration of alternative solutions and decision-making
- feasibility
- risk analysis
- production, manufacturing, or implementation processes
- detailed system description and documentation
- testing, prototyping, modelling, and validation
- effective (multi-disciplinary) teamwork and communication skills

Engineering design is a culminating aspect of program integration and demonstrates connections between the technical skills and knowledge taught in engineering programs. As such, appropriate design education weaves through programs as a connecting thread. In a well-configured program, a design course would occur in every academic year at a level commensurate with a student's abilities. Typically, design activities would help students build communication skills and present opportunities for teamwork. Successful achievement of the graduate attribute of design can be measured by the ability of a program to develop students who display the qualities associated with an effective design engineer. These qualities relate to competence in the aspects and skills described as being part of the overarching characteristics of design.

The process of design differs across disciplines and in different geographic regions, but key elements of the design process generally encompass:

- establishment of needs and description of scope in consideration of project stakeholders
- definition of objectives and criteria, including goals, constraints, and available resources
- identification of universal design needs
- synthesis, including evaluation of alternatives and descriptions of tools and techniques
- analysis
- execution, including computation, prototyping, modelling, and/or implementation
- validation and testing, including acceptance and evaluation
- reporting, including descriptions of the methods and processes applied to the design activity, recommendations, and statements on the limitations and constraints.

Design at all points in the curriculum of a program, from introductory through intermediate to advanced levels, follows this defined process or some appropriate variation. As the competency of the designer increases, the complexity of the problem, efficacy of the solution, and sophistication of the tools brought to bear on the problem will also increase. It is expected that students gain appreciation for the appropriateness of a design within the context of the problem to be solved. This can be accomplished by consideration of technological and economic issues, in addition to a demonstrated ability to understand the level of complexity suited for the problem. This type of sophistication in assessment of design by the student advances as the program progresses from entry (first-year) to senior-level learning activities. Assessment of students' engineering design skills should focus on the competencies they are expected to develop throughout the process.

Descriptions of engineering design

Engineering design can be considered as having multiple levels. As a student progresses through their engineering programs, design experiences will expand to more complex and open-ended problems. By the end of a student's education, they are exposed to a range of design experiences and are able to employ tools and resources to arrive at solutions. It is through this exposure that students come to appreciate the value of design at levels appropriate to their abilities, skillsets, and understanding. Students will then be able to make judgements of their own and present designs for evaluation with respect to validity, feasibility, economics, and practicality. In order to consistently identify engineering design within a program, the following descriptions are presented to delineate the types of activities and outcomes that are appropriate for common design exercises.

1. Introductory: Where design often follows an algorithmic approach and set standards or rules are applied. While different techniques can be used, and alternative solutions can be found, usually these converge on essentially the same final result. At this level, students are developing skills in identifying design characteristics as they learn to use these within the context and at a level appropriate to their knowledge and skillsets. The process of design should be clearly defined and understood.

2. A developmental level: Where problems are clearly defined but differing solutions can be found, often by taking varying paths towards solving or dealing with a set of objectives. At this level, a small group of solutions with similar characteristics are typically found at the end of the design process exercise. Managing constraints and objectives are commonly approached using well-established methods and a clear process.

3. Complex: Where a clear path to a solution is not generally apparent. Often this level involves bringing together differing methods for handling conflicting objectives, decision making, and constraints to recognize new and unforeseen solutions. In some disciplines, design relates primarily to technology selection, development, optimization and sizing. This work may fall outside the domain of design codes.

As described above, learning opportunities per year/level can be assigned at the discretion of the program. However, programs are encouraged to distribute engineering design activities throughout all the years of a program and not solely via capstone projects. It is noted that different engineering disciplines and pedagogies will require tailored approaches to assess engineering design content.

It is recognized that design experiences are typically handled and captured well in entry-level activities (i.e. first-year) and capstone design projects. While culminating significant design experiences (i.e. capstone projects) are usually given highest value in the design chain or sequence, valuing the entirety of the chain is important for imparting a more comprehensive view of design to students. The intermediate level design activities, usually found in the second and third years of the program, are often difficult to differentiate from engineering science. These intermediate-level experiences generally involve development of skills in parallel with the design work. Appropriate handling of these two aspects is crucial to the development of high-quality design skills.

