Revolutions, Regulations, and Realities: Licensure and Accreditation in the US and Canada

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Abstract:

In this thought piece I describe some recent successes in pushing forward a new (and potentially, ***revolutionary***) kind of engineering education at my home institution: Concordia University. I situate these successes within the highly ***regulated*** context of engineering education in Canada. The piece ends with a reflection on how some of the ***realities*** of engineering education in Canada often sit uncomfortably with the aspirations of those involved. It is my hope that this piece will provoke thoughtful comparisons and contrasts between the US and Canadian engineering education experiences; especially with regard to those engineering educators interested in the incorporation of "professional skills" into undergraduate engineering curriculum.

Licensure and Accreditation

The engineer of 2020 is currently working her way through her degree. Having reached this much anticipated moment, we find ourselves, as engineering educators, obliged to reflect on how well we have lived up to the promises of the "engineer of 2020."[1][2] In this paper I reflect on the work left unfinished and explore ways to think about what comes next. I seek to look beyond this moment and to imagine how the engineer of 2050 will be shaped. In particular, I explore the role of licensure and accreditation in shaping the pathways to engineering practice in 2050. To get at the multiple futures and the myriad of choices and alternatives that exist, I compare the American context of licensure and accreditation in engineering with the Canadian context. In doing so, I hope to foreground and highlight some of the choices that are reified through these systems. I pay particular attention to those choices involving the social and ethical components of professional engineering. In foregrounding these choices, I hope to make evident alternatives and to suggest potential changes that may better pave the road to 2050.

Professionalism in Canada and the US

Two of the primary ways the social and ethical components of the profession of engineering are shaped are licensure and accreditation. "Licensure is the mark of a professional. It's a standard recognized by employers and their clients, by governments and by the public as an assurance of dedication, skill and quality."[3] Social and ethical components reveal themselves in this arena through professional codes of ethics. Every professional

[1] National Academy of Engineering, U. S. *The engineer of 2020: Visions of engineering in the new century*. Washington, DC: National Academies Press, 2004.

[2] Phase, I. I. *Educating the engineer of 2020: Adapting engineering education to the new century*. National Academies Press, 2005.

[3] https://www.nspe.org/resources/licensure/why-get-licensed

engineer in both Canada and the US will be familiar with the primary professional obligation of the engineer to "hold paramount the safety, health, and welfare of the public."[4] This is a required competency of the professional engineer. It is a competency that is nominally required for any engineer. This requirement is further enforced by the accreditation standards that exist for engineering programs in both the US and Canada. In the US, ABET is the accrediting body that requires the training of this professional competency. In Canada, the accrediting body is the Canadian Engineering Accreditation Board (CEAB). While at first glance the two bodies (ABET and CEAB) seem to have similar standards, it will be argued here that the differences that exist are profound and result in important differences in how the role of social and ethical professional competencies are seen in the two contexts.

Two differences in particular will be focused on. First, is the professional system in which licensure and accreditation take place. The professional systems for engineering in the US and Canada differ radically. The Canadian professional system is a closed system, reserving both right to title and right to practice to professional engineers. That is, one cannot (legally) perform an act deemed to be an act of engineering if one is not a good standing member of one of the provincial professional engineering orders. Additionally, one cannot use the title of "engineer" if one is not a good standing member of one of the provincial professional engineering orders. The professional system in the US (in so far as there is anything that could be called a "system" at all) looks radically different. Becoming a professional engineer is not a requirement for all engineers in the US. Only about 20% of engineers are "professional" engineers in the US[5]. While the title of "professional engineer" is reserved to those who are properly licensed (a process that varies from state to state), engineering acts are not reserved at all. Anyone can practice.

A second important difference with regard to how social and ethical competencies enter into the profession relates to the processes involved in accreditation (as required by the CEAB and ABET). Crucially, the differing relationships between licensure and accreditation in the US and Canada create serious differences in how the social and ethical competencies are treated in the University setting. In the US, the licensure bodies are independent of the accreditation board. While there are conversations across licensing bodies, the National Society for Professional Engineers (NSPE) and ABET (often through American Society for Engineering Education (ASEE) meetings) there does not exist a formal relationship between the two areas. In Canada, the licensing bodies (the professional orders in each province) and the accreditation body (the CEAB) are formally (and legally) coupled through the national organization Engineers Canada[6].

