Strategic Priority 1.1 Investigating and validating the purpose and scope of accreditation

Futures of Engineering Accreditation

Foresight Session Event Journal

Toronto, Ontario
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1. Executive Summary

The objective of Futures of Engineering Accreditation (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 our profession.

Futures of Engineering Accreditation is a three-year collaborative journey which seeks to address Strategic Priority 1.1 of Engineers Canada's 2022-24 strategic plan: to investigate and validate the purpose and scope of accreditation.

From November 24-25th, 2022, we experienced the power of bringing a committed group of 77 actors from across the engineering ecosystem to look holistically at the engineering profession, anticipate emerging shifts and begin identifying implications for the accreditation system and the academic requirement for engineering licensure. Building off months of preparation with a Design Team comprised of representatives from the engineering ecosystem, this two-day event started by asking participants in affinity cohorts to explore the role of engineers and the engineering ecosystem.

To ground and share, groups were asked to develop metaphors to explain the role of engineers. Broadly, participants agreed that safety and safeguarding the public is the basis for all engineering work. By the end of Day 1, many individuals realised that other people in the room shared similar ideas, regardless of where in the ecosystem they sat.

On Day Two, participants were asked to envision the future of the profession through three scenarios developed by the Design Team. In futures that were uncertain, unpredictable, complex and rapidly changing, 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.

This is just one key moment along the journey to investigate and examine the academic requirement for licensure and its use in both accreditation and licensure will eventually create a path forward for accreditation in Canada. This document serves as a capture of the process and key outcomes from the session. Additional analysis will be carried out by the project team in partnership with the project's core volunteer groups.

The outputs from the Futures of Engineering Accreditation will feed into the next two years of work. Understanding what the world might look like and who engineers will have to be will create an understanding of how accreditation can support this future.

2. Project Overview

2.1 About Futures of Engineering Accreditation (FEA)

The skill set required of a modern engineer is continually shifting, and the accreditation of engineering education programs has never been more crucial to their success.

Since its creation in 1965, the Canadian engineering education accreditation system has supported Canadian engineering regulators and inspired and mentored accreditation bodies across the globe. Significant changes in engineering practice and 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 Canadian engineering accreditation system is internationally respected and represents high standards for engineering education. This strategic priority is an opportunity to bring actors from around the engineering ecosystem together in order to investigate the system from a variety of vantage points which may not have been considered previously.

FEA aims to bring together the diverse perspectives of the Canadian engineering ecosystem to create an accreditation system that moves everyone forward together.

Throughout this journey, Futures of Engineering Accreditation will:

- Conduct a fundamental review of the current accreditation system and re-examine its purpose in the context of the overall licensure system.
- Investigate best practices in engineering education to understand the current and future needs of engineering education.
- Examine the academic requirement for licensure and its use in both accreditation and licensure.
- Gather the different perspectives of the Canadian engineering ecosystem to shape future evolutions of accreditation to best meet society's needs.
- Create and share a Path Forward Report with recommendations for all stakeholders.

Futures of Engineering Accreditation is an initiative by Engineers Canada, and part of its 2022-2024 Strategic Plan. It is being done in partnership with Coeuraj, a design and facilitation consultancy that is committed to building a more inclusive, collaborative, and sustainable world.

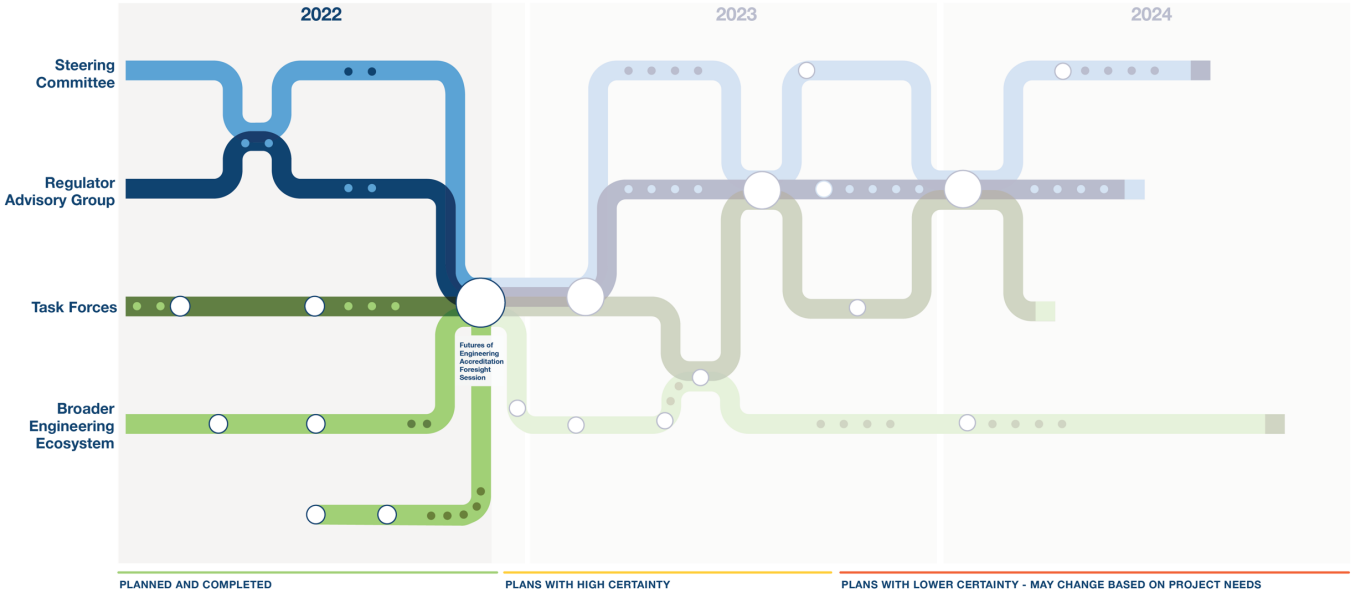
Given everything changing in the world around us and within our own ecosystems, we would like to tackle a big question:

What will the engineer of the future need to do?

This work would not be possible without the support of the project volunteers and event attendees, who took time out of their busy schedules to share their unique insights with one another in service to this work.

2.2 Project Journey

In 2022, members of the engineering ecosystem gathered perspectives on the current context in which the accreditation system functions.



In-depth research about the system and the people in the system revealed that while every actor is working to serve the best interests of the public, collaborative efforts to address key issues in the system can be stifled by a lack of mutual understanding, trust, and a shared vision.

The Strategic Foresight session was a system-wide engagement in a three-year journey to investigate and validate the purpose and scope of accreditation.

To ensure the session was relevant for all participants, a volunteer design team was created, comprised of diverse representatives from the engineering ecosystem. From August through November, this group met regularly to collaboratively design the session and tailor it to the engineering ecosystem at this unique point in time.

In 2023, we will use the outcomes of this event as a catalyst for the path forward, including simulations to ensure a robust range of options.

This multi-year journey will continue until the end of 2024.

3. Foresight Session at a Glance

3.1 Collaborative Design Process

From August through November, we convened a Design Team: seven individuals across the engineering ecosystem who contributed their time and expertise to create an environment suitable for all participants to voice their ideas and understand one another and the challenges across the engineering ecosystem. This group collaboratively defined the key questions, objectives, and outcomes for the Foresight Session, curated and co-created inputs, and informed the design of the event.

Design Team Members:
Alex Lizotte, Amit Banerjee, Claude Laguë, Kalina Bacher-René, Mya Warken, Stephanie Price and Suzanne Kresta.

Design Team Role:
The design team drew from their diverse experiences and identities in engineering practice, education and regulation across Canada to design the Strategic Foresight event with the whole system in mind.

Together, the Design Team:

- Identified change agents and other key actors across the engineering ecosystem to include as participants.
- Guided the boundaries and focus of our horizon scan to shape the inputs brought into the Strategic Foresight session.
- Collaboratively developed, reviewed and curated the content inputs - relevant knowledge and insights which enabled the desired outcomes of the event.
- Defined the objectives and outcomes of the foresight event.
- Led with curiosity, and a desire to challenge assumptions and ask questions to strengthen the collaborative design approach.

3.2 Participants

The Strategic Foresight session engaged 77 in-person voices in Toronto to look holistically at the engineering ecosystem, anticipate emerging shifts, and begin identifying implications for the accreditation system and the academic requirement for engineering licensure.

Each of the participants were invited because of the important perspective they brought – whether it was deep knowledge of building the accreditation system, the fresh perspective of someone just starting their career, or as a leader adjacent to the field who collaborated regularly with engineers. We included:

- Accreditation Board members,
- Engineering regulators,
- Engineers-in-training,
- People from higher education institutions,
- People who work with engineers,
- People working in engineering (licensed and non-licensed),
- Members of the project's steering committee,
- Students studying engineering, and
- Qualifications Board members.

The full participant list can be found in the appendices.

In addition to the 77 participants in the room, we asynchronously engaged ten additional voices across the engineering ecosystem who were unable to attend the session in person. These individuals shared their perspectives on the current state of the engineering ecosystem and considered future implications through a survey. These insights have been incorporated throughout this journal.

We look forward to inviting more new participants during the next phases of the project in order to build upon the perspectives of this group.

3.3 Objectives & Outcomes

Given the continuous change in the world around us and within our own systems, we wanted to tackle a big question: What will the engineer of the future need to do?

Session Objectives
Together, we:

1. Holistically explored the engineering ecosystem to create common ground amongst all participants.
2. Anticipated and considered how emerging shifts in society, technology, the environment, the economy, politics and values might impact our ecosystem in the future.
3. Gathered perspectives on the skills and competencies required of engineers and thoughts on what the educational foundation of future engineering graduates might be.
4. Began identifying the implications for accreditation and licensure.

Session Outcomes
As a result of our gathering, we achieved:

- Greater shared understanding of the future skills and competencies required of engineers.
- Greater shared understanding that the environment around engineering practice and education is shifting.
- A wider range of possibilities for the future of the profession, informed by actors across the ecosystem of engineering.
- A shared sense of optimism for how the profession will embrace and respond to rapid change.
- A range of possibilities for how accreditation might shift to address these challenges.

4. Key Shifts & Insights

Throughout the two-day session, there was alignment in the room that the current ecosystem needs to shift.

While the accreditation system may be a source of division and conflict, when participants took the long view on where the profession should go, there was significant alignment. It was clear that the engineers of the future need to be environmentally and socially aware, and interdisciplinary problem solvers with a strong sense of duty to the public.

How the accreditation system should adapt wasn't the focus of this session, but a shared understanding of the goals and long-term vision for the engineering ecosystem was created. There is a sense of urgency around this change, paired with optimism and a commitment to continuing to work together.

As a result of their active participation in this session, participants reported a number of shifts in their understanding and attitudes in response to the following statements:

- At 91%, there was a strong sentiment that accreditation might need to shift to address future challenges.
- 84% of participants felt that the environment around the engineering profession was shifting.
- The degree to which participants felt that they understood the future skills and competencies required of engineers increased by 11%.
- The degree to which participants felt optimistic that the engineering profession will embrace and respond to rapid change increased by 6%.

This was a small sample size, but an important data point to track and triangulate against other engagement data on this journey as we move forward.

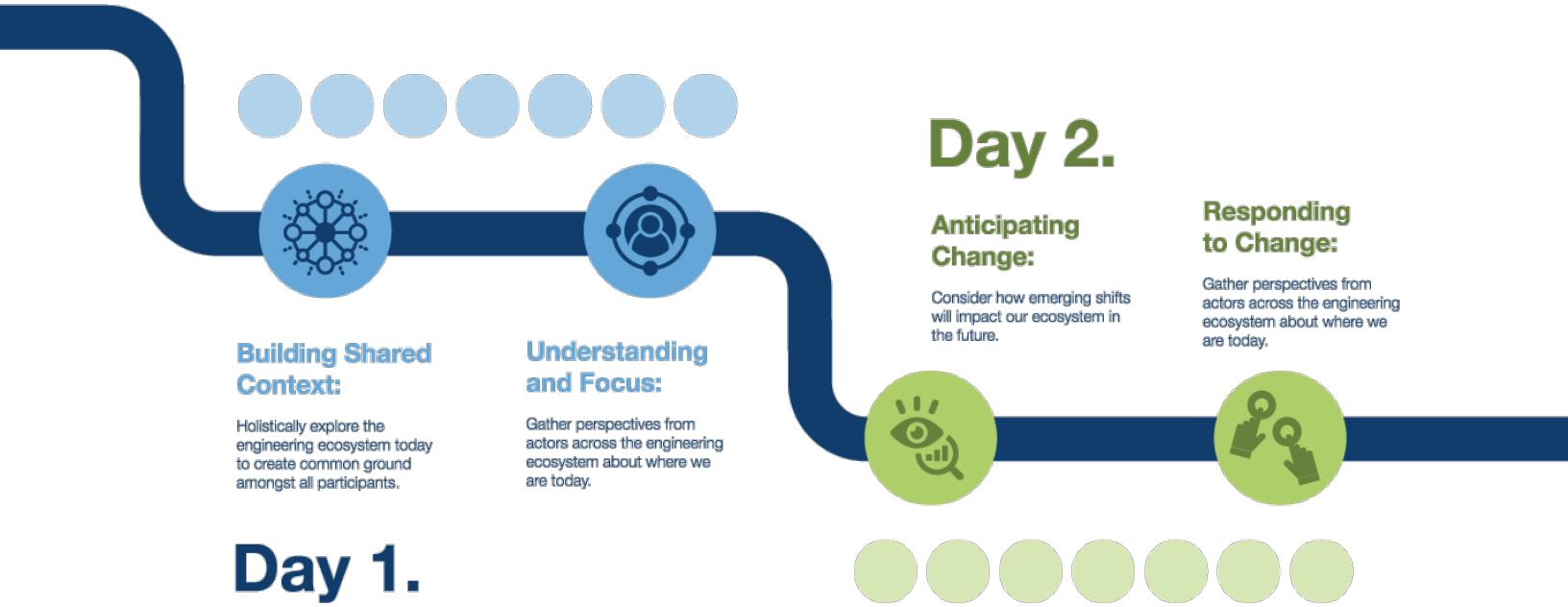
Words participants used to describe how they were feeling after attending the session.

5. Session Methodology & Findings

5.1 Overview of Session Design

The accreditation system serves to ensure that engineering education programs are academically preparing students for their careers as licensed engineers. Today's graduates will be practicing in dramatically different settings by the end of their careers, with different demands and expectations for their abilities.

As we investigate the purpose and scope of accreditation, it is important to consider what the range of possible futures that engineers must prepare and design for might be.



While a diverse set of perspectives is required to fully represent the needs of the system, it was imperative to start with opportunities for mutual understanding.

