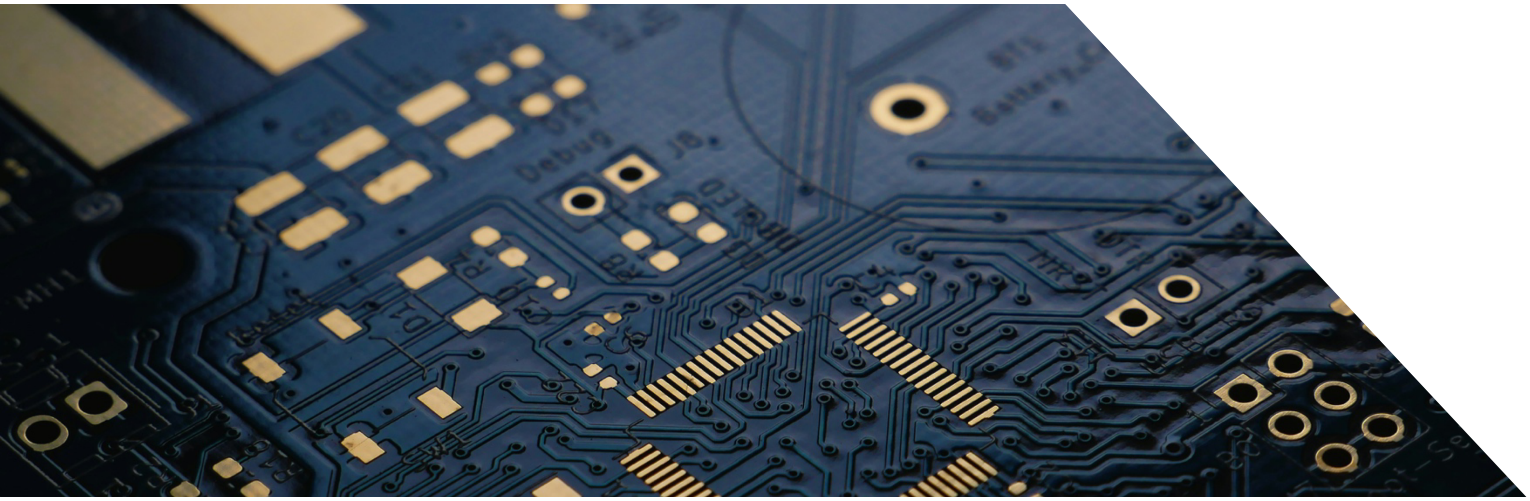
futures of engineering accreditation

Academic Requirement document

Futures of Engineering Accreditation



March 2024

Prepared for: Engineers Canada
Prepared by: FEA Academic Requirement Task Force

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Contents

About this document

We are pleased to share this document outlining the Futures of Engineering Accreditation (FEA) project's draft concept for a Full Spectrum Competency Profile (FSCP) and a National Academic Requirement for Licensure. This document was written by FEA's Academic Requirement Task Force and represents ideas and feedback the project has collected from its research and engagement with interest holders over the past two years.

The project team is grateful for the enthusiasm shown by interest holders across the engineering ecosystem and for their invaluable contributions.

This document, together with its counterpart: the Purpose of Accreditation document, provides a comprehensive overview of the draft FEA concepts at their current stage of development. This document and its contents represent work in progress.

In April 2024, a collaborative design session was held with members of the CEAB Executive Committee, CEQB Executive Committee, the FEA project Steering Committee and Regulator Advisory Group (RAG), Engineering Deans Canada (EDC), and other colleagues to review the draft concepts presented in this document and the Purpose of Accreditation document and discuss how their implementation would impact the engineering ecosystem.

The concepts will see future iterations based on continued engagement with interest holders. This work will be reflected in the final Path Forward Report, which will present the concepts in more detail and recommend approaches for their implementation.

As always, if you would like to get in touch with the FEA project team, please email fea@engineerscanada.ca. For comments or ideas about the project, please use this submission form, available for the project's duration. Submissions are reviewed by the project team and collected as valuable feedback.

Sincerely,
The FEA Project Team

Executive summary

The Futures of Engineering Accreditation (FEA) is an initiative by Engineers Canada, and part of its 2022-2024 Strategic Plan. The objective of the FEA is to leverage the insights, perspectives, and expertise of members of the Canadian engineering ecosystem to examine the current accreditation system, understand how it is serving contemporary needs, and consider how it can chart a new path for the future of the engineering profession.

Since its creation in 1965, the Canadian engineering education accreditation system has supported Canadian engineering regulators, been recognized as substantially equivalent under international mutual recognition agreements and has mentored accreditation bodies across the globe. Significant changes in engineering practice and engineering education have occurred over this same period, prompting the timely need to consider implementing a standard academic requirement that is appropriate and feasible for all graduates pursuing licensure in the profession.

Part 1 of this document introduces the Mandate of the FEA's Academic Requirement Task Force to investigate the establishment of an academic requirement for licensure that applies to all applicants.

Parts 2 and 3 explain the Need for Change in the Accreditation System and the Significance of Substantial Equivalency. There are pressing challenges due to the different approaches for assessing Canadian Engineering Accreditation Board (CEAB) and non-CEAB graduates, and risks to the fairness and equivalency of the processes.

Parts 4 and 5 introduce the Full Spectrum Competency Profile (FSCP) and how it functions as an assessment framework. An FSCP specifies the knowledge, skills, and attributes required for proficient practice within a profession. The proposed FSCP for engineering in Canada encompasses 34 competencies divided into eight domains and is designed to span the entirety of an engineer's career journey, from undergraduate studies to post-licensure practice. Appendix A features an image providing an overview of the eight competency domains and the 34 competencies.

Part 6 refines the 34 competencies of the FSCP into a subset of 16 essential competencies that comprise the proposed National Academic Requirement for Licensure (NARL). These are intended to be acquired through an engineer's academic training and determined by the point of graduation, serving as foundational skills necessary for advancement into post-graduate stages of professional development. Appendix A delineates the specific 16 competencies that constitute the national academic requirement.

Part 7 encompasses the Insights from Project Engagement and Research to provide the necessary support for the formulation and implementation of both the FSCP and the NARL.

Part 8 identifies the Gaps that could hinder support for the FSCP and NARL and provides Recommendations for resolving them.