It is my hypothesis that the closed professional system in Canada which requires the coupling of the licensure and accreditation processes provides engineering educators with greater opportunities to introduce robust methods for teaching the professional competencies around the social and the ethical nature of engineering practice. Given that the same body oversees the standards for education (the new outcomes based model —- more on this below) and also oversees the licensure standards, engineering educators are obliged (in ways that appear to us to be stronger than in the US) to take each of the graduate attributes (see below) seriously. This, coupled with the fact that ALL engineers must go through the licensure process, creates an environment in which the CEAB outcomes based assessment process is treated in a more serious way than the similar outcomes based assessment process required by ABET.

To establish this point, I will first explore the Canadian context in more detail. Next, I will explore the US context and look at how recent changes to the ABET outcomes based assessment process (especially with

[4] NSPE Code of Ethics

[5] These numbers vary depending on the source. The National Council of Examiners for Engineering and Surveying (NCEES) keeps numbers that vary from year to year. The number of P.E.s vary greatly across disciplines and industries as well.

[6] The national organization of the 12 provincial and territorial professional associations that regulate the profession of engineering. Engineers Canada is tasked with delivering national standards for engineering education, professional qualifications, and professional practice. Engineerscanada.ca

regard to General Criteria 3 (Outcomes) and 5 (Curriculum) have affected the ability of engineering educators in the US to teach the social and ethical competencies that were (not that long ago) more explicitly required by the EC 2000 criteria. This, coupled with ongoing threats to the licensure process in a variety of States[7], has created an atmosphere in which licensure and accreditation are moving further apart.

While the US has faced these changes in accreditation and licensure, the Canadian system of licensure and accreditation has solidified into a unified body overseen by an umbrella organization called Engineers Canada. We will explore some of the innovations that have been made possible under the Canadian system and suggest ways to work toward similar innovations in the US context.

Finally, we will end with a discussion of the "realities" surrounding the Canadian engineering education context. We see conversations beginning to bubble to the surface in Canada that remind us of the conversations that lead to the recent changes to General Criteria 3 and 5 in ABET. We end the piece with a warning for Canadian engineering educators to not repeat the mistakes of ABET, and an invitation to US engineering educators to learn from some of the experiences we have had in the Canadian context in which the licensure and accreditation processes are coupled.

Professional Engineering in Canada

The accreditation process for engineering programs in Canada lives within a ***closed*** professional framework. A Professional Engineering (P.Eng.) license is mandatory to practice engineering, or to use engineering titles, in every province (and territory) in Canada. It is illegal to call yourself an engineer if you are not a good standing member of one of the provincial professional engineering orders. Further, it is illegal to perform any act deemed to be an act of engineering if you are not a good standing member of one of the provincial professional engineering orders[8]. This differs from practice in the United States, which remains ***open***. In the United States, licensing confers only the right to use the title. As a result, anyone can practice. This well-known loophole, sometimes called the "industrial exception," permits entire industries to function with unlicensed professionals in the United States[9].