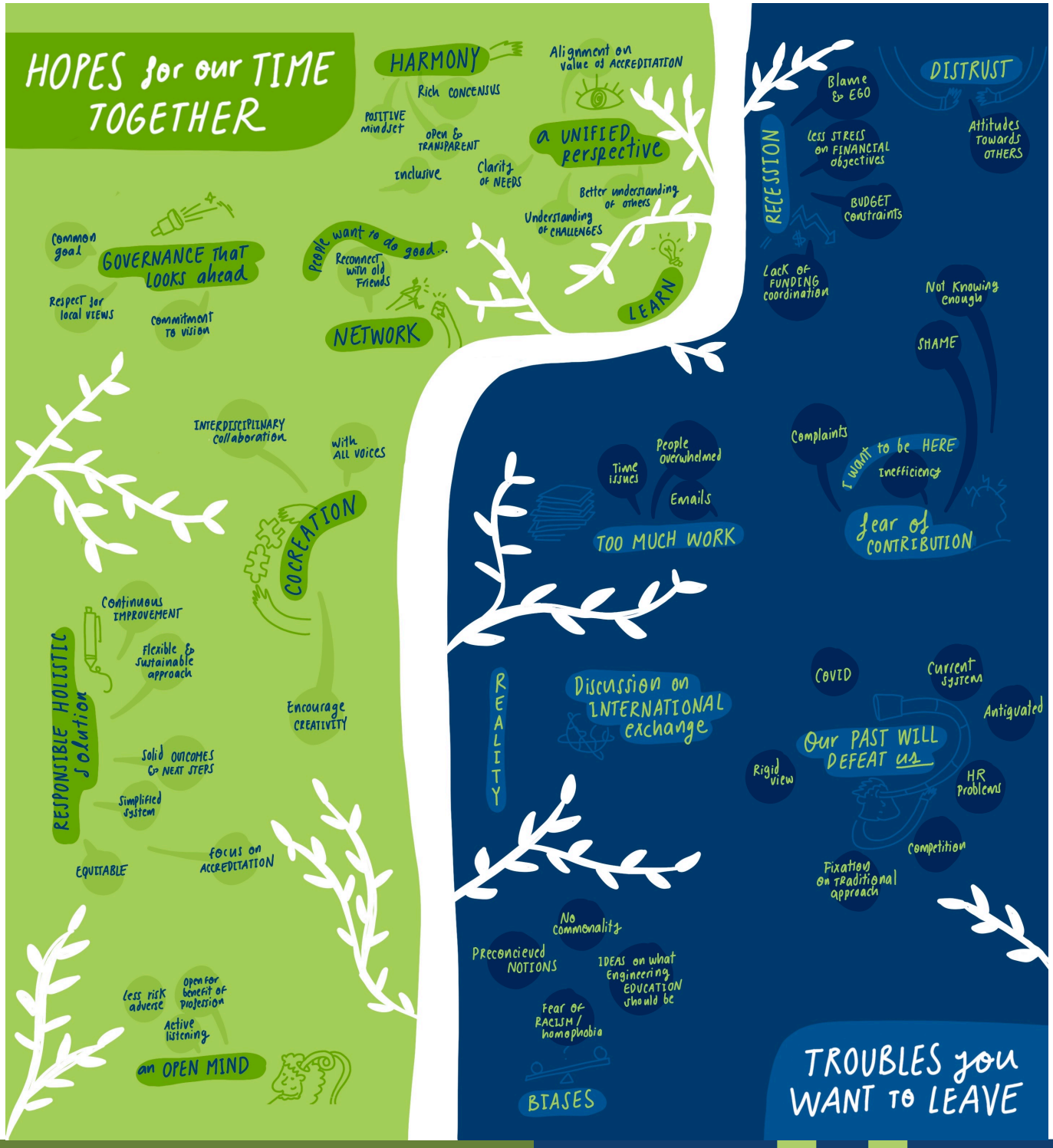
Day one was designed to enable each stakeholder group to share their mental models about the engineering ecosystem so that we could move toward shared understanding.

Using three divergent scenarios of possible futures for the profession, Day two asked participants to extrapolate current trends into the future and consider how engineers might be asked to respond. This enabled us to find common ground about the future we need to shape, together.

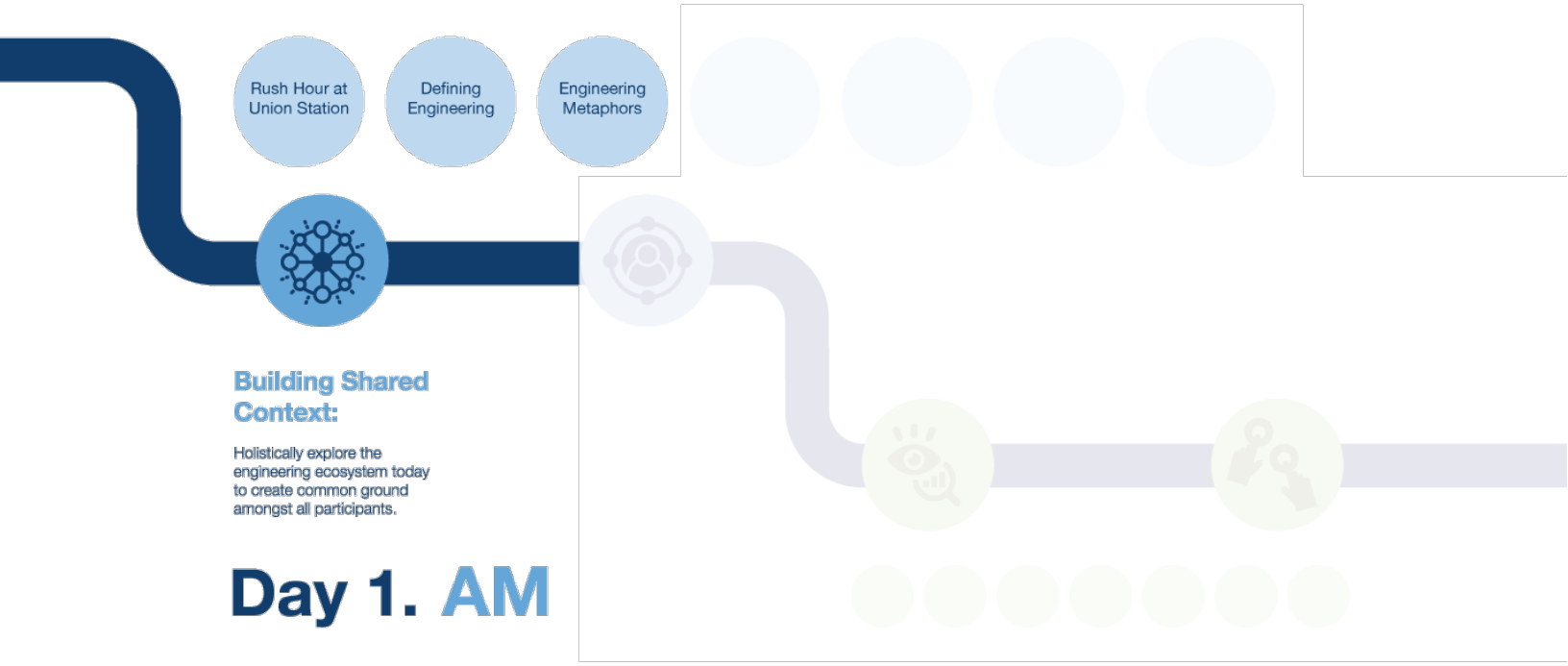
"I skate to where the puck is going to be, not where it has been."
- Wayne Gretzky

5.2 Building Shared Context: *Day 1 Pre-Session Reflection*

Before diving in, participants reflected on their aspirations for the session, and things they feared would get in the way of our collaboration.



5.2 Building Shared Context: *Thursday November 24, Morning*



Collaboratively defining a path forward for the accreditation system requires the input of a wide range of actors from the engineering ecosystem. Each vantage point brings new perspectives on the problems and opportunities involved with accreditation.

To enable diverse voices to collaborate on deeper topics, we first needed to build a shared understanding of the context we are operating in.

We sought to do this by grouping the participants into affinity groups (students, academics, practicing engineers, etc.) to engage with two modules.

These modules sought to address questions like:

- What are the skills and competencies required of engineers? What role are they expected to play?
- What does public safety/public interest mean to the various groups, from their role and profession?
- How does the engineering ecosystem behave in pursuit of these goals?

Our objective was to create a shared starting place, recognizing that the answers to these questions will continue to evolve and be refined as the project unfolds.

5.2 Building Shared Context: *Thursday November 24, Morning*

Module 1: Defining Engineering

The first module began with a group brainstorm to define what it means to be an engineer today. Questions participants were asked to consider included:

- What is expected of an engineer today?
- What role does an engineer play in society?
- How do public safety and public interest play into an engineer's role?

Each group generated a wide variety of definitions of engineering. Some of the most common definitions included:

- Engineers are creative problem solvers
- Focus on ethics, driven by provincial regulation and human rights legislation
- Engineers are a silent worker – their roles and work are assumed but not understood or defined

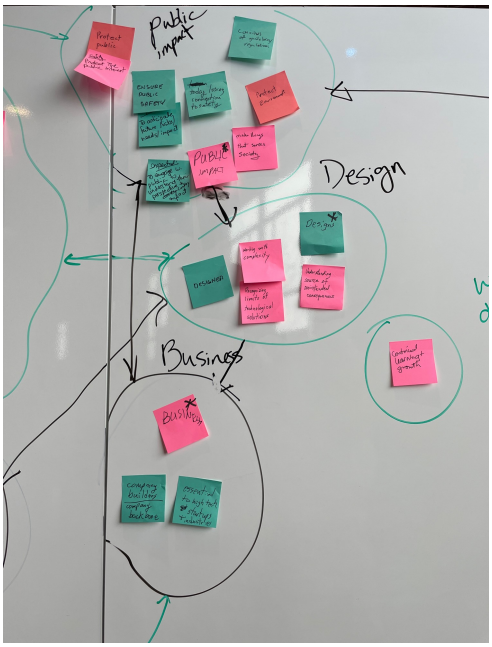
Participants who contributed asynchronously emphasized that engineers are problem solvers and described them as innovators and interdisciplinary communicators.

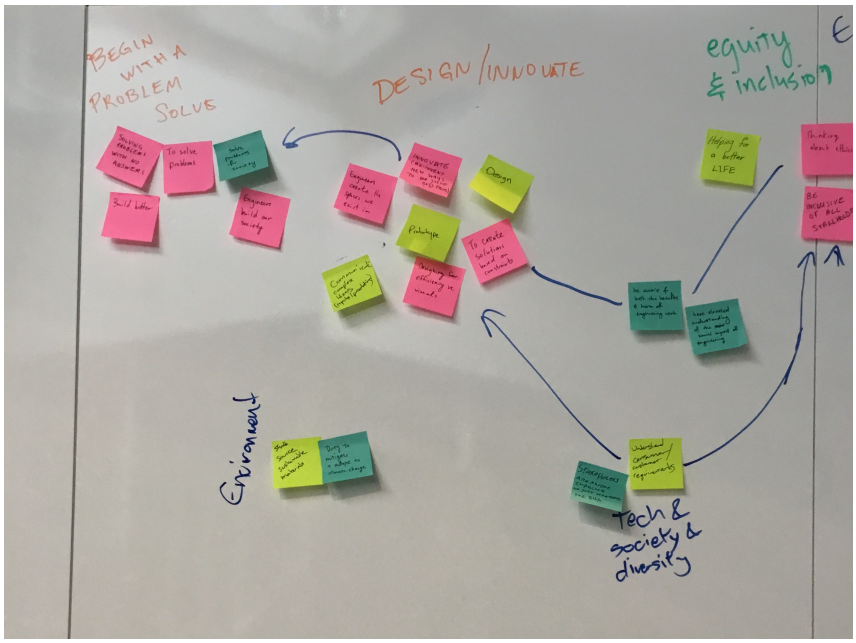
Across all participants, there was consensus that safety and safeguarding the public is the basis for all engineering work.

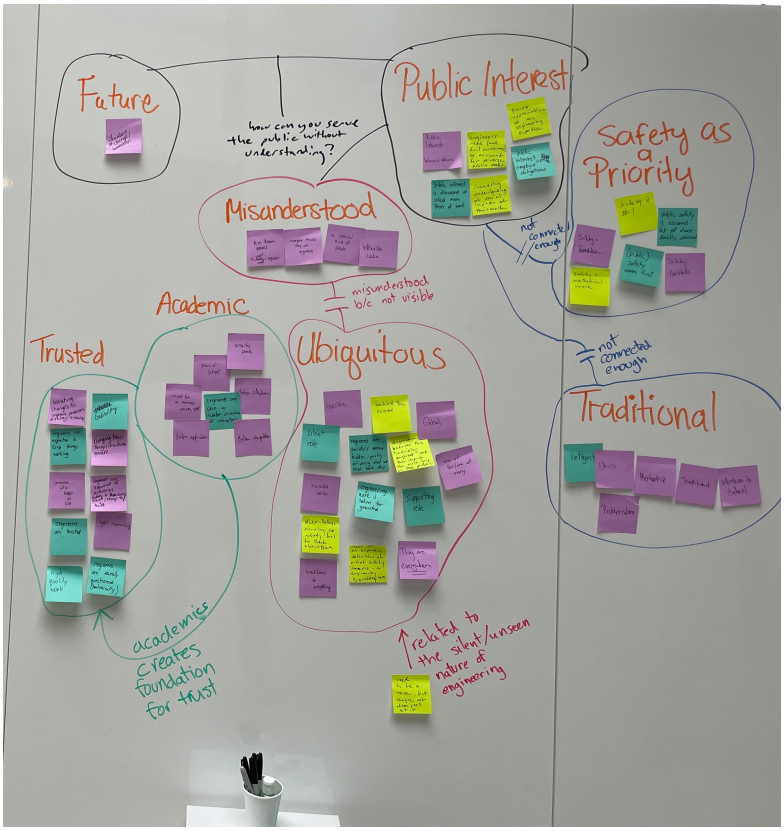
This activity produced a large amount of data in the form of clustered concepts for the roles and competencies of engineers. This raw data will be available for the project's task forces to use in their work and to start to shape the next set of activities on this journey.