Part 9 summarizes the Next Steps of the project and explains how the information presented in this document will guide the next phase of work, including the development of the Path Forward Report.

1. Mandate of the Academic Requirement Task Force

The Futures of Engineering Accreditation (FEA) is a multi-year strategic priority in Engineers Canada's 2022-2024 Strategic Plan, encompassing several distinct phases of activity. Refer to Appendix C for a comprehensive overview of the project.

In the current phase of the project, two separate task forces are working concurrently. The Purpose Task Force is focused on either validating the current purpose of accreditation or establishing a revised purpose.

Meanwhile, the Academic Requirement Task Force has been mandated to investigate the establishment of an academic requirement for licensure that applies to all applicants.

The efforts of both task forces are complementary and will contribute to determining the path forward for accreditation.

Members of the Academic Requirement Task Force as of March 2024:

A. Sidiq Ali, MEd PhD CE, contributing psychometrician
Michel Couturier, PhD, FEC, P.Eng.
Gary Faulkner, PhD, P. Eng.
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Jason Ong, visiting contributor on behalf of the Regulator Advisory Group
Dennis Peters, Ph.D., P.Eng., FEC, SMIEEE (Chair)
Aaron Phoenix, P.Eng., visiting contributor on behalf of the Regulator Advisory Group
Malcolm Reeves, FEC, P.Eng., P.Geo, FGC, FCSSE, CGeol
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André Zaccarin, ing., Ph.D.

2. The need for change

As a regulated and licensed profession, engineers must exhibit the requisite academic and experiential credentials to practise. Canada's twelve provincial and territorial engineering regulators are responsible for establishing admissions standards to the profession, which aim to safeguard the public by issuing licenses only to those deemed competent.

Academic qualifications are one of five criteria for licensure yet there is no defined standard, let alone one that is nationally agreed upon by all twelve engineering regulators.

Currently, regulators lean on the Canadian Engineering Accreditation Board's (CEAB) accreditation framework to ascertain that graduates from accredited programs meet the academic prerequisites. The CEAB's criteria encompass five broad input categories and twelve graduate attributes, while leaving individual engineering programs to shape their own curricula and determine teaching content.[1]

Regulators rely on syllabi created by the Canadian Engineering Qualifications Board (CEQB) as part of the assessment process for evaluating the academic credentials of non-CEAB applicants. These syllabi are meticulously structured based on the curricula of accredited programs. Intended to serve as a benchmark to maintain consistency in academic standards, regulators use the syllabi as an indicator about whether non-CEAB applicants have had exposure to similar content and inputs as the graduates of CEAB-accredited programs.

While the accreditation system and syllabi endeavour to establish an academic standard, a significant risk persists due to the absence of a clear definition of the essential components of an academic requirement for licensure. This gap introduces vulnerabilities into both the accreditation and licensure systems, raising concerns about the robustness and defensibility. Without a precise definition, the current system cannot delineate the necessary knowledge for safe practice and fails to provide assurance that applicants from different academic backgrounds all fulfill the safety expectations.

APEGA's 2019 study, *An Evaluation of Assessment Processes for Engineering Licensure in Alberta: Implications for a National Entry-to-Practice Examination,* strongly underscored the need to create and adopt a national engineering competency profile.[2] The report highlighted that establishing such a profile is the most important step for integrating the various phases of an engineer's professional journey by ensuring the quality and comprehensiveness of evaluation processes across all stages. A clear framework of the knowledge and abilities of a competent practitioner enhances the validity and transparency of evaluations and creates a standardized benchmark against which to assess foreign trained applicants. Furthermore, the adoption of this competency profile establishes the expectations for evaluations at every stage of an engineer's career, including defining

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[1] As described in the *CEAB's 2023 Accreditation Criteria and Procedures* https://engineerscanada.ca/sites/default/files/2023-12/Accreditation_Criteria_Procedures_2023.pdf

[2] Prepared for APEGA: Sadesky, G. (2019). An Evaluation of Assessment Processes for Engineering Licensure in Alberta: Implications for a National Entry-to-Practice Examination.

content requirements for program accreditation, evaluating work experience, conducting national examinations, and setting expectations for continuing professional development.

The implementation of a new NARL would bolster the accreditation and licensure systems' defensibility, fostering greater consistency in academic qualifications. It would promote greater accessibility to the profession by contributing to streamlined evaluation procedures that are less dependent on the origin of an applicant's education and facilitate professional mobility. It would also enhance the integrity of the engineering profession and inspire public trust by showcasing a dedicated commitment to excellence and competency.

3. The significance of substantial equivalency

The need for substantial equivalency in the system is rooted in ensuring equitable access to the profession. With the growing number of internationally trained graduates and increased attention on government-led fairness reviews, it is essential to ensure the assessment of all CEAB and non-CEAB graduates are founded on similar standards and procedures that follow principles of equity and fairness. The current system poses risks for transparency, timeliness, reliability, and consistency.

The provincial/territorial regulators are responsible for ensuring only qualified applicants are granted licensure. However, the absence of a NARL means that they have adopted their own individual assessment methods. Although many jurisdictions have moved towards Competency Based Assessment (CBA) systems, there is still a substantial gap in the harmonization and consistency of assessment practices domestically across Canada. These disparities not only create confusion for applicants, industry groups, and the public, but they also affect the mobility of professional engineers between regions and present opportunities for fairness challenges.

In 2022, in support of the need for substantial equivalency, the CEQB released the *Feasibility Study: Methods of Academic Assessment for Non-CEAB Applicants for Licensure*. The report proposed "expanding the current Core Engineering Competencies into a full competency profile that covers academic and experience entry-to-practice requirements".[3] The full competency profile would provide increased flexibility and fairness for non-CEAB applicants for licensure, improving transparency and confidence that applicants are evaluated against a common entry-to-practice standard.

[3] Prepared for the CEQB: Johnson, K. and Johnson G. (2022). Feasibility Study: Methods Of Academic Assessment For Non-CEAB Applicants For Licensure. (p.34).

Implementing a NARL would promote substantial equivalency by providing a cohesive framework for the twelve provincial and territorial engineering regulators to conduct assessments, irrespective of applicants' academic backgrounds. It would satisfy the need to balance regulators' mandate to protect public safety while maintaining flexibility in licensing qualified applicants without subjecting them to unnecessary barriers.