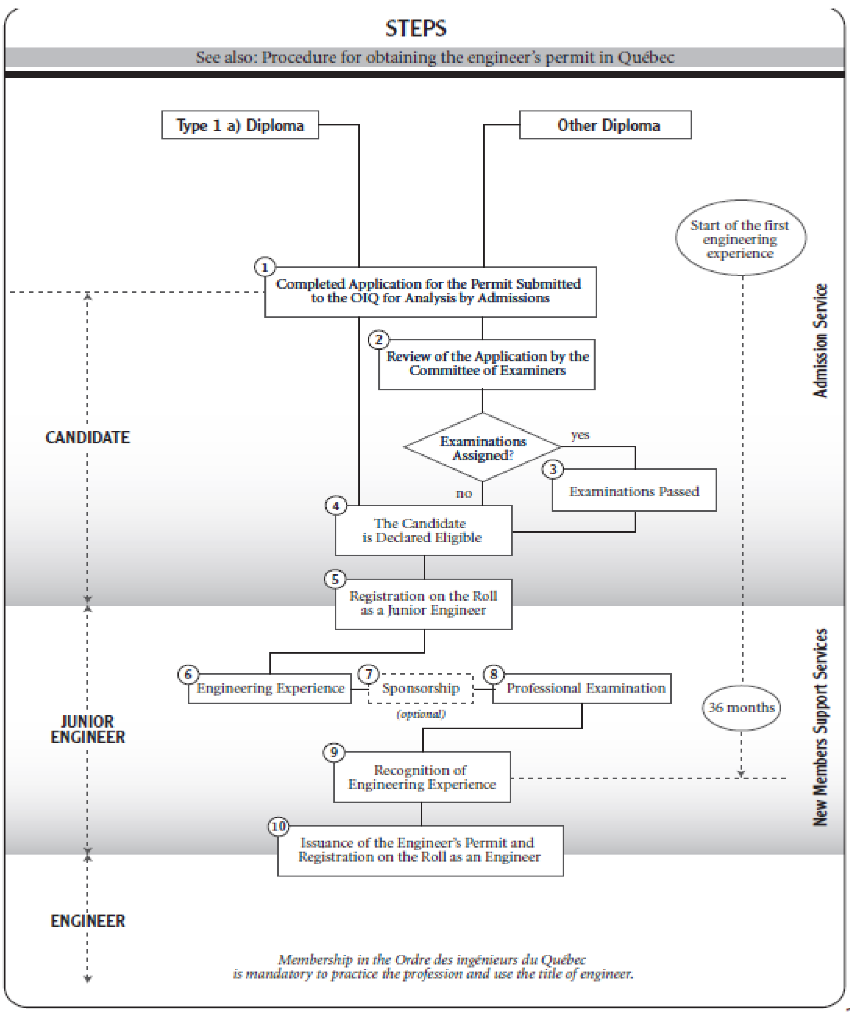
There is another key difference between the Canadian and the U.S. engineering laws. In Canada, the engineering profession is "self-regulating": each province or territory has passed an Act to create an Order of Professional engineers, which in turn regulates the profession. In the U.S. the profession is not "self-regulating" in this way. State governments appoint licensing boards to license engineers, and the governments establish regulations that the engineers must follow. Therefore, politicians typically play a more significant role in establishing and enforcing regulations in the U.S. system than they do in Canada[10].

This distinction is often hard to appreciate for individual engineers (especially those engineers in training (engineering students) that we work with every day). For them, a regulation is a regulation regardless of its origin. However, there is often some leverage to be found in reminding engineers that these regulations were not imposed upon them by some outside, non-engineering body. They were, instead imposed upon them by *other engineers*, who, having decided what they want to require from their profession, have imposed upon professional engineers certain legal requirements. Thus, there is an argument to be made that the requirement that "ethics and equity" and the "impact of technology on society" (see more below) be included in the

[7] https://www.nspe.org/resources/issues-and-advocacy/action-issues/threats-professional-licensure
[8] There is a law called the "Engineers Act" that literally names and describes all activities deemed to be an activity of engineering.
[9] For more on this see: Andrews, Gordon C., *Canadian Professional Engineering and Geoscience: Practice and Ethics*. Fifth Edition. Nelson Education Publishing, 2014.
[10] *Ibid.* p. 33

engineering curriculum is not the result of some organization that is independent of the profession of engineering. Instead, it is a requirement that comes from within the engineering profession itself.

Here is the upshot. The accreditation requirements that each engineering program must abide by (or perish) come from this "self" regulatory framework. Overseeing each of the provincial professional orders, is an organization called, Engineers Canada. Engineers Canada is the national organization of the provincial and territorial associations that regulate the practice of engineering in Canada and license the country's 290,000 members of the engineering profession.[11] Almost all of the actual regulations and policies for practicing engineers are dealt with on the provincial level by the provincial professional order. For example, in Quebec, there is a fascinating story to be told about how the Order des ingénieurs du Québec (OIQ) passed a number of new regulations after the "Quiet Revolution." However, there are a number of places where Engineers Canada requires consistency. The primary area where they orchestrate consistency is the pathway to becoming a good standing member of one of the provincial orders. This pathway is unlike anything most American engineers are used to. Below is Quebec's procedure for obtaining an engineering license (the professional engineering pipeline).