In assessing design, program visitors will consider the extent and quality to which students are presented with each of the levels of design. Further, program visitors will assess how this leads to an overarching understanding of design, in context of the discipline, creation, development, construction of devices, systems, processes, and methods both within the field and in interdisciplinary examples.

Illustrative examples

To illustrate the concepts of intermediate engineering design and to provide specific examples, consider the following problems:

<u>Multi-disciplinary engineering example</u>

A problem of moving water up a hill and across a plain. The problem may be presented to the student as:

> *What size of pump is required to move the fluid at a prescribed rate?*

This would constitute a typical sizing or selection problem involving a single, or small set of possible answers. Alternatively, the problem could be framed as:

> *Our goal is to move the fluid from the starting point to its final destination. The quantity of fluid to be moved is given, as well as the desired time to accomplish the task. Factors to*

consider in finding a solution include piping, elevation, distance, flow velocity, and others. What potential solutions might be viable? What is the final selected solution and why?

In this latter problem, the approach and specific techniques to be employed in finding solutions are not prescribed, and further, students are invited to explore options. This latter approach is more indicative of an intermediate engineering design experience. The application specific details will vary with level of the designer, from beginner (in lower years) to knowledgeable designer (near end of program) and the expectations in terms of sophistication would be commensurate. In the same way, the complexity of distinct objectives can be increased as the skill level of the designer rises. For example, the economic, environmental, and other factors can be brought to bear at appropriate levels.

<u>Software</u>

A problem of designing a point-of-sale system for a pizza restaurant. The problem may be present to the students as:

How would you build 1) database tables (for customers, orders, pizza types, employee, oven, venue, and ingredients) and 2) user Interface (customer sign up page, customer order page)?

An intermediate-level version of this problem could be presented as:

Create a point-of-sale system for a pizza franchise. This should include the following loose criteria.

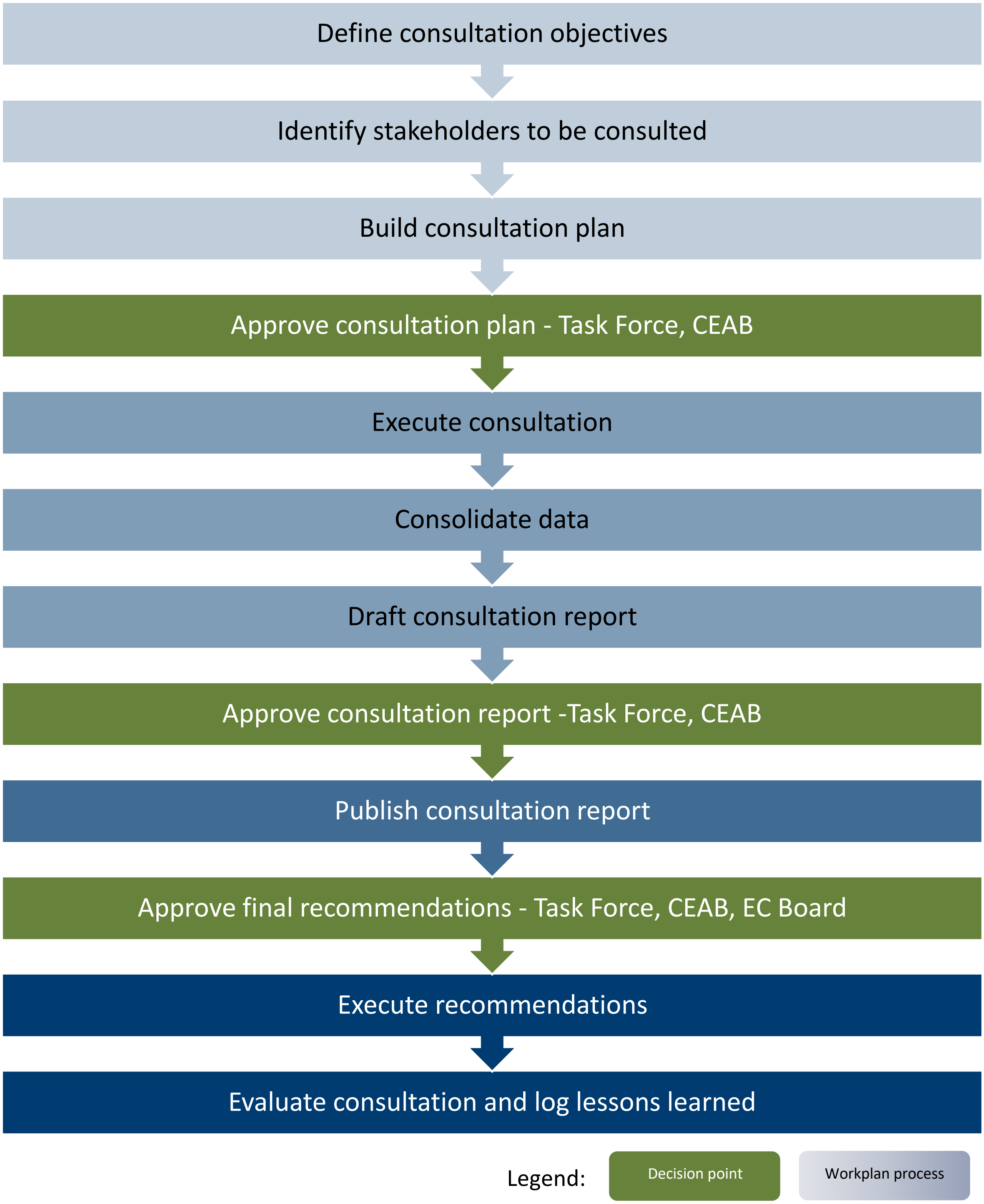
1. *Support multiple locations*
2. *Integration with food delivery services*
3. *Get pizza to customer quickly*
4. *Automatically order ingredients as needed*
5. *Optimize load by using an algorithm to decide which venue fulfils the order*
6. *Real time scaling including nodes based on demand*
7. *Work in different geographies*
8. *Make it easy for customer to signup/ order pizza*
9. *Integration with advertising engines*
10. *Proactively deciding when people want pizza and initiating advertising campaigns*
11. *Integrating social media and other information about your customer*
12. *Rewards account*