The establishment of a NARL can support fundamental principles outlined in Engineers Canada's policy guideline, *Regulators Guideline on the Academic Assessment of Non-Canadian Engineering Accreditation Board Applicants*:

1. Assessment processes must be individualized.
2. Assessment processes must be fair.
3. Education documents must be authenticated and verified.
4. Assessment of breadth and depth of education (of the program and institution) should be partly quantitative and partly qualitative.
5. Confirmation of breadth and depth of education is a requirement for all applicants.
6. Flexibility should be allowed between breadth and depth, so long as a minimum threshold is met.

4. The Full Spectrum Competency Profile

The FSCP is a comprehensive framework that specifies the knowledge, skills, and attributes required for proficient practice within a profession. When applied in an engineering context, the FSCP defines all the competencies required of an engineer at the various points in their development – from engineering graduates to point of licensure to mature/experienced professionals – and across all disciplines.

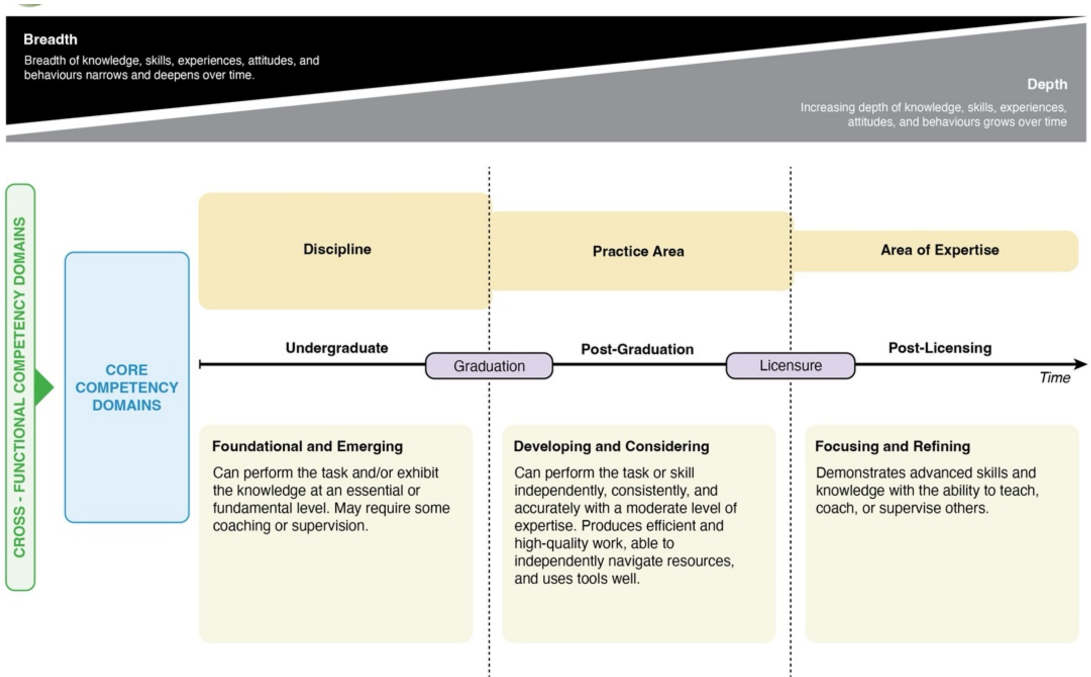

Figure 1: Competency stages. An engineer's journey from undergraduate through post-graduation and post-licensure.

The FSCP encompasses 34 competencies designed to span the entirety of an engineer's career journey, from undergraduate studies to post-licensure practice. Of these, 16 competencies have been specifically identified by the Academic Requirement Task Force in its proposal to establish a NARL. These competencies are intended to be acquired through an engineer's academic training and determined by the point of graduation, serving as foundational skills necessary for advancement into post-graduate stages of professional development.

FEA's November 2022 Foresight Session focused on the question, "What will the engineer of the future need to do?" Throughout the session, as perspectives were shared, a greater shared understanding emerged regarding the future skills and competencies required of engineers. Through a series of future scenarios, the participants identified a combination of technical and social skills and competencies essential to engineers of the future.

The *Foresight Session Event Journal* documented that "participants saw a need for engineers who are values-based leaders, who are technically excellent and actively collaborate across disciplines, are mindful of the future and maintain curiosity and a desire for lifelong learning." Beyond technical proficiency, engineers must embody a diverse range of competencies to tackle modern challenges. This includes environmental and social awareness, interdisciplinary problem-solving skills, a strong sense of public duty, and a commitment to lifelong learning. By instilling these qualities, accreditation ensures that engineers are not only technically adept but also equipped to handle ethical dilemmas, collaborate across disciplines, and contribute meaningfully to society's well-being.

During FEA simulations held in spring 2023, participants indicated support for a NARL. They emphasized the value in having clearly defined, transparent standards for engineering knowledge and competence at a national level. Responses also suggested that this requirement should address a general, baseline level of technical knowledge complemented with professional competencies and an understanding of the ethical responsibilities of an engineer.

The participants carefully evaluated three distinct models of academic requirements, including graduate attributes, foundational technical and social competencies, and discipline-specific technical knowledge. There was no clear decision emerging regarding which model would be most appropriate. Regardless of how the academic requirement was defined, it seemed that it would continue to be difficult to evaluate internationally trained applicants' competencies.

Despite the lack of consensus for a preferred model, and the agreement on the challenges of assessing internationally trained applicants, the primary objective remains focused on improving equitable access to the profession.

With this objective in mind, consideration to the FSCP model began following these events. The project team explored how to develop a tailored academic benchmark to align with the participants' vision of improving access to the profession irrespective of educational background.

The FSCP model is comprised of five components[4]:

- **Competency domains** – Groupings of related competencies. There are six core competency domains and two cross-functional domains.
- **Competencies** – The knowledge, skills, experience, attitudes, values, abilities, and behaviours that enable an individual to complete a task. Competencies can be categorized as either **core competencies or cross-functional competencies**.
- **Core competencies** – Common to all engineers, and thus mandatory for all engineering graduates, newly-licensed engineers, and mature practitioners and apply to all disciplines and areas of practice.