[11] https://engineerscanada.ca/

The very first step is having a diploma from an accredited institution. Thus, Engineers Canada is in charge of accreditation processes across all of Canada. They are the ones who answer the question of what constitutes an accredited program in engineering. To achieve this, Engineers Canada set up the Canadian Engineering Accreditation Board (CEAB) to oversee the accreditation process. This organization is, of course, very similar to ABET in the United States. However, it is important to remember here that this accreditation body is directly situated in the larger professional system we have described. One cannot enter into the professional engineering pipeline (pictured above) without having graduated from an accredited institution[12]. And, remember, one cannot be an engineer (neither call oneself an engineer or practice any activity deemed to be engineering) without having successfully completed the pipeline. Thus, the CEAB has a vastly more important role to play in the Canadian context than does ABET in the American context. Most important for us is the level with which the accreditation process is taken seriously by engineering educators. Accreditation visits are a part of the regulatory framework that engineers *must* live within. While stemming from a "self-regulatory" framework, compliance is not optional.

It is within this regulatory framework that the CEAB introduced the new outcomes-based graduate attribute accreditation system. This was borrowed very openly from the similar changes ABET made in the early 2000s. However, there are a few notable exceptions.

1. **A knowledge base for engineering:** Demonstrated competence in university level mathematics, natural sciences, engineering fundamentals, and specialized engineering knowledge appropriate to the program.
2. **Problem analysis:** An ability to use appropriate knowledge and skills to identify, formulate, analyze, and solve complex engineering problems in order to reach substantiated conclusions.
3. **Investigation:** An ability to conduct investigations of complex problems by methods that include appropriate experiments, analysis and interpretation of data, and synthesis of information in order to reach valid conclusions.
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.
5. **Use of engineering tools:** An ability to create, select, apply, adapt, and extend appropriate techniques, resources, and modern engineering tools to a range of engineering activities, from simple to complex, with an understanding of the associated limitations.
6. **Individual and team work:** An ability to work effectively as a member and leader in teams, preferably in a multi-disciplinary setting.
7. **Communication skills:** An ability to communicate complex engineering concepts within the profession and with society at large. Such ability includes reading, writing, speaking and listening, and the ability to comprehend and write effective reports and design documentation, and to give and effectively respond to clear instructions.

[12] With obvious exceptions for immigrants: https://newcomers.engineerscanada.ca/ However, unless one is coming from a country that is a signatory to the Washington Accord, this process almost always involves having to go through one of Canada's accredited institutions in one form or another. In fact, the highly regulated professional system in Quebec (including especially medicine and law) is famously hard to break into if one is coming from outside of the ***closed*** system.

8. **Professionalism:** An understanding of the roles and responsibilities of the professional engineer in society, especially the primary role of protection of the public and the public interest.

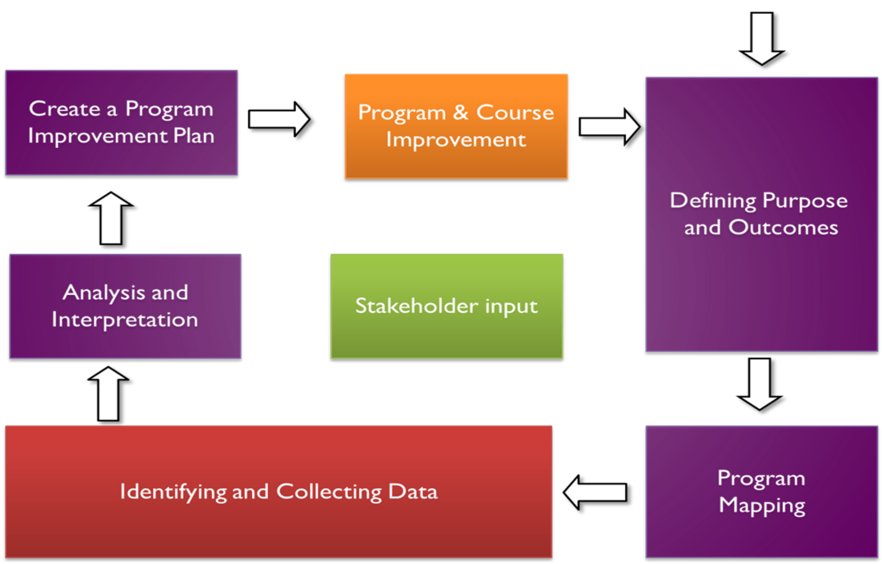
9. **Impact of engineering on society and the environment:** An ability to analyze social and environmental aspects of engineering activities. Such ability includes an understanding of the interactions that engineering has with the economic, social, health, safety, legal, and cultural aspects of society, the uncertainties in the prediction of such interactions; and the concepts of sustainable design and development and environmental stewardship.