The first problem statement is more straightforward as the student is told specifically what they need to build (i.e., database schema and UI pages); this has a high-level of prescription so instructors would not see much variability. In the second statement, students are given more room to be creative – they must decide exactly what they want to do by working around the list of loose criteria.

5. Engineering Design Consultation Report Appendices

Appendix 1: Engineering Design Task Force Report

Appendix 2: Engineers Canada's Consultation Process



Appendix 3: Engineering Design Consultation Invitation Email

(*le français suit*)

RE: Consultation on Engineers Canada's Engineering Design Task Force

Dear colleagues,

At their June 1-2, 2019 meeting, the Accreditation Board directed the Engineering Design Task Force to consult stakeholders on the recommendations of their report regarding the current definition of 'engineering design' as it relates to CEAB accreditation criteria and procedures. **All [stakeholder group] are invited to provide comments on the recommendations contained within the report.** The consultation period will be between October 1, 2020 and December 4, 2020.

Who should participate

The Engineering Design Task Force has identified [stakeholder group] as potential participants in this process. However, there may be other individuals within your organization who should be made aware of this consultation.

How to participate

1. Introduction to the consultation process - webinar

Any individual within your organization who may be interested is invited to attend one of our scheduled introduction webinars. By clicking their preferred option below, participants will be provided within instructions on how to register:

- October 15, 2020 at 10:30 am EDT (offered in English)
- October 16, 2020 at 10:30 am EDT (offered in French).

The introduction webinar will provide an overview of the report development process, highlight the recommendations contained within the report, and define the ways by which we will consult each stakeholder group. Any individual who is not able to participate in the live webinar will be able to access the webinar recording on the Engineers Canada website.

2. Webinar meeting with organization officials

Should you or your colleagues wish to organize a web meeting to discuss the Engineering Design Task Force recommendations, please email accreditation@engineerscanada.ca to schedule the meeting.