[4] Refer to Appendix A: FSCP Overview for a visual representation of these components.

- **Cross-functional competencies** – Catalyze core competencies. They support the engineer's ability to reduce or eliminate silo thinking and silo management practices and differentiate an engineer's proficiency of the core competencies.
- **Indicators** – Describe and define the competency, what is expected to demonstrate proficiency, and how to assess the competency.

At this stage of the work, the competency domains for core and cross-functional competencies are proposed along with definitions of the competencies. Defining competence in each competency and indicators at each level of proficiency (i.e., learner, graduate, license holder) will be developed at a subsequent stage, as that work is outside the scope of this project.

Competence is the engineer's ability to perform a task, function, or role to a set of prescribed standards. Competency is an explanatory model that considers how engineers engage in their professional responsibilities, duties, and tasks. Competence itself is not readily observable, but competency is inferred from the engineer's activities.
It encompasses the spectrum of knowledge, decisions, judgments, perceptions, procedures, and values that engineers employ while executing their duties.[5]

Competency is also a pragmatic notion: it demonstrates an engineer's aptitude to operate within a designated learning or work environment and leverage diverse resources to achieve desired outcomes. An engineer will draw on a combination of knowledge, skills, and attributes acquired through training and experience to adapt to changing, unforeseen, or constraining circumstances.

5. How competency profiles function

Current national standards and documents, such as the CEAB Graduate Attributes, the pan-Canadian work experience competencies, and the benchmarks established by the *International Engineering Alliance's Graduate Attribute and Professional Competencies Framework* for engineering graduates and professionals, frame competencies as observable and demonstrable actions. This approach is intended to allow for their measurement and evaluation in a concrete manner.

A competency profile, while not an assessment tool on its own, helps define the standard against which the observable and demonstrable actions of all applicants can be measured

[5] Henderson, J. P. (Ed.). (2019). Certification: The ICE Handbook. The Institute for Credentialing Excellence.

and evaluated. This practice enhances transparency and ensures consistency throughout the assessment process and promotes greater accessibility to the profession for those with diverse backgrounds and experiences.

The activities of a competency profile are determined by a community of practitioners and serve as the benchmark against which other learning and work activities are assessed. This approach fosters the expectation that a competent engineer, within a specific context, would exhibit aptitudes akin to their peers at a similar stage of development. Consequently, evaluating engineers' competencies must be done in context of the knowledge, skills, and attitudes acquisition phase, so that evaluators may ascertain if the prospective engineer 'knows how' to accomplish the task and can 'do' the task in the pre-licensure work environment.

Many regulated professions, including engineers, have adopted a competency profile to help harmonize admission requirements and facilitate enhanced labour mobility. It serves to anchor the profession's other core standards and can be used by regulators for a variety of purposes, including, but not limited to:

- Academic program approval/recognition/accreditation
- Assessment of internationally educated applicants
- Continuing competency requirements
- Input into the content and scope of entry-to-practice exams
- Policy and standard development and decision making
- Reference for professional conduct matters
- Public and employer information regarding the practice expectations of professional engineers

6. List and definitions of competencies in the proposed academic requirement for licensure

The FSCP model is aligned to *Miller's Pyramid of Clinical Competence*.[6] The pyramid was developed specifically for assessing the clinical competency of learners in health care settings. It is useful for assessing learning outcomes (competencies) at various stages of the

[6] Miller, G. E. (1990). The assessment of clinical skills/competence/performance. Academic Medicine, 65, S63-S67.

learning process. The pyramid illustrates the expected learner progression from novice (bottom) to expert (top). Novice learners should be able to recall facts, but as their competency develops, they should be able to interpret and apply, demonstrate, and perform required knowledge, skills, and attitudes in authentic practice settings. Competency assessment should also evolve from recall-based multiple-choice to more authentic, workplace-based assessments.

Figure 2: Miller's Pyramid of Clinical Competence

The complete FSCP comprises 34 competencies that are progressively acquired over the course of an engineer's professional journey. Within this framework, a subset of 16 competencies constitutes the NARL. These competencies are expected to be acquired during academic training and demonstrated upon completion of the engineering program. They serve as the foundation of an engineer's career path and are expected to be further developed and honed during the post-graduate and post-licensure phases of their career. See Appendix A for a delineation of the 16 competencies of the NARL from the comprehensive 34 competencies of the FSCP.

Below are the 16 Proposed Competencies of the NARL with working definitions. The Path Forward Report should offer recommendations on further refining these working definitions, with validation expected to occur following the report's completion.

Domain: Acquiring and furthering engineering knowledge

1. Math

Mathematics is an extension of language and is used to describe, analyze and predict scientific and engineering principles and phenomena. It includes, but is not limited to, elements of linear algebra, differential and integral calculus, differential equations, probability, statistics, numerical analysis, and discrete mathematics.

2. Natural science

Natural sciences include the exploration of the interactions and processes of the natural world and the systematic observation and understanding of natural phenomena through analytical and/or experimental techniques.

3. Engineering science: fundamentals

Engineering science fundamentals involve the application of mathematics and natural science to practical problems. They lay the foundation for discipline specific engineering science while also providing a knowledge base to ensure an understanding of the broader scope of engineering practice. Engineering Fundamentals may include, but are not limited to, engineering mechanics, materials, fluid mechanics, thermodynamics, and basic electric circuits and power.

4. Engineering science: discipline specialization[7]

Engineering science subjects involve the application of mathematics and natural science to practical problems. Topics are determined by the specific discipline of specialization and will include the applied aspects of the essential science relevant to problem-solving within that discipline.

Domain: Problem solving and design

5. Research and investigation

An ability to identify, formulate, research, and conduct investigations of complex engineering problems, by methods that include appropriate experiments, analysis, and interpretation of data, and synthesis of information, using principles of mathematics, natural science, and engineering science to reach substantiated conclusions.

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[7] It may be impossible to define Engineering Science: Discipline Specialization more precisely while still maintaining its generic applicability. As with all working definitions presented in this report, additional recommendations for refining this competency definition may be included in the Path Forward report and validated in subsequent stages of the project.