10. **Ethics and equity:** An ability to apply professional ethics, accountability, and equity.

11. **Economics and project management:** An ability to appropriately incorporate economics and business practices including project, risk, and change management into the practice of engineering and to understand their limitations.

12. **Life-long learning:** An ability to identify and to address their own educational needs in a changing world in ways sufficient to maintain their competence and to allow them to contribute to the advancement of knowledge.

In preparation for our accreditation visit (which happened this past November, 2017), each of our undergraduate programs began to collect data on how their students were performing with regard to these attributes. This process began as early as 2012. This was necessary since the CEAB required longitudinal data on how our students were performing and what curriculum changes we had made as a result of the data we gathered. This is a crucial step for us. The CEAB does not just require that we gather data on these attributes. Nor does it simply require that we demonstrate that our graduating students satisfy some minimum requirement for each of these attributes. The primary thing the CEAB seeks when they visit is a "continual improvement" plan. See below:



So, our Dean set up a task force in charge of overseeing the collection of the data, the analysis of the data, and then the curriculum improvement plans that result from this analysis. These curriculum improvement plans were the primary deliverable for our CEAB visit. The faculty of ENCS needed to demonstrate not only that we have a system in place to collect this data, but that we have a robust feedback loop in place that results in demonstrable changes (improvements hopefully) to actual curricula. This was our deliverable.

The reader will have already noticed that attributes 6-12 are non-technical engineering skills. The need and the urgency to demonstrate that attributes like “ethics and equity” and “impact of engineering on society” were not only being taught, and not only was data being gathered on the efficacy of such teaching, but that each of ENCS’s programs had demonstrable improvements made prior to the CEAB visit was what, we argue, created the opportunity for our “revolutions.”

Program Development

We have been able to develop and implement (that is to say, get past the curriculum committees of our faculty) a number of elective courses as well as a graduate certificate for undergraduate and graduate students. These include:

Development and Global Engineering: an introductory course in international development and global engineering for graduate students. Topics include evolution of development, globalization, development projects, planning and analysis, and participatory data gathering.

Cultures of Engineering Practice: The main goal of Engineering Cultures is to help engineering students (and other students) learn to work better with people who define problems differently than they do. Course modules travel around the world, examining how what counts as an engineer and engineering knowledge has varied over time and from place to place. We explore the historical emergence of dominant practices of engineering formation and patterns of engineering work across different countries, all to better understand contrasts and encounters among different engineering perspectives that live in the present.

Creativity, Innovation and Critical Thinking in Science and Technology. Examines thinking, arguing, and creativity in science and technology. It explores complex problems using theories from communication, business and psychology. Case studies of successful and failed innovations are presented. We examine the roles of experts and researchers in the diffusion of ideas, and the impact of diffusion on economics, media and society.

Science Outside the Lab (SOtL) North. a deep-dive, immersive introduction to science, policy, and societal impacts. During the week-long workshop, participants (including Master's and PhD students, as well as Postdocs and young professionals) meet and interact with the people who fund, regulate, shape, critique, publicize, and study science, including government scientists, funding agency officers, science-focused interest groups, science communicators, academics, museum curators, and others.

The Graduate Certificate in Innovation, Technology and Society. Social entrepreneurs understand that with innovation comes responsibility. With past technological fixes contributing to global warming, market crashes and animal extinction, we need creative minds to develop strategies that address the root causes of complex problems and incorporate them into viable business models. The Graduate Certificate in Innovation, Technology and Society provides you with an environment in which engineers and non-engineers work together to cultivate innovative processes across disciplines. Combining aspects of theoretical and experiential learning, the certificate offers you the opportunity to develop ideation techniques before pursuing the commercial potential of your ideas through a practicum at Concordia’s District 3 Innovation Center.