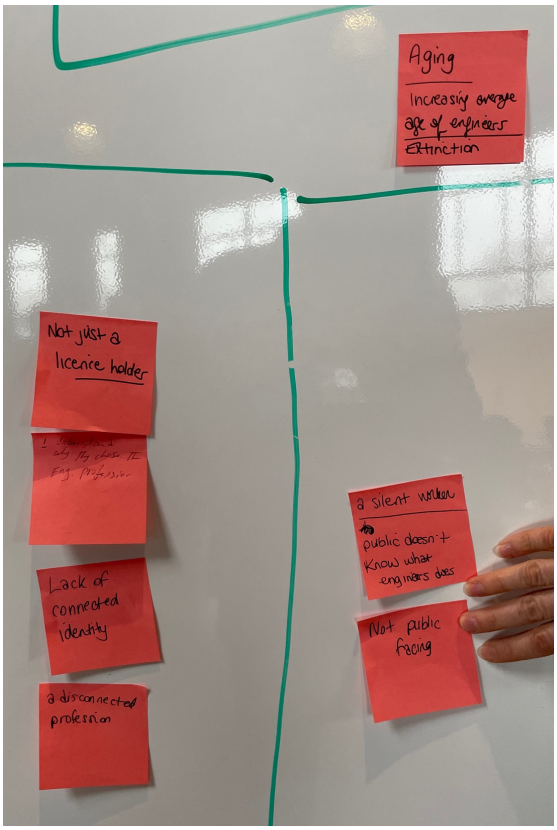
"There are other challenges we know and many more will certainly arise, and young engineers today have the opportunity, capability, and vision to solve them in line with changing societal needs and desires."
- Accreditation Board Member

5.2 Examples of Participant Work: *Defining Engineering*









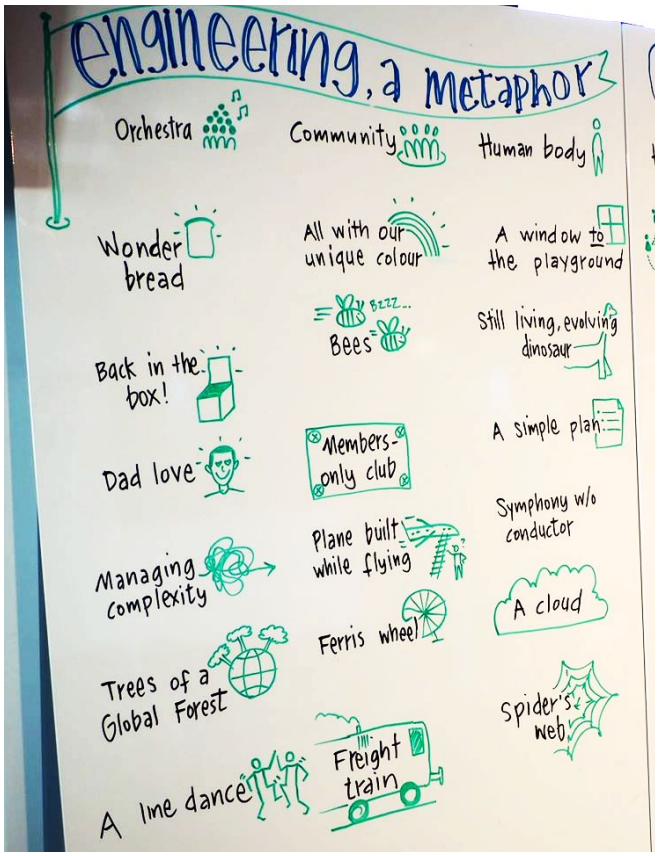
5.2 Building Shared Context: *Thursday November 24, Morning*

Module 2: Engineering, A Metaphor

A simple metaphor can reveal how differently the same system may be viewed by the actors within it. The futurist Donella Meadows encourages systems thinkers to "expose your mental models to the light of day", and the visual imagery of metaphors achieve exactly that.

Participants were asked to think about metaphors that could be used to describe the engineering ecosystem, and consider the actors, functions, and behaviours that are present.

In the metaphors that were shared, there was a clear emphasis on the relationship between nature and humans, which is not surprising considering that many facets of engineering interact with the environment in some way.



A concept that was particularly resonant with the group was the Cree teaching of Wâhkôtowin, which describes the kinship humans have with nature and others, and how everything we do has an impact on everything else.

Across 11 groups, there were 30 metaphors generated. The metaphors for the engineering ecosystem were a combination of positive and negative depictions and fall across the following categories:

- Bugs/insects, e.g., a spiderweb that is elegant, complex yet functional, fragile yet strong
- Nature e.g., coral reef that is an important but invisible part of the ocean's ecosystem
- Built environment/structures, e.g., a plane being built in flight
- Music, e.g., a symphony without a conductor
- Human systems, e.g., a modern family

5.3 Understanding & Focus: *Thursday November 24, Afternoon*

Day 1. PM

Complex systems may look very different depending on your vantage point. Illustrating the structure of the engineering ecosystem from one's own perspective is therefore a powerful tool for understanding the distinct sets of relationships, information flows, and power dynamics within which each actor operates. This can help to build empathy for the different barriers faced by each actor in the ecosystem and identify leverage points for change.

In the same affinity groups as the morning sessions, participants spent the afternoon creating ecosystem maps and sharing them with other groups.

They were asked to indicate which relationships served the needs of the engineering ecosystem well, and which relationships needed strengthening.

"Remember, always, that everything you know, and everything everyone knows, is only a model. Get your model out there where it can be viewed. Invite others to challenge your assumptions and add their own."
- Donella H. Meadows

5.3 Understanding & Focus: *Thursday November 24, Afternoon*

Module 2.1: Afternoon Commute

For many members of the profession, engineering is an identity first, and a job second.

Our personal stories are powerful drivers of our work, and the future we are seeking to build.

Before launching into ecosystem mapping, participants were paired up for a walk after lunch and asked to share what brought them to their respective fields.

5.3 Understanding & Focus: *Thursday November 24, Afternoon*

Module 3: Mapping the System

Groups were invited to choose an area of focus that best suited their interest and expertise as they created a systems map. An outline of the journey of an engineer and a honey-comb reference map were provided, and participants could make annotations directly on their map.

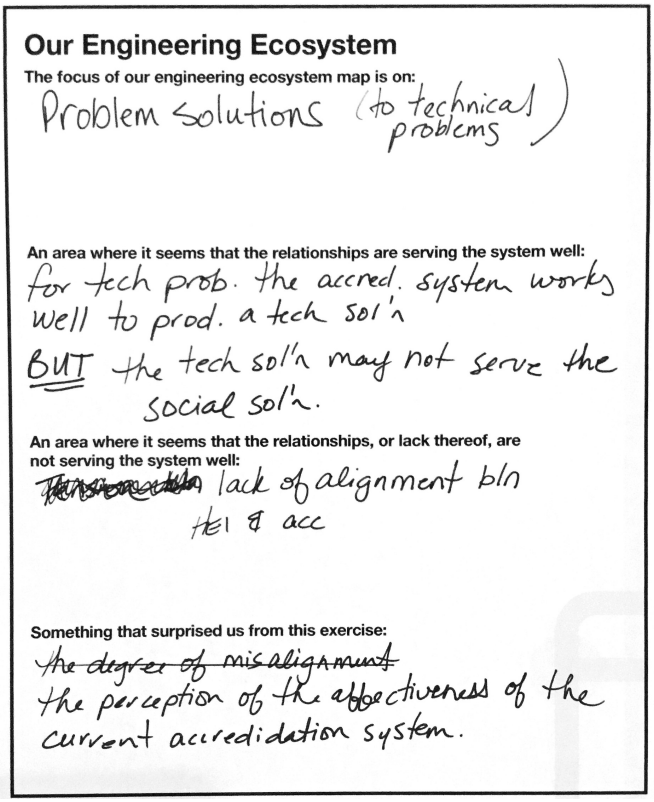
Some groups focused on the education subsystem, some on engineering practice, or regulation. Within their area of focus, groups used solid lines to indicate relationships that serve the needs of the engineering ecosystem well, and dotted lines for those that need to be strengthened.

This allowed for assumptions to be surfaced and created a visual illustration of what stakeholder groups considered to be important elements and relationships across the ecosystem.

Notably, one group rejected the reference map entirely, and chose instead to structure their own map of elements surrounding a problem that an engineer might be solving, rather than actors and relationships.

For the latter part of the module, groups sent "scouts" out to find ideas and inspiration from other maps.

A copy of the reference map and the journey of an engineer that was provided to guide participants through this exercise can be found in the appendix.



Our Engineering Ecosystem

The focus of our engineering ecosystem map is on:
Problem solutions (to technical problems)

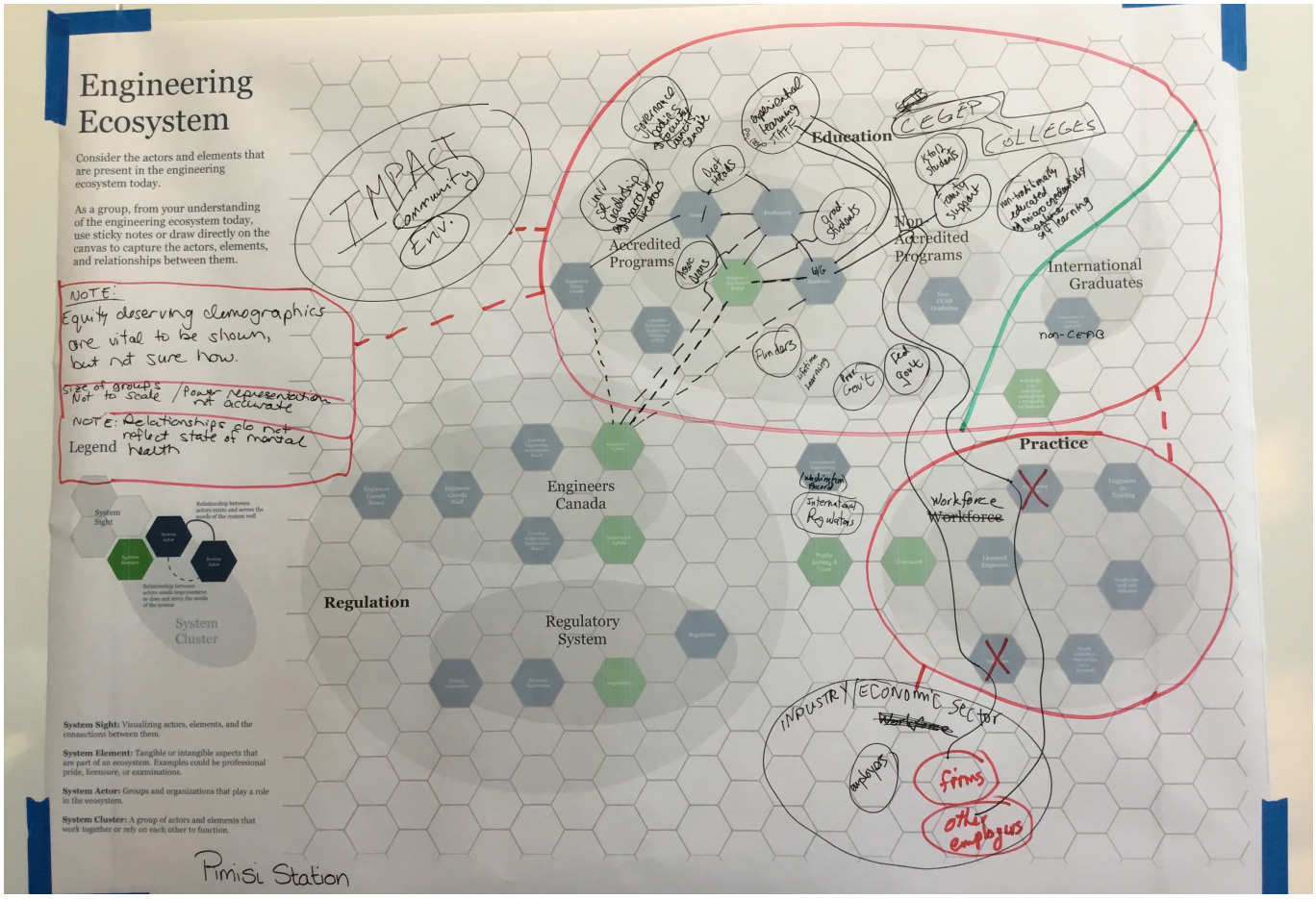
An area where it seems that the relationships are serving the system well:
for tech prob. the accred. system works well to prod. a tech sol'n
BUT the tech sol'n may not serve the social sol'n.

An area where it seems that the relationships, or lack thereof, are not serving the system well:
~~[illegible]~~ lack of alignment b/n HEI & acc

Something that surprised us from this exercise:
~~the degree of misalignment~~
the perception of the effectiveness of the current accreditation system.

This was another exercise that produced an extremely rich dataset, which will be taken forward by the project team and volunteer groups as the work evolves. The following page highlights some of the raw work done by participants.

5.3 Examples of Participant Work: *Mapping the System*



Our Engineering Ecosystem

The focus of our engineering ecosystem map is on:

Education & Accreditation/Regulation

An area where it seems that the relationships are serving the system well:

It depends. There are specific situations where the relationship is good, but in general it needs improvement

An area where it seems that the relationships, or lack thereof, are not serving the system well:

Generally everywhere.

Something that surprised us from this exercise:

How many ways the ecosystem can be visualized

Our Engineering Ecosystem

The focus of our engineering ecosystem map is on:

Holistic

An area where it seems that the relationships are serving the system well:

Programs are serving the accreditation system

An area where it seems that the relationships, or lack thereof, are not serving the system well:

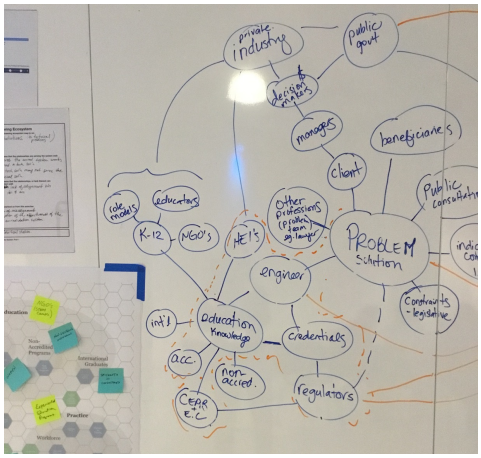
Accreditation system is not serving the Programs
- lack of flexibility
- Stifling creativity
- Burdensome
- Expensive
- ~~accreditation focused~~

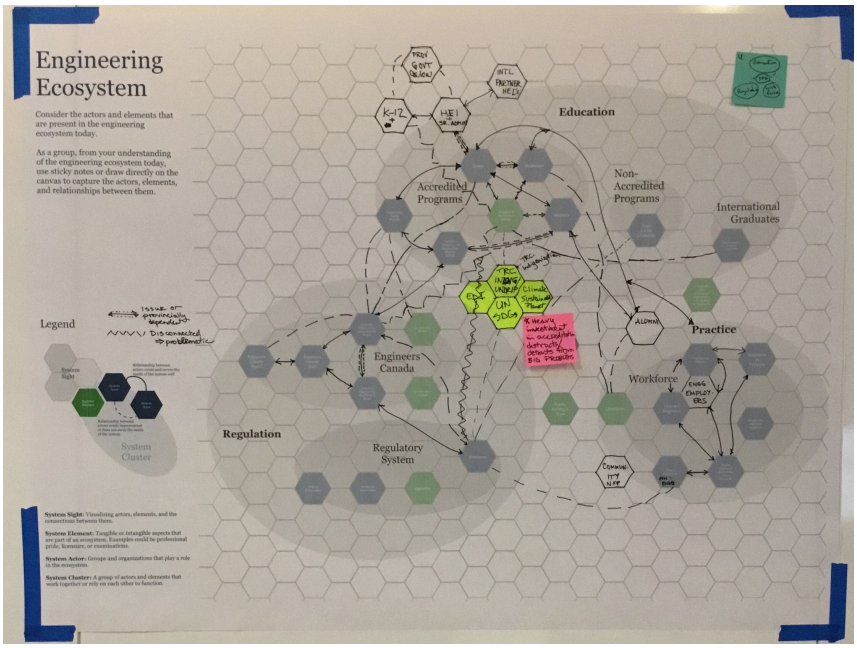
Something that surprised us from this exercise:

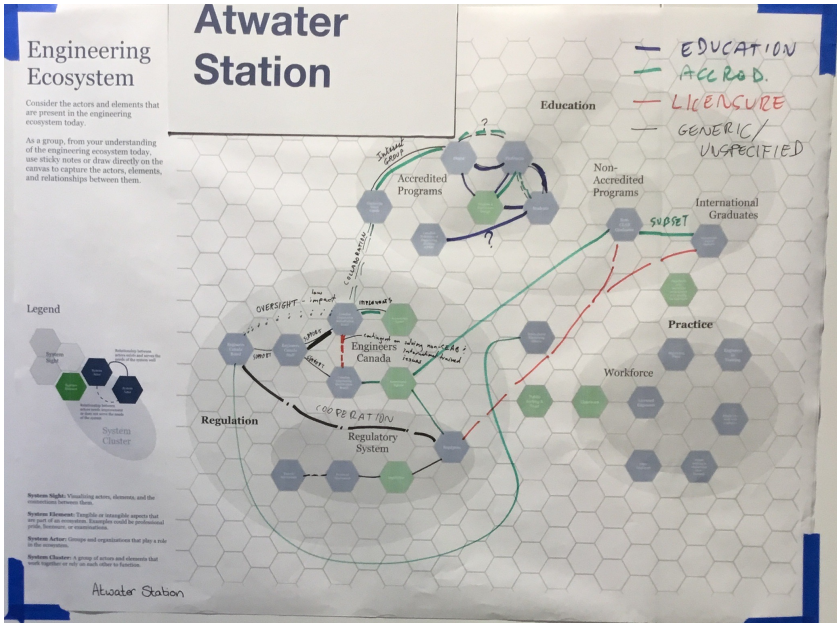
lack of a ethics box as a system element

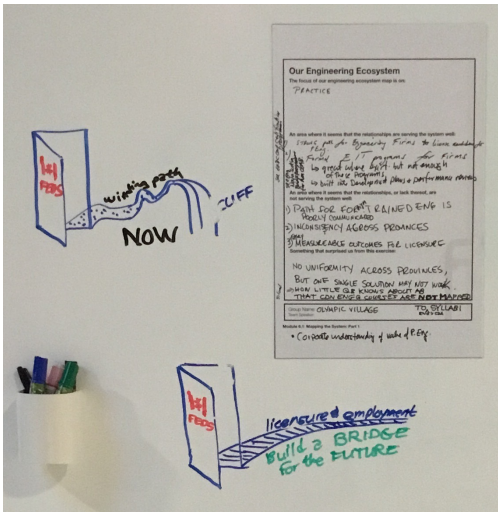
Not a common understanding of EDI and how to add it

5.3 Examples of Participant Work: *Mapping the System*









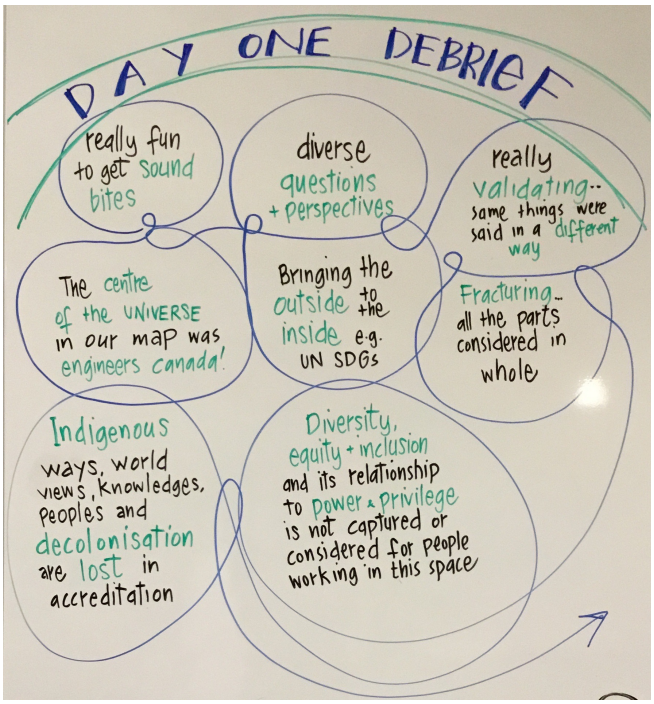
5.3 Understanding & Focus: *Day 1 Debrief*

For most of Day 1, individuals were working in their affinity groups, sharing their perspectives and surfacing assumptions to create shared context and understanding of the actors, elements, and relationships between them that are present within the ecosystem of engineering today.

During report-outs to the larger group, everyone was able to hear from a representative of an affinity group that was different from their own, allowing for new ideas and perspectives to be heard.

At the end of Day 1, participants shared their thoughts on the day. Some individuals noted that they felt validated to know that other people in the room share similar thoughts and ideas; others were appreciative of the diverse questions and perspectives that were present throughout the day. Some comments were raised regarding critical aspects of equity, diversity, and inclusion, as well as decolonization, that don't seem to fit within the boundaries of the ecosystem as it currently exists.

As the day's formal activities wrapped up, participants were invited to continue their conversations over a shared meal together.

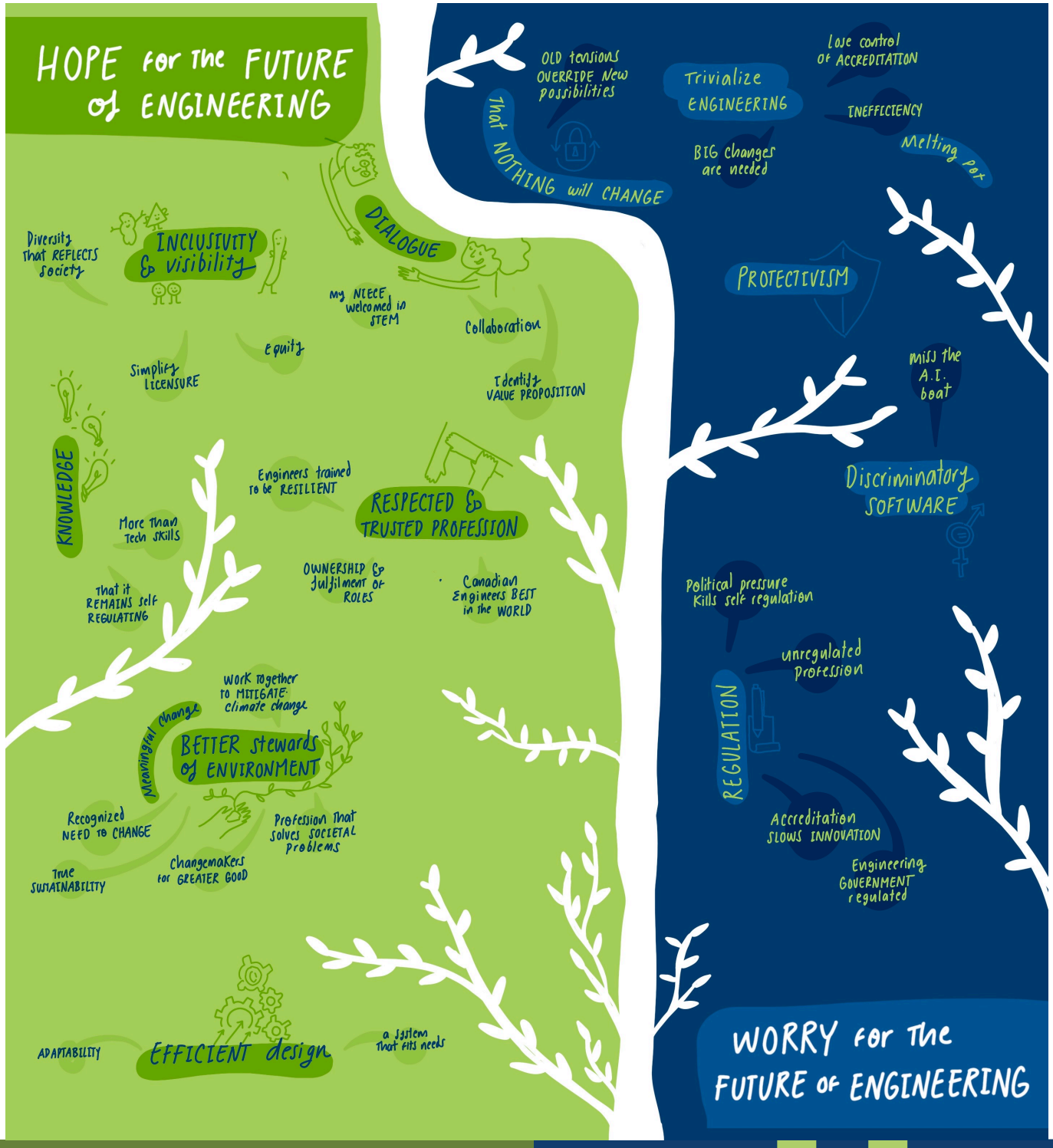


The data generated during Day 1 will form part of the framework for the simulations (an exercise in 2023 that will pull on the engineering ecosystem to test possibilities and assumptions).

The data will also help build common ground and a common understanding with engineers and other professionals in the ecosystem who were not part of this session. Specifically, language data and specific terms will ensure that during simulations, we have a strong degree of consistency.

5.4 **Anticipating Change:** *Day 2 Pre-Session Reflection*

Before beginning day 2, participants reflected on their hopes and worries for the future of engineering.



5.4 Anticipating Change: *Friday November 25, Morning*

To begin Day 2 in a good way, ancestral knowledge keeper and Anishinaabe grandmother, Kim Wheatley, invited us to tend to the relationships between us, bring our ancestors into the room, and honour our descendants. Through this opening ceremony, we **grounded ourselves in our responsibilities** and our relationships with our more-than-human relations.

"Kim grounded us for the day and spoke to the relevance and urgency of the work."
- Engineering Regulator

Kim Wheatley's Reflections

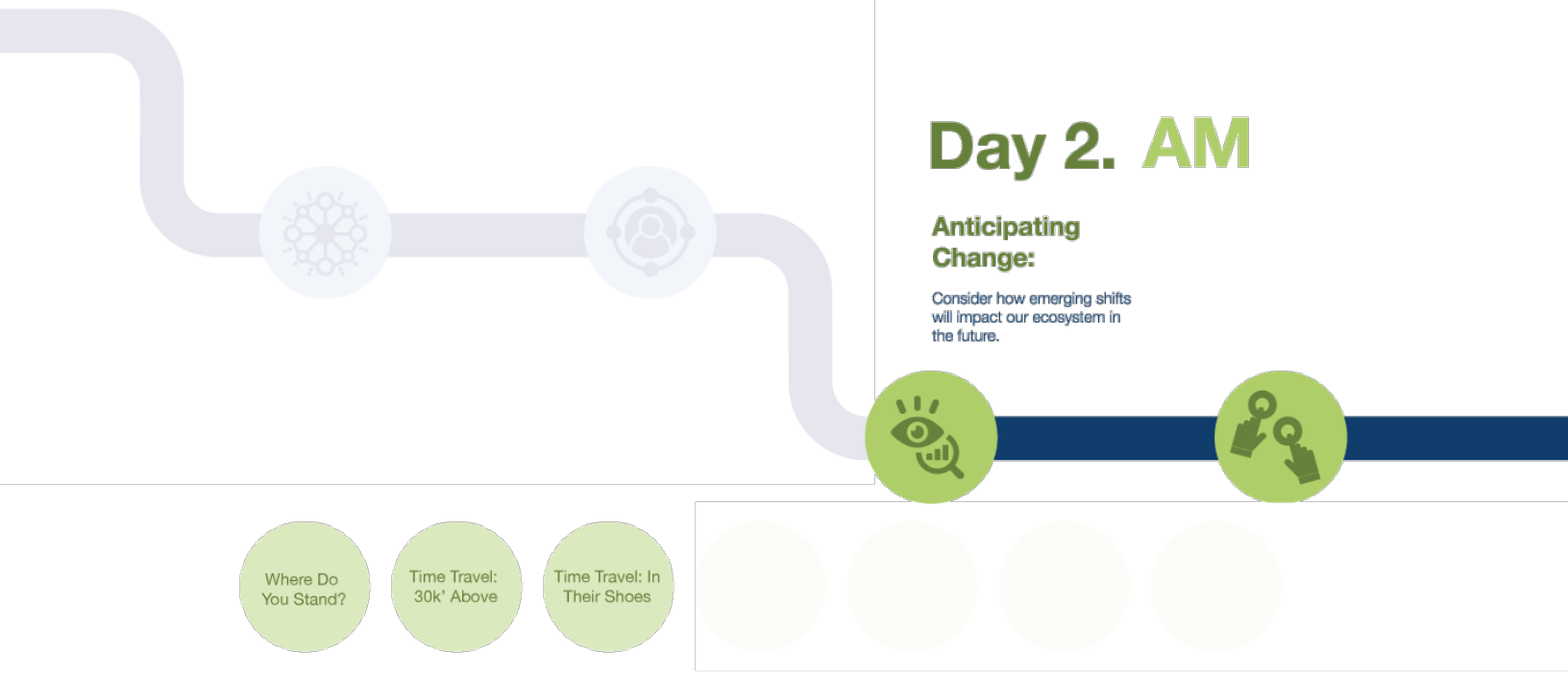
The gathering of engineers was a new event and experience for me as a Traditional Ancestral Knowledge Keeper who has interacted very little with this realm of profession. I found the event surprisingly welcoming and interesting. Sitting with people who use their minds all the time had me thinking that a pause for holistic wellness through a traditional Anishinaabe protocol and practice might not fit in well with a group of deep thinkers like engineers. Surprisingly, my words resonated with many who took the time to thank me and explain how it made them feel. I shared the connections of creation and its importance in all aspects of our lives with those present. It was my intention to leave them better than when they came to embrace body, mind and spirit wellness. It was important for me to represent the First Nations Metis and Inuit voice by connecting the history of the land to our hearts. To encourage moments of meaningful self-care and to expand possibilities through presentness.

The challenge I shared with all was to nourish all aspects of who we are as humans by remembering those that came before us and those that will come after us. By ensuring we make good decisions for the greater good we honour the past and gift the future. I spent time visiting the hubs of planners/thinkers and was surprised at how intensely inclusive the thought process was to create change. I felt honoured to witness what shapes every aspect of our lives through the talent of engineering. Personally, I have met very few in this profession and truly did not understand how diverse the professional realm is but it was a gift to listen, learn and leave so inspired about possibility and Indigenous inclusion.

We are naturals in this profession and our ancestors were experts in engineering. There are so many examples of this from our traditional dwellings to the canoe! Understanding impacts from decisions made with this brilliant group of minds was heartwarming for me. I want to believe that harmonious relationships to creation while creating is important to those who change the environments we live in. This experience has imbedded in me a desire to encourage Indigenous people to look at this field as a place to plant their futures within. It is a profession that is full of potential and currently underrepresented by Indigenous folk. I believe change is on the horizon and I deeply thank the event organizers for including me in the preparatory process of creating a more inclusive future.

Ancestral Knowledge Keeper Grandmother Kim

5.4 Anticipating Change: *Friday November 25, Morning*



On Day Two, the participants mixed into multistakeholder groups, each of which spent the day envisioning the future of the profession within one of three future scenarios.