3. Submit written feedback

You are invited to participate in the consultation through any of the means listed above. Additionally, you are invited to submit a formal written response. Written responses should be directed to accreditation@engineerscanada.ca or by mail to:

Engineering Design Task Force
c/o Mya Warken
Engineers Canada
300-55 Metcalfe St.
Ottawa, ON K1P 6L5

Written responses must be received by **December 4, 2020.**

How your feedback will be used

Following each meeting, we will synthesize the feedback you have given and provide it for validation to our primary contact at your organization. All feedback from all stakeholders will be collected and presented to the Engineering Design Task Force, CEAB, and Engineers Canada Board of Directors. A summary of all feedback received will be circulated to stakeholders and posted on the Engineers Canada website.

Background

Engineering Design is a nebulous term to define and use. The CEAB uses the terms in both inputs (AUs) and outcomes (GAs):

- CEAB Criterion 3.1.4 defines "Design" as *"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."*

- CEAB Criterion 3.4.4.5 defines "Engineering Design" as *"Engineering design integrates mathematics, natural sciences, engineering sciences, and complementary studies in order to develop elements, systems, and processes to meet specific needs. It is a creative, iterative, and open-ended process, subject to constraints which may be governed by standards or legislation to varying degrees depending upon the discipline. These constraints may also relate to economic, health, safety, environmental, societal or other interdisciplinary factors."*

HEIs, Program Visitors and CEAB members potentially have differing subjective interpretations of the term. As a result, the CEAB struck the Engineering Design Task Force with a mandate to explore the challenges with the current state across stakeholder groups and to establish a consistent interpretation and application of the definitions of "design" in the context of the CEAB. The goal is to have a single, accurate and comprehensive definition and interpretive statement on "Engineering Design".

On behalf of the Engineering Design Task Force, the Accreditation Board, and Engineers Canada, thank you for considering this invitation. Should you have any questions, please do not hesitate to contact me (mya.warken@engineerscanada.ca or at 1-877-408-9273 extension 206) or Elise Guest (elise.guest@engineerscanada.ca or at 1-877-408-9273 extension 260).

Best regards,

Mya Warken
Manager, Accreditation

Objet : Consultation sur le rapport du Groupe de travail sur la conception en ingénierie d'Ingénieurs Canada

Chers collègues,

Lors de sa réunion des 1er et 2 juin 2019, le Bureau d'agrément a demandé au Groupe de travail sur la conception en ingénierie de consulter les parties prenantes sur les recommandations de son rapport concernant la définition actuelle de la « conception en ingénierie », telle qu'elle est donnée dans les Normes et procédures d'agrément du Bureau. **Les [parties prenante] sont invités à faire part de leurs commentaires sur les recommandations présentées dans le rapport**. La consultation se tiendra du 1er octobre au 4 décembre 2020.

Participants recherchés

Le Groupe de travail sur la conception en ingénierie a dressé une liste de participants potentiels au processus mais il y a peut-être d'autres personnes au sein de votre organisme qui devraient être informées de cette consultation.

Comment participer

4. Présentation du processus de consultation – webinaire

Toute personne intéressée de votre organisme est invitée à assister à l'un de nos webinaires. Il suffit de cliquer sur l'une des options ci-dessous pour savoir comment s'inscrire :

- 15 octobre, 10 h 30 (HE) en anglais
- 16 octobre, 10 h 30 (HE) en français

Dans le webinaire de présentation, nous passerons en revue le processus de rédaction du rapport, les recommandations contenues dans celui-ci et les modalités de consultation de chaque groupe de parties prenantes. Si vous n'êtes pas en mesure d'assister au webinaire en direct, vous en trouverez un enregistrement dans le site Web d'Ingénieurs Canada.

5. Webinaire avec les représentants des organismes

Si vous ou vos collègues voulez organiser une réunion en ligne pour discuter des recommandations du Groupe de travail sur la conception en ingénierie, veuillez envoyer un courriel à accreditation@engineerscanada.ca pour fixer une date.

6. Soumission de commentaires par écrit

Vous pouvez participer à la consultation d'une des façons indiquées ci-dessus. Vous pouvez aussi soumettre vos commentaires par écrit à accreditation@engineerscanada.ca, ou les envoyer par la poste à l'adresse suivante :

> Groupe de travail sur la conception en ingénierie
> a/s de Mya Warken
> Ingénieurs Canada
> 55, rue Metcalfe, bureau 300
> Ottawa, ON K1P 6L5

Les réponses écrites doivent nous parvenir au plus tard le **4 décembre**.