6. Financial analysis and viability

An ability to appropriately use financial principles to determine the economic viability of proposed engineering projects and to select between independent alternatives. Engineering economic principles include the importance of finance in business decisions, project cash flows, time value of money, depreciation, present worth analysis, rate of return analysis, and risk analysis.

Domain: Protection of the public

7. Sustainability

Sustainability is a long-term goal. Sustainable development is a strategy employed to meet the economic, environmental, and social needs of the present without compromising the ability of future generations to meet their own needs.[8] Sustainable engineering requires:

- consideration of economic efficiency and profitability for investors,
- navigating the tension between technical constraints and the need to broaden the design space to include ecological and environmental impact,
- meaningful consideration of design processes and outcomes that can preserve or improve social equity, and
- intergenerational equity, an emerging area for consideration, arises from non-Western knowledge systems that consider the impact of our actions seven generations into the future.

8. Equity, diversity, and inclusiveness

Equity is the promotion of fairness and justice for each individual that considers historical, social, systemic, and structural issues that impact experience and individual needs. Elevating equity in a good way removes barriers for the entire population.

Diversity is a measure of representation within a community or population that includes identity, background, lived experience, culture, disciplinary expertise, and many more.

Inclusion is the creation of an environment where everyone shares a sense of belonging, is treated with respect, feels heard, and is empowered to participate.

[8] This definition is provided in part from the UN. https://www.un.org/en/academic-impact/sustainability

It is important to note that while an inclusive group is by definition diverse, a diverse group is not always inclusive. An inclusive working environment or team strives for equity and respects, accepts, and values differences.[9]

Domain: Teamwork and collaboration

9. Project management

Project management involves the comprehension of a project at various levels from full ownership at a coordination level to being knowledgeable about a project at a level of day-to-day tasks. Project management involves a set of principles that span the planning, implementing, and executing stages, and involves necessary attributes such as relationship building, budgeting, and resourcing, as well as considerations for safety, sustainability, and regulatory requirements.

10. Cross-discipline collaboration

An awareness of the importance of working effectively on projects that may involve collaboration across different disciplines and practice areas of engineering including other professions.

11. Interest holder engagement

Interest holder engagement is the process by which an organization embarks on meaningful collaboration with key groups/individuals who may be impacted by actions and decisions being made. Meaningful engagement involves the recognition that all engineering work has an impact and that those affected should be provided with accessible and appropriate information and be given the opportunity to voice those concerns.

[9] This definition is from the University of Toronto. https://research.utoronto.ca/equity-diversity-inclusion/equity-diversity-inclusion

Domain: Analytical Skills

12. Numerical analysis

The use of algorithms and numerical approximation techniques in mathematical analysis as applied to engineering problems. Topics include direct and iterative methods, conditioning and discretization, and generation and propagation of errors.

13. Data analysis

The knowledge and skills required to ask and answer a range of questions by analyzing data including developing an analytical plan; selecting and using appropriate statistical techniques and tools; and interpreting, evaluating, and comparing results with other findings. An ability in data analysis implies knowledge in data awareness, cleaning, discovery, ethics, exploration, tools, and visualization.[10]

14. Statistics

Ability to use statistical principles to summarize data and draw conclusions from it. Important concepts include probability, frequency distributions, mean, standard deviation, propagation of errors, hypothesis testing, sample size determination, and regression.

15. Computer and information sciences

The knowledge and skills to use computer systems to store and manipulate large quantities of information. Topics include programming theory, computer system architecture, data repositories (e.g., databases, cloud storage, data lakes), and computation theory.

16. Modelling

Modelling is the purposeful development of an analytical, numerical, or empirical description of a real system. These models can be mathematical or physical in nature and are created with the specific intent of describing, analyzing, testing, demonstrating, and/or predicting behaviours, properties, or other characteristics of the system.

[10] This definition is provided from Statistics Canada. https://www.statcan.gc.ca/en/wtc/data-literacy/compentencies

7. Insights from project engagement and research supporting the NARL

i. Mapping the FSCP to existing benchmarks

As part of the analysis about the suitability of the FSCP, Engineers Canada conducted a mapping exercise to compare it with established benchmarks, including the CEAB's Graduate Attributes, the pan-Canadian work experience competencies, and the International Engineering Alliance's (IEA) Graduate Attributes and Professional Competencies Framework. This mapping was presented to interest holders during the 2023 Fall Consultations to showcase that FSCP's alignment with the existing frameworks and bolster its credibility and reliability. Refer to Appendix B for the mapping of the FSCP to other benchmarks.

ii. Alignment with competency based assessment

The 2022 report *Current and Emerging Practices in Engineering Education* highlighted the increasing interest in CBA methods among educators. Most Canadian engineering regulators have already implemented CBA, comprising 34 competencies across seven different categories. The adoption of the FSCP represents a formalization of this assessment approach and supports the delineation of the NARL. Furthermore, competencies can be clearly defined, which facilitates transparent communication to interest holders regarding expectations for fulfillment and the evaluation processes.

Educators have also been expressing increased interest in CBA. Certain engineering programs have begun implementing CBA techniques, which enable students to effectively demonstrate their competencies on targeted tasks, facilitating their successful completion of courses.

iii. Alignment with other professions

In the 2022 report *Benchmarking the Canadian Engineering Accreditation System*, all eight of the accreditation systems under study, comprising five engineering and three other professions, are characterized as outcomes-based accreditation systems. A combination of graduate attributes, experience examples, and competencies are used as part of the accreditation system measures of student outcomes.[11] Preparing the FSCP and

[11] See Metric 1.4, page 15.

its subset of competencies that comprise the NARL would be consistent with these established models of accreditation.

The 2023 interviews with leadership from the Canadian nursing, accounting, and architecture professions revealed a shared reliance on competency profiles. Notably, all academic programs within these professions follow a competency-based approach, alongside national exams for licensure/certification.