Constructivist Technology Assessment in Engineering Design Courses. Introducing constructivist technology assessment mechanisms into open-ended design courses, such as our Capstone design course. Borrowing from the literature on constructive technology assessment and responsible research and innovation, we have developed a three-part process that walks engineering students engaged in project design courses through the process of incorporating these considerations into the research and design phases of their projects. Following the literature on social construction of technology (in particular Guston and Sarewitz, 2002), we call this pedagogical approach "Real-Time Technology Assessment." The aim of this approach is to provide an explicit mechanism for observing, critiquing, and influencing social values as they become embedded in innovations. This approach to technology assessment differs from traditional models that typically focus on "impact assessments" of what the effects of a new technology are on society after the technology has been introduced. Real-time technology assessment attempts to incorporate potential societal implications into the actual "real-time" design processes that go into the construction of a new technology. It differs from other traditional pedagogical approaches to teaching ethics as well. This assessment mechanism allows students to engage with real technologies that have real social, ethical, and legal dimensions. In this way, students are encouraged to learn experientially through a real-world technology that is being developed in real-time.

Each of these has been accomplished within the last five years. Rather than dwell on the details of each of these success stories we here seek to uncover and foreground the context in which these successes were made possible. As my colleagues and I discussed the common denominator between each of our initiatives, we came to realize that it is largely the unique opportunities provided by our *Canadian* engineering education context that informs each of our stories. Being regular participants in both the American Society for Engineering Education (ASEE) and the Canadian Engineering Education Association (CEEA), we are regularly confronted with the importance of the often terribly underappreciated differences in context between these two societies. For example, our American colleagues are often shocked to learn that we have as one of our twelve graduate attributes "Ethics and Equity." This shock often turns to disbelief when we describe the larger regulatory framework in which these attributes operate.

Some of the more poignant examples of the members of CES being called in from the margins to participate in the center of curriculum change due to the urgency of the need created by the accreditation deliverables (and, of course, accreditation's place in the larger regulatory framework in Canada) are worth discussing further here.

In addition to the simple existence of the Centre for Engineering in Society and the four core courses we teach (designed to handle precisely the non-technical attributes described above --- indeed, three of the courses borrow their names directly from the wording of the graduate attributes), the faculty sought to take full advantage of having in-house social scientists who specialize in precisely these areas.

This has created an unprecedented opportunity for CES to establish lasting changes in how the social and ethical dimensions of engineering practice are taught at Concordia. We were able to harness the potential of this moment by implementing and evaluating a novel approach to teaching engineering students how to incorporate ethical, legal, and social considerations into engineering design courses. Borrowing from the literature on constructive technology assessment and responsible research and innovation, we have developed a three-part process that walks engineering students engaged in project design courses through the process of incorporating these considerations into the research and design phases of their projects. Following the literature on social construction of technology, we call this pedagogical approach "Real-Time Technology Assessment." The aim of this approach is to provide an explicit mechanism for observing, critiquing, and influencing social values as they become embedded in innovations. This approach to technology assessment differs from traditional models that typically focus on "impact assessments" of what the effects of a new technology are on society after the technology has been introduced. Real-time technology assessment attempts to incorporate potential societal implications into the actual "real-time" design processes that go into the construction of a new technology. It differs from other traditional pedagogical approaches to teaching ethics as well. This assessment mechanism allows students to engage with real technologies that have real social, ethical, and legal dimensions. In this way, students are encouraged to learn experientially through a real-world technology that is being developed in real-time.

Through a series of negotiations with each of the four departments in the engineering faculty at Concordia University, we have secured agreements with each department to work with the final year capstone design courses. A lecture at the beginning of the Fall and Winter semesters will familiarize each capstone cohort with the idea of real-time technology assessment. After the lecture at the beginning of the semester, each capstone team will then make an appointment to meet with CES to address how the technology assessment mechanism applies to their specific capstone project. It has been agreed that we will be responsible for 10% of the final grade for each of the capstone design teams. This provides us with an unprecedented level of participation in technical design courses, and does so in a way that will incentivize students to take real-time technology assessment seriously. The average number of students engaged in a capstone design project across all four departments in engineering at Concordia each year is about 600 students spread across about 100 teams.