Utilisation de vos commentaires

Après chaque rencontre, nous ferons une synthèse de vos commentaires et la ferons parvenir à votre principale personne-ressource pour validation. Les commentaires de toutes les parties prenantes seront colligés et présentés au Groupe de travail sur la conception en ingénierie, au Bureau d'agrément et au conseil d'Ingénieurs Canada. Un résumé de tous les commentaires reçus sera envoyé aux parties prenantes et affiché dans le site d'Ingénieurs Canada.

Contexte

La conception en ingénierie est un terme dont la définition et l'utilisation sont nébuleuses. Le BCAPG l'utilise à la fois dans les intrants (unités d'agrément) et les résultats (qualités requises des diplômés) :

- La norme 3.1.4 du BCAPG définit la conception comme suit : *Capacité de concevoir des solutions à des problèmes d'ingénierie complexes et de concevoir des systèmes, des composants ou des processus qui répondent aux besoins spécifiés, tout en tenant compte des risques pour la santé et la sécurité publiques, des aspects législatifs et réglementaires, des normes, ainsi que des incidences économiques, environnementales, culturelles et sociales.*

- La norme 3.4.4.5 du BCAPG définit la conception en ingénierie comme suit : *La conception en ingénierie intègre les mathématiques, les sciences naturelles, les sciences du génie et les études complémentaires pour développer des éléments, des systèmes et des processus qui répondent à des besoins précis. Il s'agit d'un processus créatif, itératif et évolutif qui est assujetti à des contraintes pouvant être régies par des normes ou des lois à divers degrés selon la spécialité. Ces contraintes peuvent être liées à des facteurs comme l'économie, la santé, la sécurité, l'environnement et la société ou à d'autres facteurs interdisciplinaires.*

Les établissements d'enseignement supérieur, les visiteurs de programme et les membres du BCAPG ont peut-être des interprétations subjectives différentes de ce terme. Le BCAPG a donc mis sur pied le Groupe de travail sur la conception en ingénierie en lui confiant le mandat d'examiner les défis de la situation actuelle pour les groupes de parties prenantes et d'établir une interprétation et une application cohérentes des définitions de la « conception » dans le contexte du BCAPG. L'objectif est d'en arriver à une définition et un énoncé d'interprétation uniques, exacts et exhaustifs de la « conception en ingénierie ».

Au nom du Groupe de travail sur la conception en ingénierie, du Bureau d'agrément et d'Ingénieurs Canada, je vous remercie de considérer cette invitation. Si vous avez des questions, n'hésitez pas à communiquer avec moi (mya.warken@engineerscana.ca ou 1 877 408-9273, poste 206) ou avec Elise Guest (elise.guest@engineerscanada.ca ou 1 877 408-9273, poste 260).

Cordialement,

Mya Warken
Gestionnaire, Agrément

Appendix 4: Consultation Presentation Slide Deck

Definition of “Engineering Design”

2020 Consultation

Jeff Pieper, FEC, P. Eng.
Chair, Engineering Design Task Force
October 15, 2020

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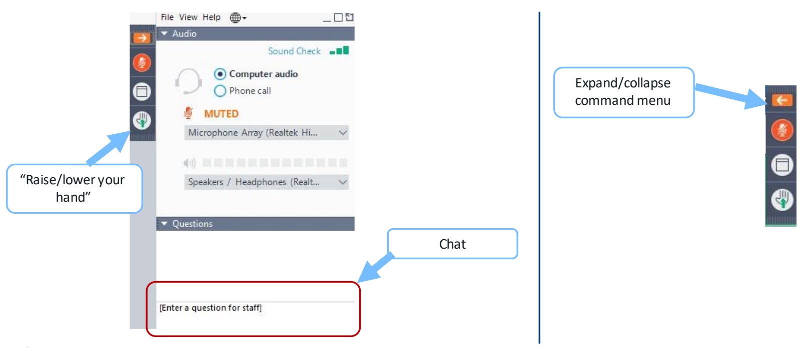
Have a question?