In the case of internationally trained applicants, nursing employs a competency-based review for assessing academic qualifications. Internationally trained architects with seven or more years of experience are not subjected to academic assessment; rather, their licensure process centers on a comprehensive competency review of their extensive professional experience.

iv. Versatility

The FSCP represents versatility, accommodating the varying timeframes that make up the engineer's career journey. Its competencies can be tailored to suit the needs of diverse user groups, ranging from undergraduate learners to post-graduation trainees and post-licence practitioners. The approach allows for seamless adjustments in measuring and evaluating proficiency in competencies at each stage, ensuring appropriate assessments of both breadth and depth based on the stage of development. Additionally, the competencies are not limited to a specific discipline and encompass all areas of engineering practice equally.

v. Readiness for the future

During FEA's Foresight Session and virtual simulations, interest holders were invited to reflect on the anticipated future landscape of the engineering ecosystem. An emerging consensus suggests that engineers will operate in environments marked by heightened uncertainty and rapid change. Acknowledging this evolving reality, the FSCP becomes crucial in preparing tomorrow's engineers to effectively confront multifaceted and interdisciplinary challenges. By encompassing not only technical knowledge and abilities but also analytical, interpersonal, and social skills, the FSCP offers a comprehensive framework to ensure that engineers emerge as well-rounded and adaptable professionals equipped to navigate diverse professional contexts.

vi. Engineering education

The FSCP encourages flexibility and innovation within engineering programs, aligning closely with the core purpose of accreditation. By embracing the FSCP, programs can tailor their educational offerings to meet the evolving needs of the engineering profession while maintaining the standards expected by accreditation bodies.

The FSCP also represents an outcomes-based approach, which reflects the pedagogical practices of many other jurisdictions covered in the 2022 report *Benchmarking the Canadian Engineering Accreditation System*. The use of outcomes-based approaches bolsters the credibility and effectiveness of engineering education.

vii. Increased diversity and inclusion

The FSCP presents a significant opportunity to address diversity and foster inclusion within the engineering profession. By embracing the FSCP, engineering programs can adapt their approaches to accommodate diverse learning styles and offer multiple pathways to licensure. This inclusive approach ensures that individuals from various backgrounds and experiences have greater opportunities for access to, participation in, and success within the engineering field.

8. Known gaps and actionable recommendations for the path forward

There are known gaps that could potentially impact the successful adoption and implementation of the FSCP and the NARL. Many of the known gaps will require further exploration and collaboration in the next phase of the FEA project.

i. Urgency to complete the NARL

Known gap: There is an urgent imperative to thoroughly develop and implement a NARL that is universally adopted by all regulators. This imperative contrasts with the longer development timelines needed to meticulously outline the FSCP. While the FSCP and NARL are complementary, their differing timelines may complicate how they are received, adopted, and accepted.

Recommendation: Prioritize the finalization and implementation of the NARL.

It must be seamlessly integrated into the entire accreditation system, encompassing accreditation processes and all academic assessments conducted by regulators. The next phase of the project should:

- Engage with employers, as outlined in one of the unfulfilled mandates of this Task Force, to gather valuable insights.
- Undertake refinement of the competencies, definitions of competence for each competency and subsequent development of indicators of competence, through assessment experts' structured and guided consultation with the engineers in academia and industry.
- Undertake refinement of the competencies and subsequent development of indicators.

Additionally, the completion and adoption of the FSCP should remain a longer-term goal.

ii. Continued development of the FSCP

Known gap: Accreditation system participants must maintain their focus on the long-term development of the FSCP and actively work towards its widespread adoption across the entire system. Achieving a comprehensive assessment as intended by the FSCP would require significantly more effort from all involved parties, which may not align with regulators' current priorities. The ongoing government pressures to expedite applications and entry to practice stand in contrast to the requirement for heightened assessment efforts.

A widespread acceptance of the FSCP lies in challenging certain patterns of thought and underlying beliefs. These include perceptions that the FSCP:

- Is overly complicated and difficult to clarify without criticism
- Is diminishing the current rigorous standards instead of enhancing them
- Limits assessments to a predefined set of competencies, overlooking critical attributes such as public safety, accountability, and liability
- Makes it challenging to strike a balance between evaluating academic and experiential competencies
- Constrains the flexibility, diversity, and innovation for the system's interest holders

Other assumptions erroneously suggest that the heightened workload and meticulous attention to assessment details inherent in the FSCP will invariably lead to improved outcomes and heightened public protection. There is an implicit, albeit not necessarily completely warranted, trust in the thoroughness of the FSCP assessment process.

Recommendation: Continue to develop the FSCP competency definitions and indicators to achieve a comprehensive assessment framework.

Prioritizing and promoting the implementation of the NARL will generate momentum and drive success for the broader adoption of the FSCP. This focused effort will establish the foundational aspect necessary for a robust framework of ongoing system enhancements. Moreover, leveraging the interest holders' familiarity with the significant efforts required to transition to CBA can further encourage their embrace of the FSCP.

iii. Substantial equivalence with IEA Graduate Attributes and Professional Competency Framework

Known gap: While the FSCP has been mapped onto existing frameworks such as CEAB's Graduate Attributes, the pan-Canadian work experience competencies, and the IEA's Graduate Attributes and Professional Competencies benchmarks, there are still gaps that need to be addressed to improve alignment with these models.

Recommendation: Maintain FSCP and NARL's alignment with the IEA's Graduate Attributes and Professional Competencies Framework.

Ensuring the substantial equivalence of the FSCP and NARL with the graduate attribute and professional competency profiles of the IEA is paramount, since maintaining signatory status in the Washington Accord, the International Professional Engineering Agreement (IPEA), and the Asia-Pacific Economic Cooperation (APEC) Agreement is a priority for Engineers Canada. A steadfast focus on compatibility between the frameworks is crucial to sustain alignment with global standards.

iv. An Imperative for National Adoption

Known gap: There is a significant risk that not all regulators will be willing to endorse the NARL. Without universal support, disparities in accreditation standards and licensing outcomes for engineering graduates in different Canadian jurisdictions will persist. Moreover, this lack of consensus will hinder the engineering community's ability to address the current issues surrounding perceived differences between CEAB and non-CEAB applicants, further exacerbating existing challenges related to fairness and equity in the accreditation process.

Recommendation: Strive to achieve national adoption of the NARL across all Canadian jurisdictions.

A collaborative approach grounded in shared principles will be essential. Interest holders must engage in ongoing dialogue and co-design sessions to develop a collective understanding of the NARL and its benefits. Allowing all parties to contribute their perspectives and work towards consensus can foster alignment and ensure successful adoption of the NARL across the system. This approach is crucial for addressing disparities in licensing outcomes and ensuring equitable access to the profession.