Because no one can predict the future, we can say with certainty that it will be different from our expectations. Scenarios are plausible, provocative, alternative views of the future that are meant to magnify change happening today and challenge our assumptions about tomorrow.

The scenarios were developed collaboratively by the FEA Design Team, using a bank of present trends spanning politics, ecology, technology, society, and economics. These are all listed in the appendix.

Key questions that we sought to address included:

- What will society expect of engineers in the future? Will it be the same as the past or will it be different?
- What will motivate engineers in the future and how will they identify?
- How will the engineering profession and the ecosystem embrace rapid change as a way of ensuring the reliability of engineering work?
- Is there a single engineering profession of the future? Or multiple engineering professions? And what does that mean?

Our primary objective was to ask participants to envision how the environment around the accreditation system is likely to continue shifting, to inform the design of the upcoming simulation exercises.

5.4 Anticipating Change: *Friday November 25, Morning*

Overview of the Scenario Development Process

To answer the question "What does the engineer of the future need to do?", our Design Team prepared a set of three alternative future scenarios that explored the broader external environment around engineering accreditation and licensure.

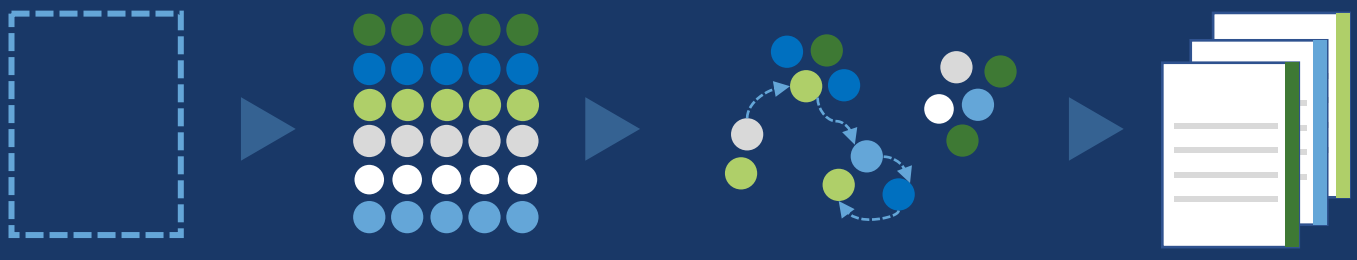
The scenario development process began with a public "Call for Signals" in early September 2022 that resulted in a collection of articles, papers, and other signals of change to serve as inputs into the scenario development process. There was also a previous Envisioning Survey, which took thoughts from across the engineering landscape in late 2021.

Over the course of two months, 83 unique and significant signals of change were gathered and curated from many hundreds of signals, spanning topics related to society, technology, the economy, the environment, politics, and values. These signals of change were then grouped and synthesized into 18 driving forces that are present in today's external environment and are likely to influence the future of the engineering ecosystem. The design team was guided through a process of ideation, drawing connections, and creating synthesis across the signals of change to arrive at three scenarios.

A summarized version of each scenario follows.

The Signal Bank that was used to generate the scenarios can be found in the Appendix.

Foresight Event Design Team
Scenario Development Process



Set the boundary and focus

Gather & curate Signals of Change from across the ecosystem

Map connections and causal relationships across signals

Iteratively develop a set of alternative future scenarios

5.4 Anticipating Change: *Friday November 25, Morning*

Scenario Summaries

SCENARIO 1: ADAPTATION, REPUTATION
"All current trends continue"

Scenario 1 extends all trends in their current direction and features an urbanizing, increasingly populous, multicultural Canada that has come through a successful process of Truth and Reconciliation and has adjusted to multiple pandemics and climate challenges by shifting the burden to technology. Canadian postsecondary engineering education has committed to creating a diverse and holistically educated profession, but after protracted disagreements between provincial regulators, few graduates pursue licensure. The hiring landscape is reputational and skills based, dominated by an online user review system.

SCENARIO 2: COMPANY TOWNS
"Working within existing constraints"

Scenario 2 is one of continuous change, with lunar colonies in progress, regional wars and accelerating climate change adding to volatility, and breakthroughs in quantum computing softening the effects of climate change through better weather modeling and improved agricultural yields. The new National Board of Regulators, which replaced the self-governing provincial system, has introduced many changes, including a leveled licensure system that can begin in high school, and an easier path to licensure, raising questions about future quality of engineering services. American companies have begun to recruit Canadian high school graduates for continued in-company education/ certification and multi-year work commitments.

SCENARIO 3: WANING AND SEEDING
"The system no longer functions"

Scenario 3 includes migration pressure along the U.S. – Canada border, which has led to a military step-up. A Libertarian Party takeover in 2026 has led to the partial defunding of higher education and the repeal of the regulatory acts surrounding many professions, including engineering. "Legacy" engineering education survives only at Canada's military academies; many aspiring engineering students are emigrating to nations where engineering has evolved into a holistic and thriving profession that has become central to climate mitigation and social justice. Infrastructure connecting Canada's south to the Arctic is growing—and driven by climate change and political volatility, many in Canada are dispersing northward to new, Indigenous-led mixed settlements.

Full scenarios can be found in the Appendix.

"As I read through our group's scenario, I found myself thinking; 'I don't like this outcome. But it feels pretty plausible'. We need to do something about this."
- Steering Committee Member

5.4 Anticipating Change: *Asynchronous Engagement*

Participants unable to join the in-person session were invited to anticipate change asynchronously. To do this, they were presented with video summaries of each of the three scenarios that participants were reading and analyzing in the live session. As members of the engineering ecosystem, they were asked to view the scenario videos and consider what has gone right or wrong in each, and what skills and competencies engineers would need in that future. Some of their reflections are captured here:

SCENARIO 1: ADAPTATION, REPUTATION

- Without practice standards, the profession could turn into a “wild west” situation with hugely negative consequences
- A world with less regulation would likely lead to lesser quality of engineering
- Equity, diversity, and inclusion as an investment in engineering higher education is positive

SCENARIO 2: COMPANY TOWNS

- Engineering education in high school can't hurt, especially if it is optional. This could help increase diversity of practitioners and thought
- Reduction in standards to prevent brain drain could have detrimental effects
- The concept of a national regulatory body is something that several asynchronous participants thought was interesting
- An increase in nuclear and space engineering will require stringent safety protocols

SCENARIO 3: WANING AND SEEDING

- Skills and competencies required of engineers in this scenario: collaboration, adaptability, resilience
- Indigenous leadership is seen as positive
- Huge opportunity for engineering with northward migration (e.g., infrastructure needs) but engineers will need cultural competence to do good work with Indigenous-led communities

Beginning to step into these possible futures encouraged all stakeholder groups present to consider the ways in which the constantly and rapidly changing world we live in might influence various elements within the engineering ecosystem.

5.4 Anticipating Change: *Friday November 25, Morning*

Module 4: Time Travel: From 30,000 ft

This exercise invited participants to travel to one of these future worlds to consider how broader changes in the external environment around us could impact what tomorrow's engineers might need to do.

In mixed stakeholder groups, participants considered how engineers in a particular future would be different from today, and generated hypotheses for the key skills and competencies an engineer would need in their scenario.

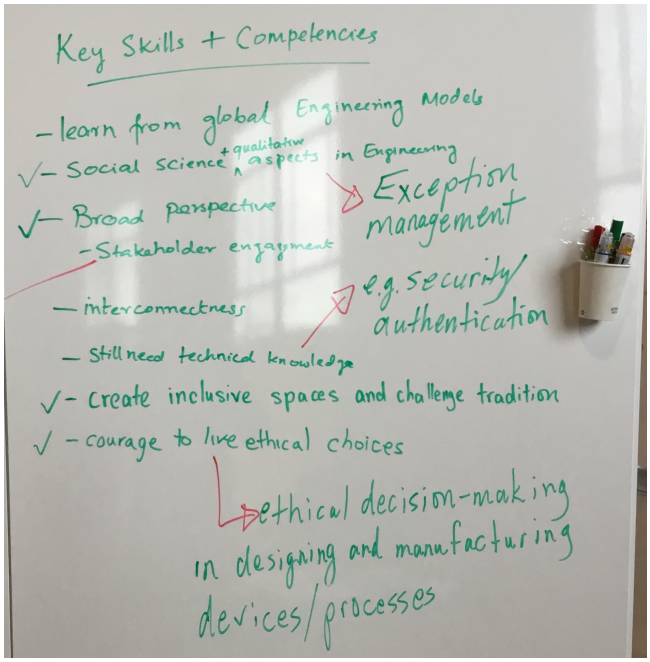
Most groups identified a combination of technical and social skills and competencies, including:

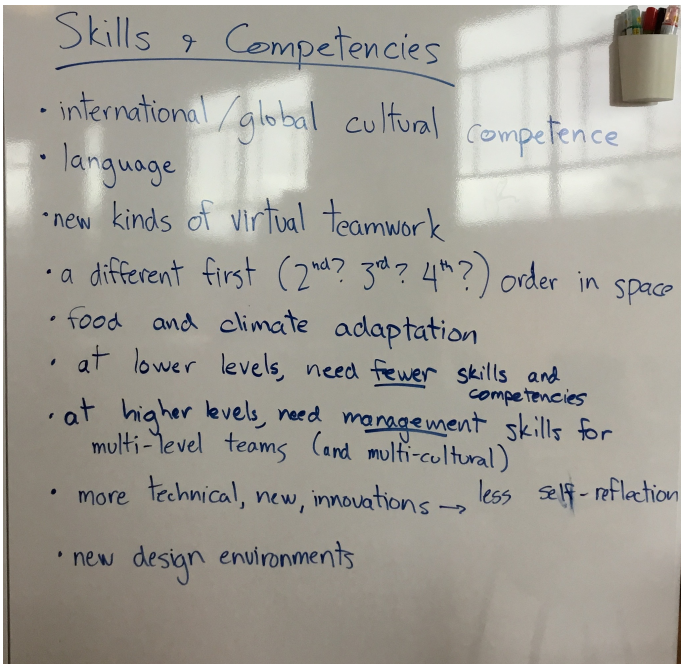
- Ethics or strong ethical considerations
- Communications, across team and disciplinary boundaries
- Global competence and other aspects of globality, including learning from international engineering models
- Sustainability and regenerative or circular design
- Adaptability and versatility

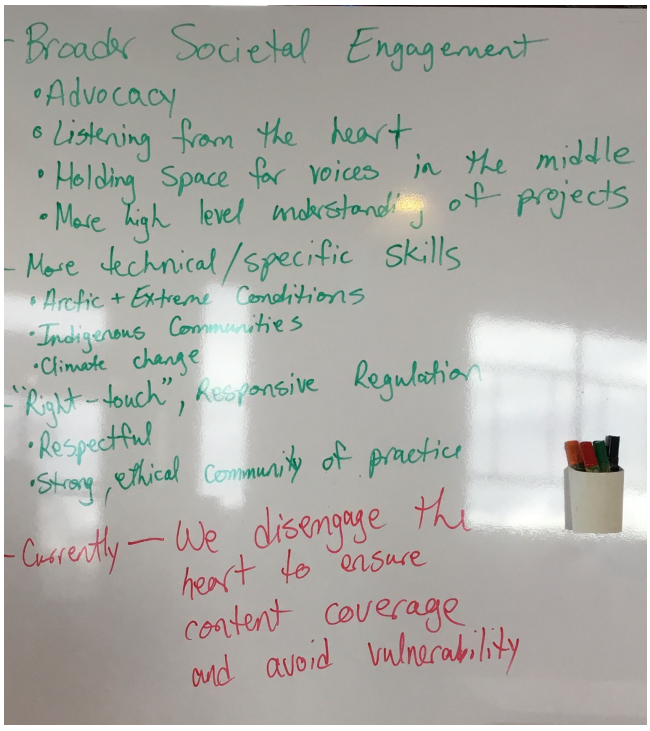
From the themes generated across groups, it appears as though the key skills and competencies required of engineers of the future are not too far beyond what is expected of engineers today.

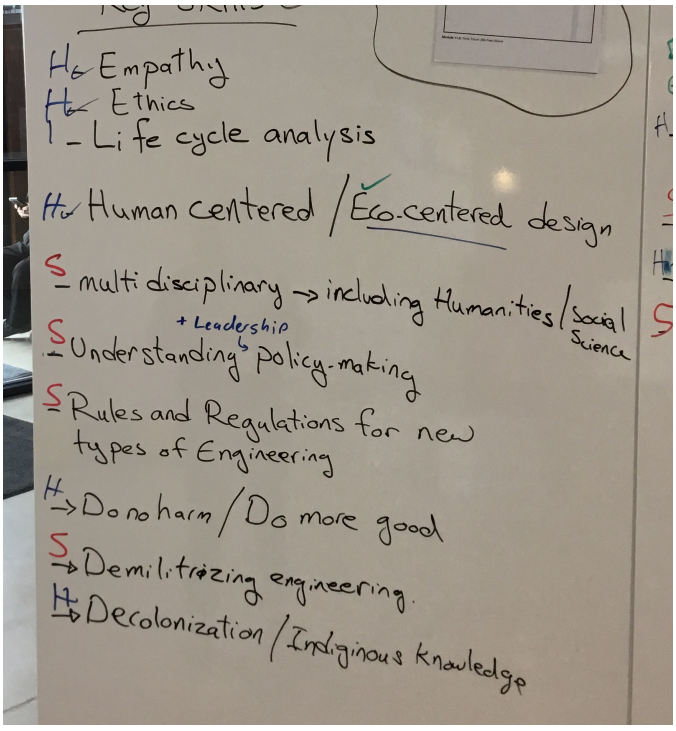
A lot of very rich data was generated during this session, which will be analyzed with other data sets in January to help set the parameters of the next phase of work; the simulations.

5.4 Examples of Participant Work: *Time Travel: From 30,000 ft*









5.4 Anticipating Change: *Participant Photos*

5.4 Anticipating Change: *Friday November 25, Morning*

Module 5: Time Travel: In Their Shoes

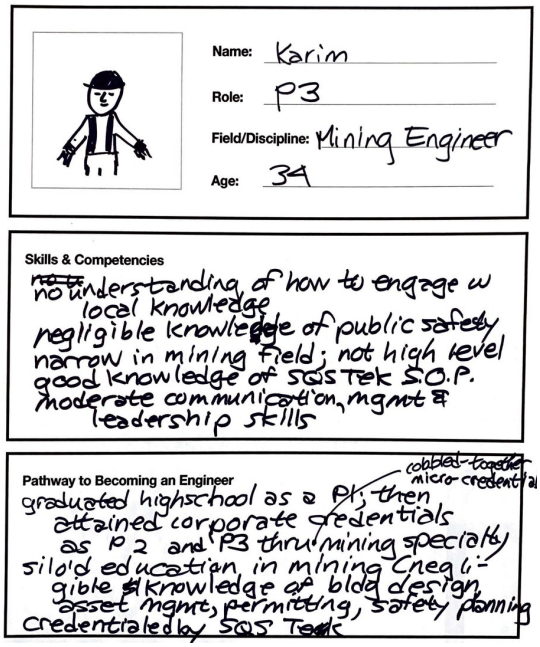
After immersing themselves into a future scenario, groups were given a situation that provided a "day in the life" narrative set in each of the scenarios.