Pushback in Canada

The new outcomes-based accreditation requirements are, relatively speaking, new in Canada. Most engineering programs are going through this new accreditation process for the first time. Concordia (our home institution) was one of the earlier universities to go through the process (we found out this past June that we did so successfully, receiving the maximum number of accredited years (6) for each of our programs). The novel approaches we have taken to provide the CEAB with the evidence of our continual improvement process have placed us in a unique position and has opened up the national stage to us. Many of us are now being called upon by other engineering universities across Canada to help out with the non-technical attributes. We have done so through our involvement in national organizations such as the Canadian Engineering Education Association (CEEA)[13], the Canadian Chapter of Engineers Without Borders (EWB)[14], the Engineering Graduate Attribute Development (EGAD)[15] project, the National Initiative on Capacity Building and Knowledge Creation for Engineering Leadership (NICKEL)[16], the Ontario Society for Professional Engineers (OSPE)[17] and, most recently, the Engineering Change Lab[18].

However, it would be misleading to give the impression that all Canadian engineering educators are satisfied with the current processes involved in accreditation. As is the case with ABET requirements, there is growing pressure to "streamline" the graduate attributes (especially with regard to the non-technical attributes that have allowed CES so much leverage).[19] It is a truism that Canada tends to go the way of its southern neighbor. This is evidenced by the wording in the CEAB attributes already. However, those opposed to the new outcomes-based accreditation requirements tend to make two arguments that are specific to the Canadian context. The first, is to argue that the regulatory framework in which the accreditation process lives (described here as something of a strength) is a weakness. These folks tend to employ arguments lamenting top-down

[13] https://ceea.ca/en/
[14] https://www.ewb.ca/en/
[15] https://egad.engineering.queensu.ca/
[16] http://www.engineeringleaders.ca/nickel/
[17] https://www.ospe.on.ca/
[18] http://www.engineeringchangelab.ca/en/home/
[19] https://www.insidehighered.com/news/2015/06/26/faculty-members-criticize-proposed-changes-gen-ed-accreditation-standards-engineers This article discusses the "watering down" of general education requirements in ABET.

approaches to the management of engineering education. They rightly point to the radical diversity that exists across Canada and the engineering schools therein and argue that a one-size fits all approach to engineering education is counter-productive. The second argument strikes at the very core of the professional system for engineers. The simple truth is that only 60% of engineering students in Canada go on to work in an engineering field. If these numbers are to be believed, then, the argument goes, it is silly to be preparing all undergraduate engineering students to become something that only 60% of them will become.

The flip side of this argument is that the only thing requiring engineering programs to teach these non-technical skills is the regulatory requirement. As is the case in the U.S., the engineering curriculum is absolutely jam packed, with very little room for change. The CEAB argues that it is the regulatory framework that binds engineering departments to teach these skills[20].

This is a familiar back and forth for those acquainted with how ABET has changed its requirements recently. The issue of the difficulty in assessing some the professional skill attributes has come to the fore in Canada in ways strikingly similar to the US. The response to these complaints by ABET have been explicitly appealed to by some in the engineering education arena in Canada. We fear that the same "pulling back" that has happened with ABET criteria (especially with regard to the social and ethical competencies found in criteria 3 and 5) might happen in Canada.

Take Warning

In her ASEE 2016 proceedings piece, Donna Riley lays out the problematic assumptions underlying the rationale behind the recent changes to ABET criteria 3 and 5[21]. In this piece, Riley analyzes…

> …the recent proposed changes to ABET's baccalaureate-level programs accreditation General Criteria 3 (Student Outcomes) and 5 (Curriculum) in light of two problematic ideologies at work in engineering education: an over-reliance on Outcomes-Based Education (OBE) and an emphasis on "evidence-based" research and practice, where "evidence" is narrowly defined following the medical model of randomized controlled trials (RCTs), nearly impossible to execute validly in educational settings. The changes remove or weaken requirements for educational breadth, including global and social context, engineering ethics, and lifelong learning.
>
> One of the stated rationales for these changes is that some outcomes are difficult to assess. To the contrary, the engineering education community has invested a great deal of time and effort innovating assessment methods to create increasingly valid, concise, and easy to implement tools for exactly this purpose. This reveals not only a "research to practice" gap in which ABET leadership may not be aware of these advancements, but also an epistemic gap where "evidence-based" logic has all but eliminated some of the most effective tools we have in educational assessment.
>
> This immediate crisis is brought on by our own commitment to Outcomes-Based Education. It is this obsession that leads to the logic under which, even if student outcomes were difficult to assess, that this would somehow constitute grounds for their elimination. Ultimately, we assess what we value; and we have come to value measurability of outcomes over student learning. We ask "what

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[20] This was something stated publicly by the CEAB representative at the Engineering Change Lab meeting at Concordia University, June 2018.