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Outline

1. Background
2. Timelines
3. Report recommendations
4. National consultation objectives, process, and timelines
5. Next steps

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Engineering Design is a nebulous term

- Institutions and visiting teams often have differing opinions on what constitutes "engineering design".
- Two CEAB similar (but different) definitions of engineering design
  - One for Accreditation Unit (AU) counts
  - One for Graduate Attributes
- Of issues raised in CEAB decision meetings approximates 1/3 deal with engineering design and capstone courses

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Two definitions of 'design'

…and how they are used.

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Graduate attribute #4

"Design"

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

CEAB Accreditation Criteria and Procedures 2019

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Criterion 3.4.4.5 "Engineering Design"

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

CEAB Accreditation Criteria and Procedures 2019

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Relevance

GA #4 "Design"

One of 12 attributes that the institution must demonstrate that graduates of a program possess.

Demonstrated through:

- CIS form: how each course covers the GA(s) (1-12) and at what learning-level (I/D/A);
- Curriculum maps 3.1.1 (all courses) and 3.1.1a (GA measurements): which GA is covered in which course in which semester;
- Curriculum maps 3.1.1b (all courses) and 3.1.1c (GA measurements): Graduate attribute learning-levels (I/D/A) and AU %s.

Criterion 3.4.4.5 "Engineering Design"

"Curriculum content and quality" criteria assure a foundation in mathematics and natural sciences, a broad preparation in engineering sciences and engineering design, and an exposure to non-technical subjects.

Engineering science + engineering design = 900 AUs.

Engineering Design = minimum 225 AUs

Demonstrated through:

- 4.1c: Program AU totals (minimum path);

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Relevance
Minimum curriculum components

Curriculum component	Minimum AUs
Mathematics	195
Natural sciences	195
Mathematics and natural sciences combined	**420**
Engineering science	225
Engineering design instructed by P.Eng./ing.	225
Engineering science and engineering design combined (600 of which to be instructed by P.Eng./ing.)	**900**
Complementary studies	225

The program must have a minimum of **1,850** AUs

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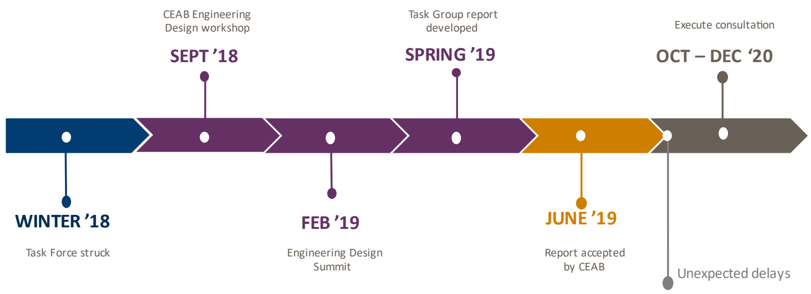
Timelines



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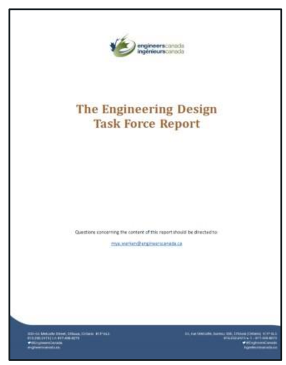
Task Force report

- To be submitted to all stakeholders for consultation starting October 1
- **Three recommendations**



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Recommendation 1

Adopt a new definition of ‘engineering design’:

> Engineering design is the process of making informed, thoughtful and creative decisions in devising a product, system, component, or process to meet specified needs. It is an open - ended and generative activity often iterative and multidisciplinary in which natural science, mathematics, and engineering science are incorporated into solutions that satisfy defined objectives within identified requirements and constraints. Typically, the constraints include economic, health and safety, environmental, societal, cultural, and regulatory aspects.

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Recommendation 2

Apply the new definition to:

- Criterion 3.1.4 (Design Graduate Attribute); AND
- Criterion 3.4.4.3 (measurement of design in curriculum content).

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Our questions

Recommendations #1 and #2

Is the definition of the "Engineering Design" broad enough to apply to Criteria 3.1.4 *and* Criteria 3.4.4.3 yet specific enough to support consistent application of the definition in the context of the CEAB? If not, what is missing, inconsistent or inaccurate?