Groups then generated an "Engineer of the Future" persona, inspired by the conditions of the scenario and situation. For each persona, groups listed skills and competencies, as well as the pathway their persona took to becoming an engineer.

This exercise generated a divergent set of personas, depending on the scenario that each group worked with. For some, the pathway to becoming an engineer started in high school, while others obtained industry micro-credentials. Similar across all personas was a focus on competencies like ethics, empathy, and human-centred design. Other common themes across groups was the need for sustainability and a knowledge of systems thinking.

5.4 Examples of Participant Work: *Time Travel: In Their Shoes*

Engineer of the Future Hypothesis

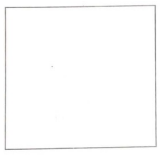


Name: Karim
Role: P3
Field/Discipline: Mining Engineer
Age: 34

Skills & Competencies
~~no~~ understanding of how to engage w local knowledge
negligible knowledge of public safety
narrow in mining field; not high level
good knowledge of SQS Tek S.O.P.
moderate communication, mgmt & leadership skills

Pathway to Becoming an Engineer
graduated highschool as a P1; then cobbled together micro-credentials
attained corporate credentials as P2 and P3 thru mining specialty
siloed education in mining
negligible knowledge of bldg design, asset mgmt, permitting, safety planning
credentialed by SQS Tools

Engineer of the Future Hypothesis



Name: Malcom
Role: student
Field/Discipline: chemical eng.
Age: +/- 21

Skills & Competencies
- understanding env./pol./soc.... issues
- generalist as well as specialist
- understanding the global drivers/# tech.
- leadership
- Problem identifier in addition to problem solver
- emotional intelligence
- Remain proficient in technical skills, use of advance tools
- critical thinking

Pathway to Becoming an Engineer
Multiple pathways into eng. profs. which has room for pol./social studies, international exp. Generally more humanities

Engineer of the Future Hypothesis

Name: Siku Noksana
Role: Specific Specialist / Interdisciplinary Project Coordinator
Field/Discipline: Any
Age: Young

Skills & Competencies
- Community Engagement
- Systems knowledge
- Interdisciplinary Engineering
- Communication
- Confidence (Self-efficacy + Self worth).
- Open, innovative → Connected to their passion.
- Self directed learner → System can help → Able to apply education

Pathway to Becoming an Engineer
- Took school near their home
- Calling not more school
- Lived experience is honoured
- International recognition
- Professors who they can ID with

Engineer of the Future Hypothesis

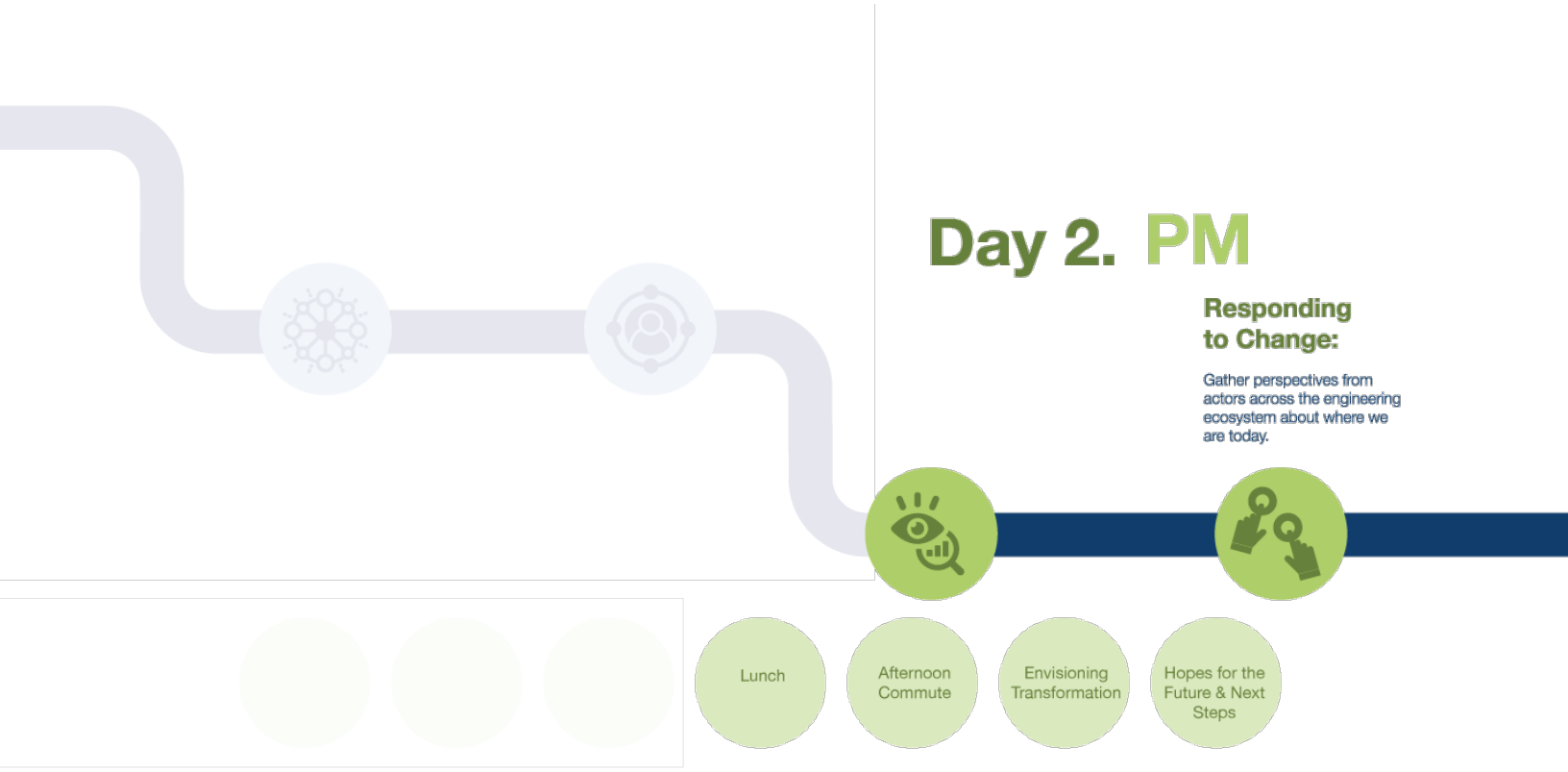
Name: Keisha
Role: PEng level 3 Engineer
Field/Discipline: Nuclear Eginear
Age: 25

Skills & Competencies
- teamwork
- technically competent
- socially/globally/culturally aware
- good communication skills
- digital & data fluency
- language agnostic

SHOULD HAVE
- highest sense of duty to society & environment
- sustainability, societal, ethical awareness
- good understanding of risk and impact
- mentorship from legacy PEng
- Standard method of assessment

Pathway to Becoming an Engineer
- Passing a series of standardized assessments (6 levels) about technical & soft skills, ethical implications, environmental & societal impact
- learn remotely, in classes (university/college)
- mentorship from senior eng
- multi disciplinary

5.5 Responding to Change: *Friday November 25, Afternoon*



To close out the work for the session and set up the next phase of work, groups were asked to envision what positive transformations for the engineering ecosystem could look like.

These were anchored by the core values they felt were at the heart of engineering practice and informed by the same driving forces which the design team had used to develop the first three scenarios.

This led to the creation of vision statements for the future of the engineering ecosystem and the expectations that would be upheld by engineers in this future.

"The future is fluid, not frozen. It is constricted by our shifting and changing daily decisions, and each event influences all others."
- Alvin Toffler

5.5 Responding to Change: *Friday November 25, Afternoon*

Module 6: Envisioning Transformation

For the final exercise of the session, groups were tasked with creating vision statements for the future of the engineering ecosystem that encompasses the skills, competencies, and pathways needed for an engineer of the future. Participants were given a "futures triangle" exercise and were asked to identify the values/practices from the past that were most important to continue, select drivers of change and then create a positive vision for a possible future engineering ecosystem that preserved what was important, and was designed to be resilient.

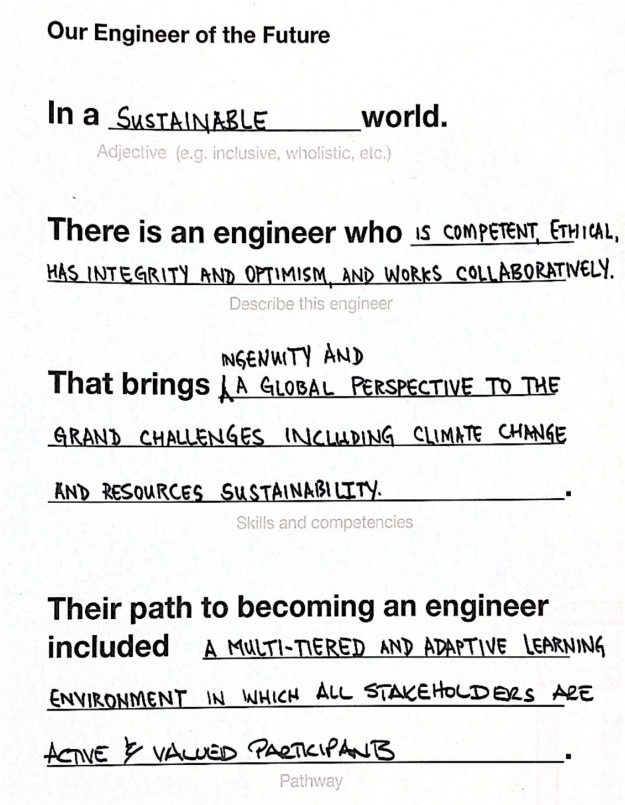
There was consensus amongst all groups that the engineer of the future would be operating in a constantly and rapidly changing, complex world. Groups also determined that the uncertainty and unpredictability of the future creates environmental, social, and political challenges that demand engineers be:

- Ethical, inclusive, and values-based leaders
- Mindful and aware of the future of humanity
- Actively collaborating across disciplines in multi-disciplinary teams
- Incurably curious, showing up with creativity and empathy
- Technically excellent and focused on their lifelong learning journeys

Based on the broader context of what participants identified as needed of engineers, the engineering ecosystem of the future may need to:

- Offer multiple paths to becoming an engineer
- Provide opportunities to constantly explore and harness new technologies
- Prepare and equip engineers to work with teams diverse in knowledge and identity
- Provide permission to partner with others inside and outside of the profession
- Embed a responsibility for sustainability and the outcomes of work
- Shape a collective culture of collaboration and integrity
- Encourage curiosity and experimentation as the same time as the demand for safety

5.5 Examples of Participant Work: *Envisioning Transformation*



Our Engineer of the Future

In a SUSTAINABLE **world.**

Adjective (e.g. inclusive, wholistic, etc.)

There is an engineer who IS COMPETENT, ETHICAL, HAS INTEGRITY AND OPTIMISM, AND WORKS COLLABORATIVELY.

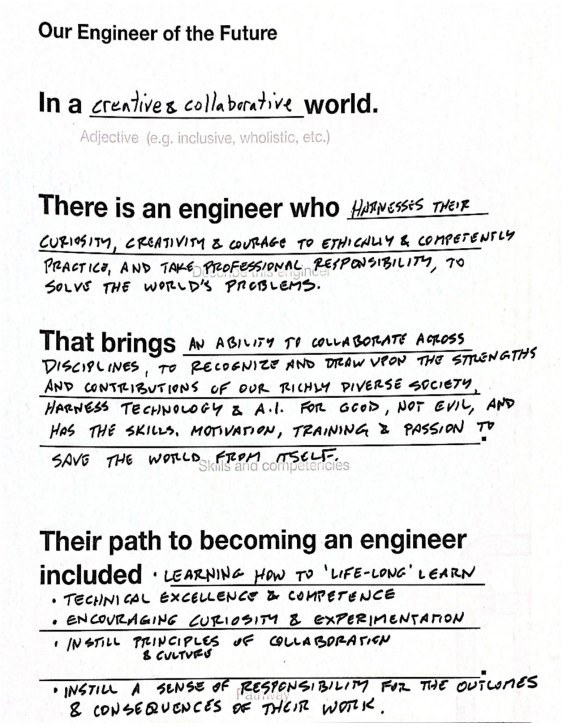
Describe this engineer

That brings INGENUITY AND A GLOBAL PERSPECTIVE TO THE GRAND CHALLENGES INCLUDING CLIMATE CHANGE AND RESOURCES SUSTAINABILITY.

Skills and competencies

Their path to becoming an engineer included A MULTI-TIERED AND ADAPTIVE LEARNING ENVIRONMENT IN WHICH ALL STAKEHOLDERS ARE ACTIVE & VALUED PARTICIPANTS.

Pathway



Our Engineer of the Future

In a creative & collaborative **world.**

Adjective (e.g. inclusive, wholistic, etc.)

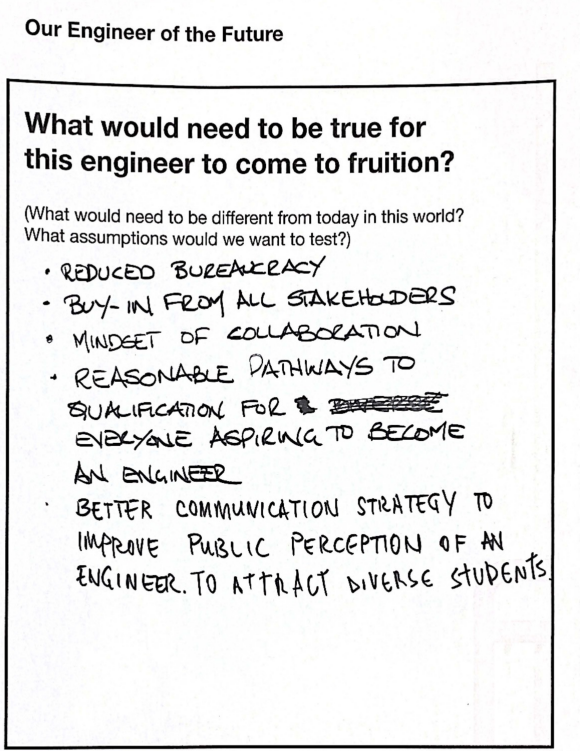
There is an engineer who HARNESSES THEIR CURIOSITY, CREATIVITY & COURAGE TO ETHICALLY & COMPETENTLY PRACTICE, AND TAKE PROFESSIONAL RESPONSIBILITY, TO SOLVE THE WORLD'S PROBLEMS.

That brings AN ABILITY TO COLLABORATE ACROSS DISCIPLINES, TO RECOGNIZE AND DRAW UPON THE STRENGTHS AND CONTRIBUTIONS OF OUR RICHLY DIVERSE SOCIETY, HARNESS TECHNOLOGY & A.I. FOR GOOD, NOT EVIL, AND HAS THE SKILLS, MOTIVATION, TRAINING & PASSION TO SAVE THE WORLD FROM ITSELF.

Skills and competencies

Their path to becoming an engineer included

- LEARNING HOW TO 'LIFE-LONG' LEARN
- TECHNICAL EXCELLENCE & COMPETENCE
- ENCOURAGING CURIOSITY & EXPERIMENTATION
- INSTILL PRINCIPLES OF COLLABORATION & CULTURES
- INSTILL A SENSE OF RESPONSIBILITY FOR THE OUTCOMES & CONSEQUENCES OF THEIR WORK.