[21] Riley, Donna M. "We Assess What We Value:" Evidence-based" Logic and the Abandonment of" Non-Assessable" Learning Outcomes."

works" rather than what is appropriate for engineers to learn entering the profession in the 21st century.

It is our hope that it is not too late to close the "research to practice" gap that seems to be reveling itself in the Canadian engineering education context. Many of the same unfortunate rationales are being employed by engineering educators. It is crucial that Canadian engineering educators learn about the highly problematic reasons for how and why the changes to ABET have been made. The simple fact that ABET has done this, cannot be allowed to count as a reason on its own for why CEAB should follow suit (although we have heard precisely this line of argument repeatedly at national meetings).

In conversation with engineering educators in the US, the consensus seems to be that the *perceived* lack of quality tools of assessment for the professional competencies (such as ethics and social implications) is largely to blame. This is exacerbated by the fact that it seems to be the case that many engineers in ABET (and those with the ear of ABET) simply do not value these skills as "engineering" skills. This is Riley's main point in the quoted section above. If we assess what we value, and ABET has reduced the requirements for assessing ethical and social professional skills, the message is clear.

Thus, if Canadian engineering educators wish to follow ABET's lead and reduce the social and ethical requirements for accreditation, they ought to be aware of the underlying reasons for why this happened in the US context. It is our suspicion that if the argument for reducing the accreditation requirements for CEAB were appropriately framed as an argument to reduce the ethical training of engineers in Canada, there would not be a many voices as there are now calling for such a reduction. And those that are calling for it would hesitate before getting very loud.

It is our hope here to have laid out how the current regulatory framework has allowed us, as critical engineering educators, to make real change. It has been the hypothesis of this piece that the regulatory framework and the existing graduate attributes (e.g., ethics and equity) have created real opportunities to affect real change in how engineering education operates in our institution. Removing such a framework would, it seems to us, make the chances that our successful revolutions being repeated less likely. It has been noted that the Outcomes based ABET criteria DID indeed create more opportunities for US engineering educators to experiment and that these experiments were largely successful![22] Student competencies (especially in those professional competencies) approved across the board. It would be a real shame to undo the work made possible by CEAB's new assessment criteria as ABET did.

An Invitation for US Engineering Educators

In addition to speaking to our Canadian colleagues about the potential negative consequences of abandoning the current CEAB outcomes based accreditation process, we would like to speak to our American colleagues about what is to be gained by emulating the Canadian model.

The greatest strength of the Canadian engineering education system (and the accreditation process that helps to shape it) is the coupling of the accreditation process with the professional licensure process. In conversation with US engineering educators and past ABET members, we have come to learn that the continued decoupling of these institutions is the result of conscious choices. The idea of coupling licensure and accreditation in the US is not a new one. It is one that ABET, NSPE, and the other professional societies have

[22] Lattuca, Lisa R., et al. "The changing face of engineering education." BRIDGE-WASHINGTON-NATIONAL ACADEMY OF ENGINEERING- 36.2 (2006): 5.

visited repeatedly throughout the history of the professional "system" in the US. Resistance from industry (due to the associated increase in cost of wages for professional engineers) as well as a general apathy toward the "soft skills" in engineering on the part of professional engineers seem to be the two biggest obstacles to the idea of the coupling of licensure and accreditation being taken seriously.

The argument for coupling the two is a simple one. Since it is the case that the profession values ethics (as demonstrated by the code of ethics that binds all professional engineers) and especially values public welfare (above all other values) and since it is the same body that accredits engineering institutions, it follows as self-evident that engineering education must take the professional competencies seriously. Unless the profession believes that the code of ethics and the mandate to "hold paramount" public health, safety, and welfare is nothing but window dressing and an inauthentic gesture to placate a worried public, once the licensure body and the accrediting body are coupled, engineering educators will have to not just teach ethics, but emphasize them and foreground them in the curriculum.

As we think about the best pathways to the engineer of 2050, surely the idea of coupling licensure and accreditation in the US context is worthy of consideration.