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Our questions (cont'd)

Recommendation #2

What are the ramifications, both positive and negative, of implementing the proposed definition and interpretive statement? What risks will be incurred by this implementation? How can these risks be mitigated?

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Recommendation 3

Adopt a new interpretive statement on engineering design.

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Our questions (cont'd)

Recommendation #3

What is missing or unclear in the interpretive statement on engineering design that could offer more guidance to visiting teams and HEIs on how to apply and assess 'design' in the context of the CEAB?

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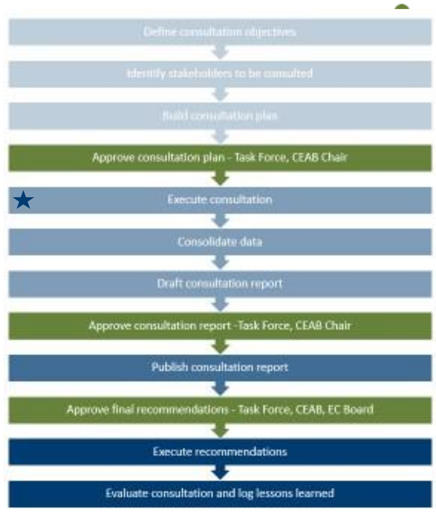
National consultation

Legend: Decision point | Workplan process



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National consultation: objectives

1. Inform stakeholders of an alternate definition of engineering design (and therefore revisions to the Design Graduate Attribute, Criterion 3.4.4.3, and development of a new interpretive statement on engineering design) is being considered.
2. Investigate stakeholder reaction to the report recommendations.
3. Consolidate and synthesize stakeholder feedback with the objective of putting forward a list of recommendations for implementation.
4. Identify barriers to change if the report recommendations are adopted.
5. Develop a reasonable implementation plan that accommodates the diverse viewpoints of stakeholders.

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Stakeholder groups being consulted

- CEAB members
- CEEA Design Education/Design Communication Special Interest Group
- CEQB members
- Canadian Federation of Engineering Students
- Engineering regulators' councils/Boards of examiners/Academic review committees
- Higher Education Institutions
- NSERC Design Chairs
- National Admissions Officials Group (NAOG)
- Engineering Deans Canada

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Consultations: What to expect

- We are working with stakeholders to schedule 1-hour webinars or face-to-face meetings with stakeholders.
- During the consultations we will:
  - a) Review the paper's three recommendations
  - b) Ask 5 questions about recommendations 1 and 2
  - c) Address questions, hear feedback, and consider stakeholder point-of-view
- Notes from each meeting will be provided to stakeholder groups for verification

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Next steps

- We are scheduling meetings with groups of stakeholders
- This webinar has been recorded and will be available on our website

Written responses can be submitted to:

accreditation@engineerscanada.ca

or by mail to:

c/o Mya Warken
Engineers Canada
300-55 Metcalfe St.
Ottawa, ON K1P 6L5

Submission deadline: **December 4, 2020**

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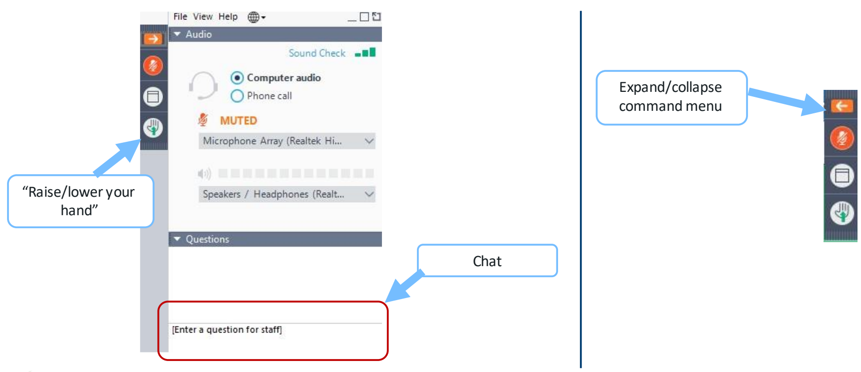
Have a question?



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Thank you

For more information:

accreditation@engineerscanada.ca | 613.232.2474

engineerscanada.ca/accreditation

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