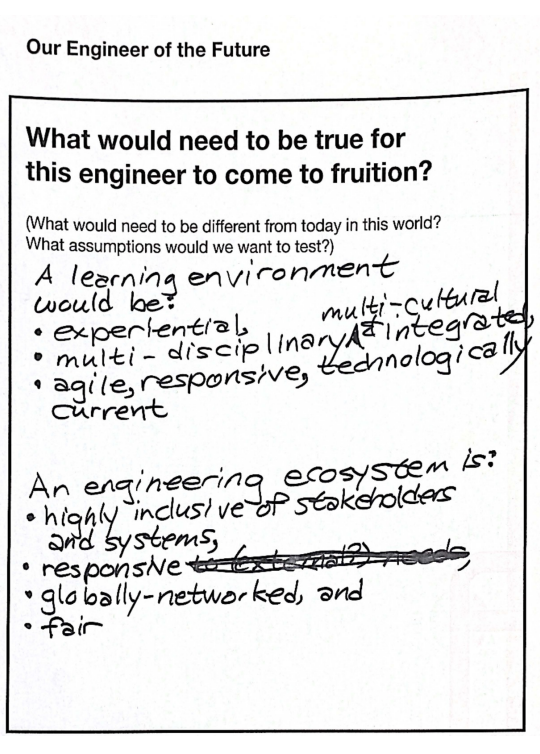


Our Engineer of the Future

What would need to be true for this engineer to come to fruition?

(What would need to be different from today in this world? What assumptions would we want to test?)

- REDUCED BUREAUCRACY
- BUY-IN FROM ALL STAKEHOLDERS
- MINDSET OF COLLABORATION
- REASONABLE PATHWAYS TO QUALIFICATION FOR ~~EVERYONE~~ EVERYONE ASPIRING TO BECOME AN ENGINEER
- BETTER COMMUNICATION STRATEGY TO IMPROVE PUBLIC PERCEPTION OF AN ENGINEER. TO ATTRACT DIVERSE STUDENTS.



Our Engineer of the Future

What would need to be true for this engineer to come to fruition?

(What would need to be different from today in this world? What assumptions would we want to test?)

A learning environment would be:
- experiential,
- multi-disciplinary & multi-cultural,
- agile, responsive, integrated, technologically current

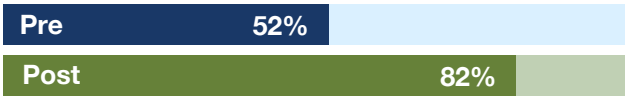
An engineering ecosystem is:
- highly inclusive of stakeholders and systems,
- responsive ~~to (external) needs~~,
- globally-networked, and
- fair

5.5 Responding to Change: *Friday November 25, Afternoon*

Results of Baseline Survey

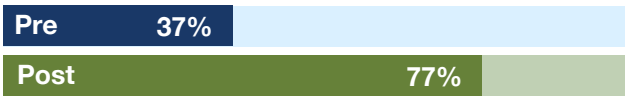
Participants responded to a baseline survey pre- and post-session. The survey sought to understand the changes in sentiment on four questions that were based on the session outcomes, using a scale of 1 to 5:

1. To what degree do you feel you understand the future skills and competencies required of engineers?



2. To what degree to do you feel that the environment around engineering practice and education is shifting?

3. To what degree do you feel optimistic that the engineering profession will embrace and respond to rapid change?



4. To what degree do you feel that accreditation might need to shift to address future challenges?

Graphs show the percentage of participants who rated their sentiment as 4 or higher for each question.

Among participants representing engineering regulators, the median opinion that accreditation needed to change increased from 4.0 to 5.0 by the end of the session.

Table Pre-Session Survey Responses

Which stakeholder group do you mostly identify with?	#
Higher Education Institution	22
Accreditation Board Member	11
Engineering Regulator	10
People Who Work with Engineers	10
Qualifications Board Member	6
People Working in Engineering (licensed and non-licensed)	4
Student Studying Engineering	3
Steering Committee	2
EIT	2
Total	70

**Given the small sample size for many stakeholder groups, data validity is constrained by the number of respondents in each group. Consequently, responses should be taken as early indicators rather than conclusive results.*

6. Where to from here?

6.1 Reflections & Next Steps

Key Reflections from the Session

Since 1965, the Canadian engineering ecosystem has worked to create an internationally recognized accreditation system.

This project is a three-year journey to understand, explore and develop how accreditation can continue to be world class while adapting to a changing world. Over the course of the remaining two years of this project, we must continue to lift the best parts of our current system, while also acknowledging that the world around us continues to change in increasingly accelerated ways. As the profession adapts to address emerging changes and challenges, the accreditation system will likely to continue to serve as a vital leverage point to ensure that our educational programs are setting graduates up for success as they uphold the great responsibilities of the profession.

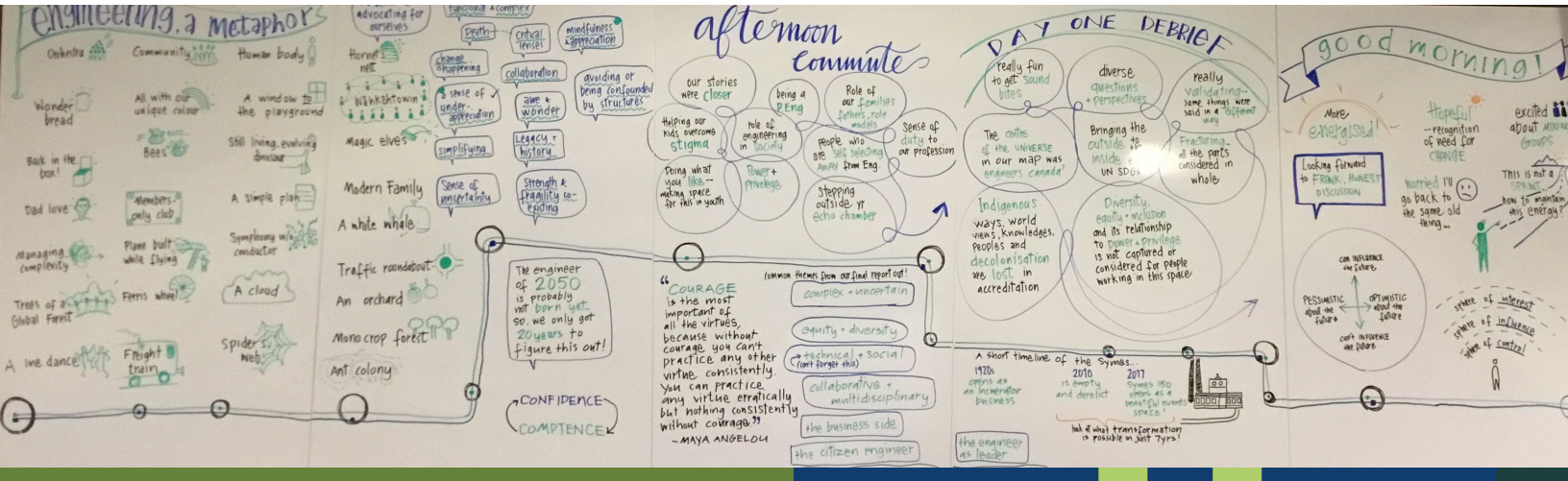
The accreditation system is a source of significant division and conflict. **However, when we pulled back to take the long view on where we wanted to go as a profession, we found significant alignment.**

We all want engineers of the future to be environmentally and socially aware, interdisciplinary problem solvers with a strong sense of duty to the public.

While there is a long road ahead to build cross-system alignment on the mechanisms that the accreditation system should employ in service to these ultimate goals, this session revealed a shared long-term vision we are seeking to create together.

One of the most important outcomes from the FEA session was a strong sense of urgency. The pace of social, technological and environmental change continues to accelerate, and the most troubling scenarios envisioned together seemed all too plausible. However, this was also paired with a strong sense of optimism and commitment to continue working to find a shared path forward. At the end of the session, participants were asked to indicate their desire to continue to be involved in the desktop simulations in late Q1 of 2023.

Approximately 90% of participants indicated that they would be interested in continuing to contribute to this next phase of the project.



This event was a key step in generating a broad hypothesis of the future roles engineers are likely to play and the competencies they will need to succeed. Over the next two years, we will continue to work collaboratively to focus on the purpose and scope of the accreditation system and the academic requirement for licensure that will enable the engineer of the future to become a reality.

Next Steps

At the beginning of 2023, our immediate work includes:

- Further data analysis of the outputs generated during the event to inform the design of desktop simulation activities
- Engaging our core project volunteers (the Regulator Advisory Group; the Steering Committee; the Purpose of Accreditation Task Force and the Academic Requirement for Licensure Task Force) in collaboratively designing simulations to test key hypotheses for the future of accreditation

Simulations will start at the end of Q1 2023 and involve working virtually in small groups to rapidly test concepts for the purpose of accreditation and the academic requirement for licensure. They will allow us to continue building on the work of the FEA session, and to scale the conversation to a greater number of new voices who represent a diversity of viewpoints with an interest in the future of the engineering system. This will include a greater number of students, practicing engineers, and professionals from emerging disciplines, as well as equity-deserving groups within the engineering ecosystem.

From the FEA session and our other research activities in 2021 and 2022, some key themes have emerged for us to explore, including:

- Equity, diversity and inclusion and accessibility in the engineering ecosystem
- Responsiveness to rapid change and emerging professions
- Increasing equity between the CEAB applicant and non-CEAB applicant pathways to licensure.

The Engineers Canada and Coeuraj teams will continue to engage the project volunteer groups in a highly participatory manner throughout this process. They will be involved in data analysis as well as the design of the simulations. We will also seek to include additional voices from across the ecosystem, especially those who have not traditionally been involved.

The project team will also work in the latter half of 2023 and into 2024 to consult with the engineering regulators to understand the feasibility and desirability of potential purpose statements for the accreditation system and academic requirements for licensure as they are developed.

Ultimately, the project will culminate in a Path Forward report to be published in late 2024.

6.2 Acknowledgements & Contacts

Acknowledgements

To all participants, and those who contributed asynchronously:

Thank you for taking the time to contribute your expertise and lived experiences to the session. The FEA journey is driven by the collective insights shared by members of the engineering ecosystem; your voice is an integral part of the project, and of the advancement of our shared profession.

To the Design Team:

Thank you for your leadership in crafting our two-day experience. Your voices were a key driver in shaping the session for all participants.

To the volunteers involved in the project so far:

Thank you for your dedication to the overall project and for bringing this session to life. The insights captured could not be uplifted without your work and effort.

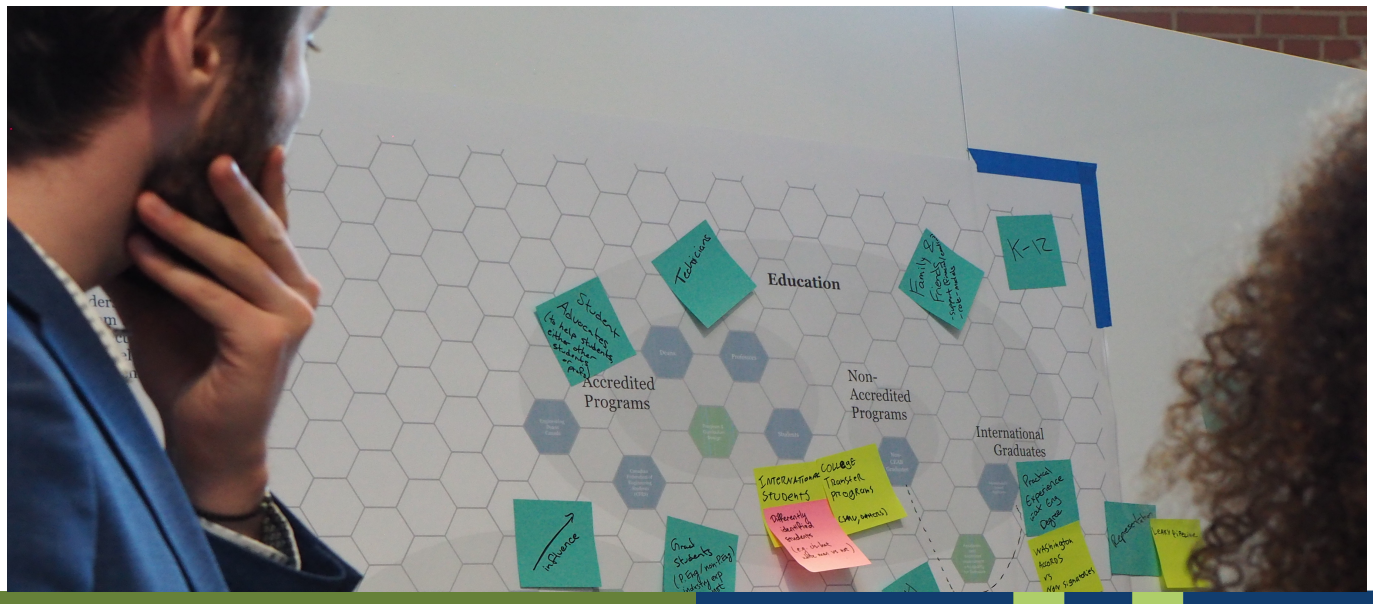
Invitation to Participate in the Desktop Simulations

Through the spring of 2023 we will be hosting a series of desktop simulations that will develop and test possible purposes and academic requirements. These will be highly interactive and participatory and will generate foundational pieces from which we will build an accreditation system: the purpose and the academic requirements for licensure. We are looking for people across the engineering ecosystem to join us for no more than five sessions that will shape the future of the professions.

More Information + How to Get Involved

For more information about Futures of Engineering Accreditation, please visit engineeringfutures.ca.

If you have any questions about the project, or are interested in getting involved, please contact our team at fea@engineerscanada.ca.



7. Appendices

7.1 Participant List

A. Sidiq (Sid) Ali
Adam Wallace
Albert Banahene
Alex Lizotte
Amit Banerjee
Anders Nygren
Andrew Maxwell
Annette Bergeron
Celeste MacNeil
Chris Roney
Christopher Yip
David Coleman
David Smith
Dennis Peters
Ernie Barber
Eugene Porter
Frank Collins
Gary Faulkner
Gehna Kahani
Gillian Pichler
Griffin Murdoch
Hanan Anis
Imani Trusty
Jason Blackstock
Jason Ong
Jeff Pieper
Jessica Christou
Jessica Vandenberghe
Jillian Seniuk Cicek
Jim Lee
Jim Nicell
John Newhook
Joshua Leon
Julius Pataky
Kalina Bacher-René
Karen Savage
Kate MacLachlan
Kear Porttris
Ken Coley
Kevin Deluzio
Kris Dove
Laleh Behjat
Luigi Benedicenti
Madeleine Redfern
Mahsa Berjis
Malcolm Reeves
Margaret Anne Hodges
Marisa Sterling
Mark Fewer
Mathieu Laberge
Michel Couturier
Michel Huneault
Michelle Charlotte Liu
Mohja Alia
Mya Warken
Nadine Ibrahim
Nathalie Roy
Nick Krouglicof
Paul Amyotte
Paula Klink
Pemberton Cyrus
Pierre Bourque
Ramesh Subramanian
Rebecca White
Renato Bezerra-Rodrigues
Rosamund Hyde
Roydon Fraser
Ryan Melsom
Samer Inchasi
Stephanie Price
Suzanne Kresta
Tom Coyle
Valerie Davidson
Waguih ElMaraghy
Wayne MacQuarrie
Yomi Ojutalayo
Zoey Zhang

7.2 Engineering Ecosystem Reference Map

As part of the system mapping exercise, participants were asked to visually map relationships and connections between actors and elements they see present in today's engineering ecosystem.