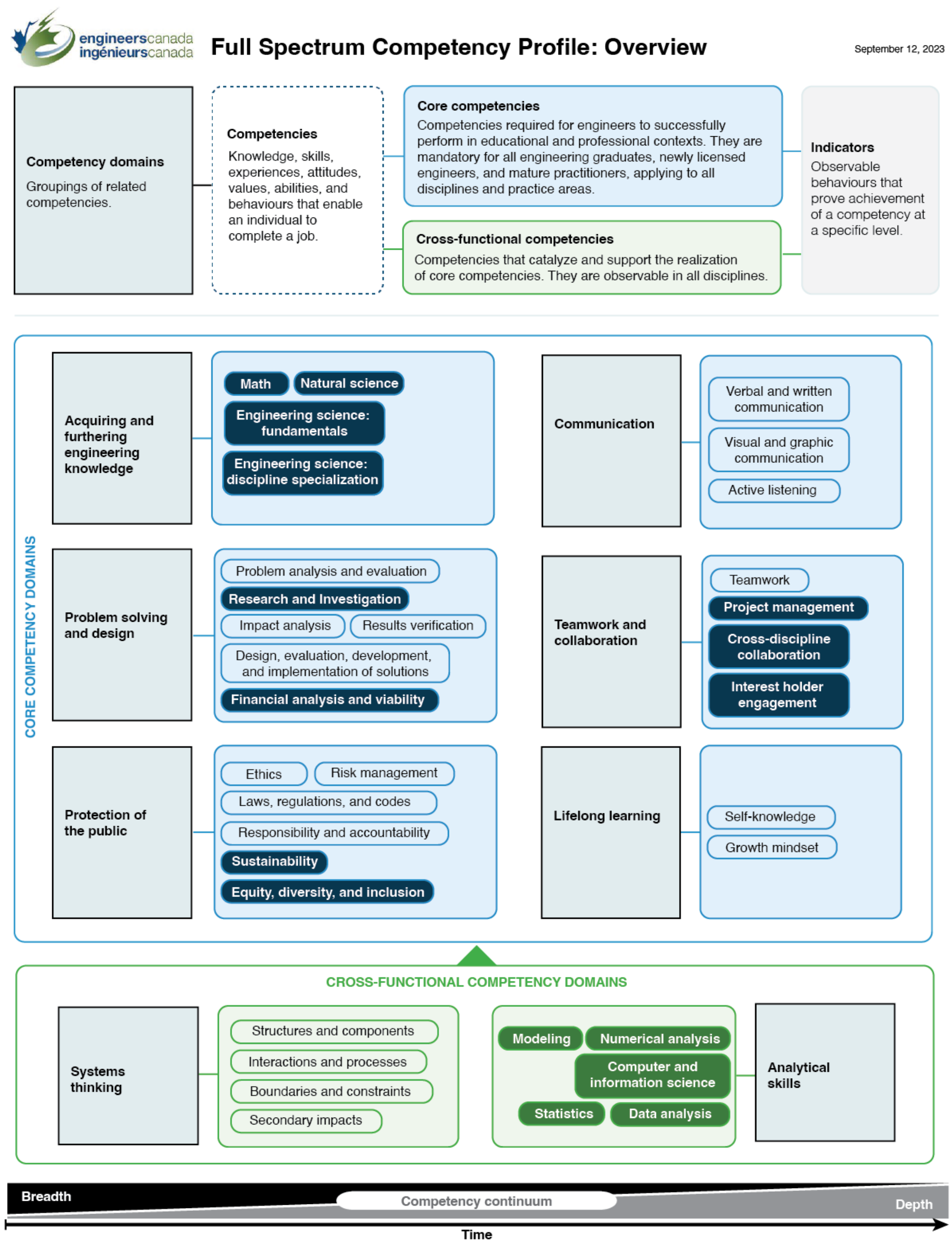
9. Next steps

The information and recommendations in this document will serve as foundational inputs for the discussions and preparations of the Co-Design Session scheduled for April 2024. This session, with participation from key interest holders, including the project Steering Committee, the CEAB, CEQB, Engineering Deans Canada (EDC), and the Regulator Advisory Group, will concentrate on the contents of this document and the accompanying document from the Academic Requirement Task Force.

During the Co-Design Session, the participants will prioritize addressing how to tackle the identified gaps and recommendations. After the session, the conclusions drawn from these discussions will shape the contents of the Path Forward Report. This report will outline the direction of accreditation and propose implementation strategies aimed at achieving the envisioned future system.

Appendix A: FSCP Overview

The FSCP consists of 34 competencies organized into eight domains. The subset of 16 competencies that constitute the proposed NARL are shaded in dark blue and green.



Appendix B: Mapping the FSCP

Mapping the Full-Spectrum Competency Profile

- - - - - Dashed border indicates a weaker link.

September 14, 2023

FSCP Competencies	CEAB Graduate Attributes	IEA Graduate Attributes	IEA Professional Competencies	Pan-Canadian Work Experience Competencies
Acquiring and Furthering Engineering Knowledge	A Knowledge Base for Engineering	Engineering Knowledge	Comprehend & Apply Universal Knowledge Comprehend & Apply Local Knowledge	
Problem Solving and Design	Problem Analysis Investigation Design Use of Engineering Tools	Problem Analysis Design/Development of Solutions Investigation Tool Usage	Problem Analysis Design & Development of Solutions Evaluation	Technical Competence
Protection of the Public	Professionalism Impacts of Engineering on Society & Environment Ethics & Equity	The Engineer & the World Ethics	Protection of Society Legal, Regulatory, & Cultural Ethics Judgement Responsibility for Decisions	Professional Accountability Social, Economic, Environmental, & Sustainability
Communication	Communication Skills	Communication	Communication & Collaboration	Communication
Teamwork and Collaboration	Individual & Team Work Economics & Project Management	Individual & Collaborative Team Work Project Management & Finance	Manage Engineering Activities	Project and Financial Management Team Effectiveness
Lifelong Learning	Lifelong Learning	Lifelong Learning	Continuing Professional Development & Lifelong Learning	Personal Continuing Professional Development
Systems Thinking Analytical Skills	Not specifically called out as a distinct competency in any framework.			

Appendix C: Project background

a. About the Futures of Engineering Accreditation

The FEA is an initiative by Engineers Canada, and part of its 2022-2024 Strategic Plan. The objective of the FEA is to leverage the insights, perspectives, and expertise of members of the Canadian engineering ecosystem to examine the current accreditation system, understand how it is serving contemporary needs, and consider how it can chart a new path for the future of the engineering profession. The strategic priority aims to bring together the diverse perspectives of the Canadian engineering ecosystem to create an accreditation system that moves everyone forward together. Expected project outcomes include:

1. All interest holders understand the purpose of accreditation.
2. Regulators have an academic requirement for licensure, applicable to all.
3. Engineers Canada, including the CEAB and CEQB, have direction to implement systems aligned with the purpose and the academic requirement for licensure.

This project is done in partnership with Coeuraj, a design and facilitation consultancy. The "project team" includes Engineers Canada staff and Coeuraj personnel.

b. Adapting accreditation: The evolution and importance to Canadian engineering

Since its creation in 1965, the Canadian engineering education accreditation system has supported Canadian engineering regulators, been recognized as substantially equivalent under international mutual recognition agreements, and has mentored accreditation bodies across the globe. Significant changes in engineering practice and engineering education have occurred over this same period. From technological advancements to the emergence of new and alternative educational delivery methods, the learning context for today's engineers is far different from that of the past.

The skill set required of a modern engineer is continually shifting. Engineers Canada wants to ensure that accreditation still provides value while remaining contextually relevant by adapting to the changing educational and professional environments.

c. Project journey

This is a multi-year project with different phases. The key activities include:

- Benchmarking the Canadian accreditation system and investigating a minimum academic requirement for licensure.
- Conducting a fundamental review of the current accreditation system and re-examining its purpose in the context of the overall licensure system.
- Gathering the different perspectives of the Canadian engineering ecosystem to shape future evolutions of accreditation to best meet society's needs.
- Delivering a Path Forward report which provides direction to Engineers Canada, including the CEAB and the Canadian Engineering Qualifications Board (CEQB), with direction to implement systems aligned with the purpose of accreditation and the academic requirement for licensure. The report will explain future direction, and present recommendations to close the gaps between the current and envisioned future state.

There are four main phases of the project which have spanned from 2021 until the present. They are as follows:

Phase 1 – Research

In May 2021, the engineering regulators approved a new strategic priority to investigate and validate the purpose and scope of accreditation. To begin this work, members of the engineering ecosystem gathered perspectives on the current context in which the accreditation system functions. The Benchmarking Accreditation Task Force was created to conduct research to compare the Canadian engineering accreditation system with national and international comparators. The Engineering Education Task Force was created to understand current and emerging trends in engineering education. In a workshop with educators and regulators, the current realities of engineering education were explored with those who experience them daily. The two task forces compiled their findings in their respective reports, *Benchmarking the Canadian Engineering Accreditation System* and *Current and Emerging Practices in Engineering Education*. The reports were published in March 2022 and subsequently discussed with regulators to set the context for all future work. This upfront work served as the foundation for the project pathway.

Phase 2 – Understanding the existing system

Members of the Canadian engineering ecosystem were engaged to share their unique perspectives, including their experiences and expertise in the overall licensure process and accreditation system.

In May 2022, the project team facilitated a collaborative session with EDC to map out responses to four key questions pertaining to the purpose and scope of accreditation. In September 2022, the project team convened separate meetings with the CEAB and CEQB and collected their perspectives on the purpose and structure of the accreditation system.

In November 2022, the project team hosted more than 70 individuals from the engineering community at a strategic foresight session to imagine "the engineer of the future" and the prerequisites for their success. One of the central messages emerging from the event, as documented in the Foresight Session Event Journal, is that "participants saw a need for engineers who are values-based leaders, who are technically excellent and actively collaborate across disciplines, are mindful of the future and maintain curiosity and a desire for lifelong learning."

Phase 3 – Introducing new voices

Over six weeks during Spring 2023, the project team led a series of virtual simulations, a structured form of brainstorming and exercises which invited 80 participants from the engineering community to explore the accreditation and licensure systems. The simulation experience was designed to bring together a variety of perspectives for envisioning who the engineer of the future is and what they need, and to understand how the systems might react to different purposes of accreditation and to potential national academic requirements for licensure. The virtual simulations unlocked key learnings about the collective work needed to evolve the engineering accreditation system. The data synthesized from the simulations indicated that:

- Participants are aligned that accreditation should have a role in the engineering ecosystem to ensure quality control and professional integrity, but it needs significant change to be fit for purpose.
- There is value in having clearly defined, transparent standards for engineering knowledge and competence at a national level. The data also suggest that this requirement should address a general, baseline level of technical knowledge complemented with professional competencies and an understanding of the ethical responsibilities of an engineer.
- The relationship between accreditation and the academic requirement for licensure is not yet clear and requires further work.

The Purpose Task Force and the Academic Requirement Task Force used the data from the virtual simulations to build viable options for the future. In Fall 2023, the project team conducted 13 in-person consultations with regulators, the EDC, the CEAB, and the CEQB to discuss draft concepts for a renewed purpose of accreditation and a national academic requirement for licensure.

Also in late 2023, the project team conducted four interviews with leadership from Canadian accreditation and/or regulatory bodies for the professions of nursing, accounting, and architecture. The findings underscore the shared challenges and approaches among these professions in accrediting programs for interest holders with different needs and objectives, evaluating foreign-trained practitioners, and offering diverse pathways into the profession.

During the same timeframe, the project team launched a survey aimed at actively engaging specific interest holders, including current and former students of CEAB-accredited programs, international engineering graduates, applicants for engineering licensure, and people with or without an engineering license working in engineering. Participants were asked to share their insights and experiences related to accreditation, competencies, and the process of obtaining an engineering license in Canada. The survey responses contributed to the ongoing work and validation around development of the purpose of accreditation and a national academic requirement for licensure.

Current Phase (Phase 4) – Nurturing an emergent system

The Purpose Task Force and the Academic Requirement Task Force relied on data collected during the previous phases of the project to inform and define the future purpose and scope of accreditation and a national academic requirement for licensure. Recommendations from the task forces will become the foundation for shaping the future of the accreditation system, which will be documented in the Path Forward report for release later in 2024.