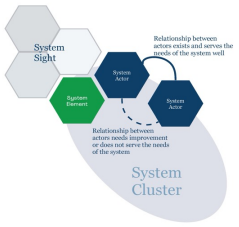
The Engineering Ecosystem reference map was developed to provide participants with a common starting point that included clusters of actors and elements, including education, practice, and regulation.

Engineering Ecosystem

Consider the actors and elements that are present in the engineering ecosystem today.

As a group, from your understanding of the engineering ecosystem today, use sticky notes or draw directly on the canvas to capture the actors, elements, and relationships between them.

Legend

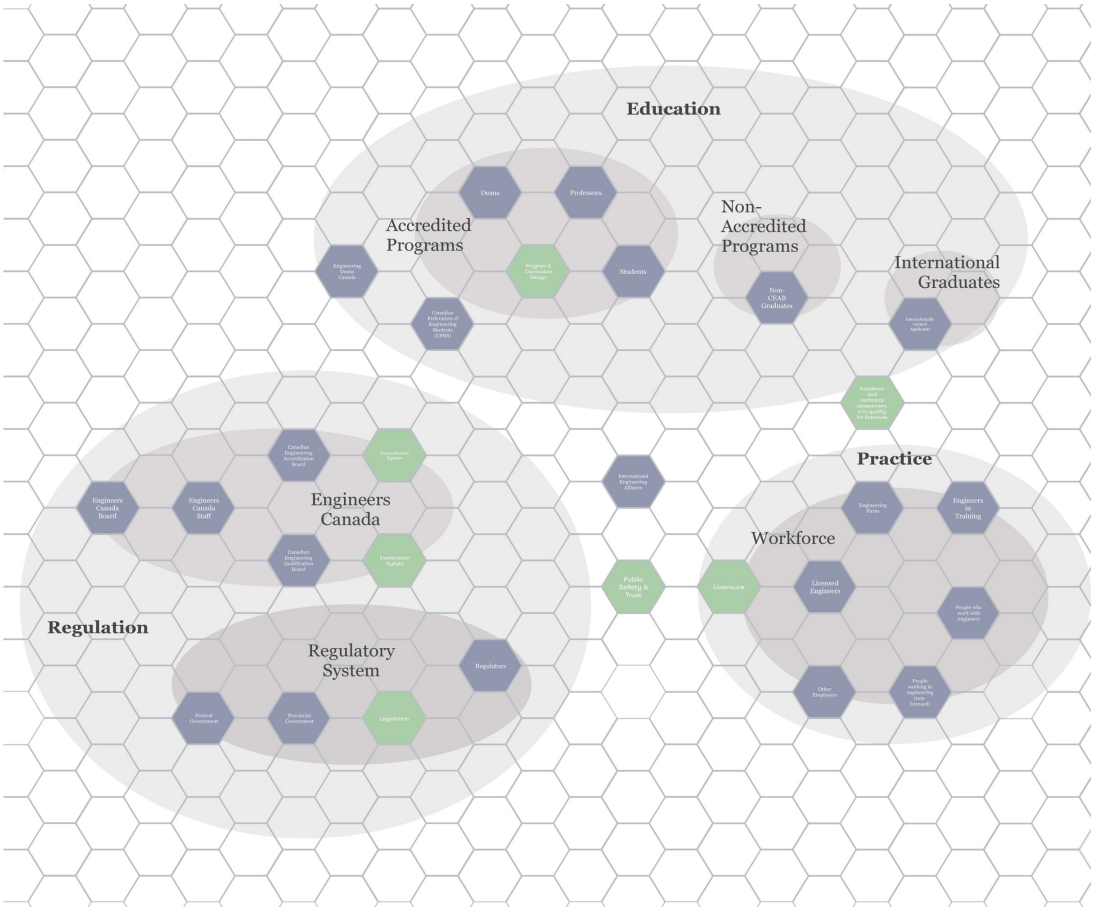


System Sight: Visualizing actors, elements, and the connections between them.

System Element: Tangible or intangible aspects that are part of an ecosystem. Examples could be professional pride, licensure, or examinations.

System Actor: Groups and organizations that play a role in the ecosystem.

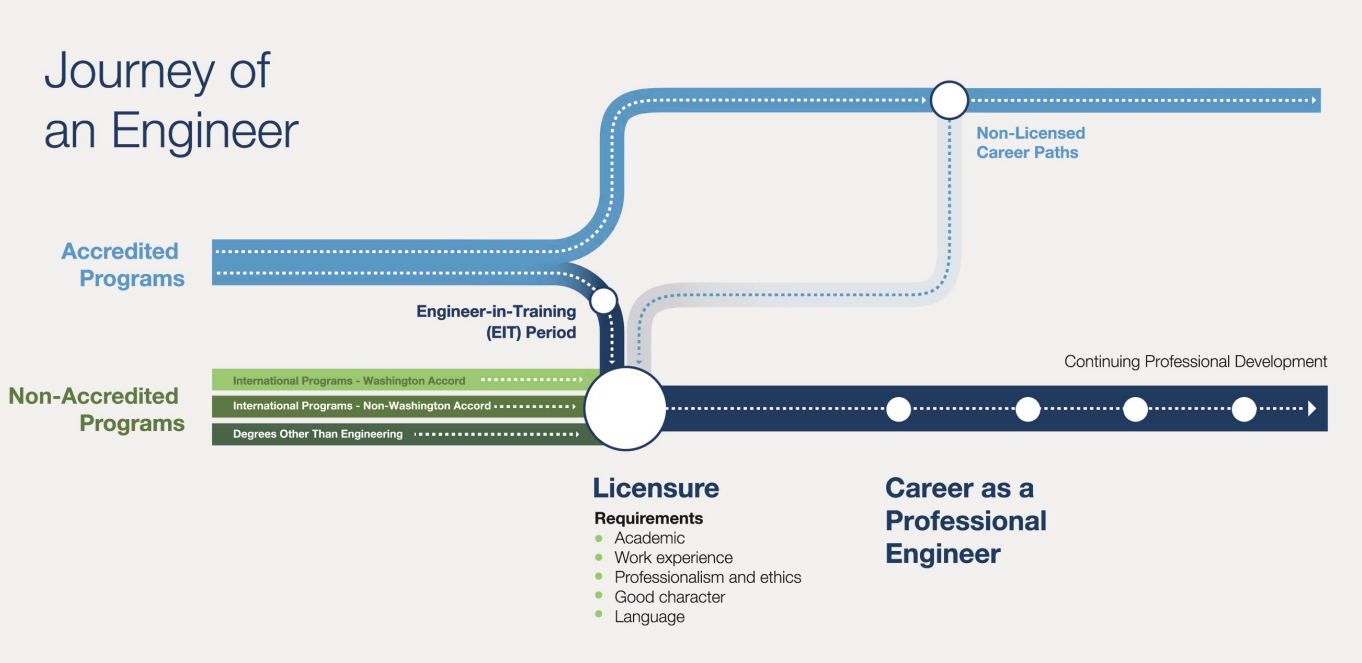
System Cluster: A group of actors and elements that work together or rely on each other to function.



7.3 Journey of an Engineer

As part of the system mapping exercise, participants were asked to explore the ecosystem of engineering from their vantage point, with the journey of an engineer in mind.

The Journey of an Engineer diagram was developed in collaboration with Engineers Canada to provide a common language around the key milestones and on-ramps within the profession.



7.4.1 Signals Bank – *Social*

Social signals include ways of life (e.g., use of leisure time, family living patterns), demographic structures, social inclusion and cohesion issues, levels of (in)equality, educational trends.

Title	Description	Source
A Larger, More Diverse Canada	In 2041, if current trends continue, half of the Canadian population will be made up of immigrants and their Canadian-born children. According to the reference scenario, the Canadian population would reach 47.7 million in 2041, and 25.0 million of them would be immigrants or children of immigrants born in Canada, accounting for 52.4% of the total population.	*Statistics Canada – Canada in 2041 (2022)*
Fostering a Culture of Care on University Campuses	There is emerging attention to students' well-being, strengths and needs as a whole person. This is in addition to and in conjunction with addressing inequities that differentially impact student well-being.	*Current and Emerging Trends in Engineering Education (2022)*
Scalable & Flexible Experiential Learning	Engineering programs have many courses that are well suited to experiential learning opportunities, some of which are commonly found in Canadian institutions, such as: work-integrated learning experiences (e.g., co-op/internships), 'hands-on' laboratory education, and design project courses that see students working on 'real-world' challenges. There is a call for this type of learning from the industry as well.	*Current and Emerging Trends in Engineering Education (2022)*
Soft Skills at the Heart of Engineering	Members of the IOQ have noted an increased need for the following soft skills: change management, computer programming, emotional intelligence and interpersonal relationship management, continuous individual learning, collaboration and teamwork, and creativity.	*OIQ - Profil de l'ingénieur d'aujourd'hui et de demain (2022)*
Intercultural Understanding Needed for Reconciliation	"'Engineers interface with and directly impact Indigenous communities through infrastructure and economic development projects. So, building student capacity for intercultural understanding, empathy, and mutual respect is critical in our profession contributing to Reconciliation.'"	*Current and Emerging Trends in Engineering Education (2022*
Vertical Literacy & Evolution of Consciousness	There is an opportunity to reconceive the 21st century university as a unity of research, teaching, and the praxis of transforming society and self. Most educators are focused on horizontal development - adding another skill or course here and there. Whereas vertical development focuses on the evolution of consciousness.	*Presencing Institute (2019)*
Transforming Dangerous Streets through Art	Low-income communities are less likely to have safe sidewalks, street crossings or recreational walking areas, which increases the risk of pedestrian incidents or death. A new project that transforms dangerous streets through art is tackling dangerous streets in an effort to reduce the number of pedestrian incidents	*Reasons to be Cheerful (2022)*

Title	Description	Source
Indigenous-led Programs Grounded in Land-based Learning	Across Canada, more youth-focused programs that weave together Land-based knowledge systems and STEM (science, technology, engineering and math) are forming . The merging of Indigenous knowledge, STEM education, and land-based learning can pave new pathways into STEM education for Indigenous youth.	Social Connectedness (2022)
Young & Growing Indigenous Population	The number of people identifying as Indigenous in Canada grew almost twice as fast as the non-Indigenous population and now stands at 1.8 million — about five per cent of the population — according to newly released census data. From 2016 to 2021, the number of people in Canada identifying as Indigenous grew by 9.4 per cent. The non-Indigenous population grew by just 5.3 per cent over the same period.	Statistics Canada (2022)
Co-Creation & New Models of Consultation	Communities are rejecting performative or "check mark" consultation processes that do not meaningfully include their voice in decision making. Increasingly, there is a shift towards more intentional, tailored processes that invite stakeholders to "co-create" with governments and industry, contributing land-based knowledge to reach more effective and appropriate solutions.	FEA Design Team
Rise of Gen Z in Workplaces	"The future of work will call for a return of the Renaissance figure: a person with many talents, interests, and areas of knowledge." Gen Z's priorities are salary, engagement with cutting-edge technology, and how their job helps make the world better.	*Deloitte (2019)*
Decolonizing Eng. Practice & Education at a National Level	There is a movement in engineering education in Canada to increase Indigenous representation and belonging, reconcile relations, and to decolonize and Indigenize engineering curricula. Much of this work is being undertaken by individuals or small groups within institutions and it is vital to share and examine the initiatives that are taking root nationally.	*Teaching in Higher Education (2021)*
Micro-Credentials, Badges, & Stackable Certifications	Increasing desire to recognize competency through pathways that don't include a traditional degree. Alternatives might include micro-credentials (rapid training programs offered by postsecondary education institutions), badges (to aggregate learning achievements) and stackable certifications (combination of certifications aligned with a specific job-role.).	*Statistics Canada (2022)*
Tuition Waiver for Youth in Extended Society Care	As of fall 2022, Toronto Metropolitan University will offer tuition waivers for students who grew up in extended society care (previously known as Crown Wards) in Canada, and are currently enrolled in an OSAP-eligible program at the institution. The tuition waiver will cover full tuition and ancillary costs.	*Toronto MU (2022)*
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Cultivating an Ecosystem to Encourage Black Girls in STEM	An Ontario-based non-profit organization is working to encourage young Black girls to forge careers in science, technology, engineering and mathematics (STEM) related fields through programming designed specifically for them.	*City News (2022)*

7.4.2 Signals Bank – *Technology*

Technology signals include rates of technological progress, pace of diffusion of innovations, problems and risks associated with technology (including security and health problems).

Title	Description	Source
Training Engineers to Craft Parameters for Generative Design	As generative design tools become more commercially available, engineers will need to learn how to carefully craft constraints for AI assisted design.	*The Manufacturer (2022)*
Geoengineering to Mitigate Climate Change	Researchers at MIT are exploring the potential of space-based geoengineering to mitigate the effects of climate change on earth. The group is investigating what might happen if we position a shield of bubbles at Lagrangian Point 1 - a point in space where the gravitational pulls of the Earth and the sun form a sort of equilibrium that would keep the shield in orbit there indefinitely.	*Freethink (2018)*
Measuring Learning with Brain Scans	Learning can now be measured with brain scans. Researchers examined a high school science course and found that students' brains changed as they learned the course material, as shown by Magnetic Resonance Imaging (MRI) scans, and these changes were compared to conventional methods of measuring learning (e.g., changes in test scores).	*SciTechDaily (2022)*
Planetary Defence Technology to Move Asteroids	After 10 months flying in space, NASA's Double Asteroid Redirection Test (DART) – the world's first planetary defense technology demonstration – successfully impacted its asteroid target on Monday, the agency's first attempt to move an asteroid in space.	*NASA (2022)*
Autonomously Building Infrastructure with Robots, 3D printing, and AI	Team of researchers at Tsinghua University in Beijing have created plans to construct a 594 ft tall dam using robots, 3D printing, and AI. No human labour needs to be directly employed in building the structure.	*ArsTechnica (2022)*
Shifting Boundaries of Engineering	With the explosion in new technological frontiers, the ways in which engineers can be useful are also expanding. A conversation should be had about the current edges of engineering in biosciences, software, and more, and how that may impact the way engineering is thought of, taught, and managed.	*Engineers Canada Envisioning Exercise (2022)*
Digital Dependency Intensifies Cyberthreats	Intensified by COVID-19, industries have undergone rapid digitalization, workers have shifted to remote work where possible, and platforms facilitating this change have proliferated. At the same time, cybersecurity threats are growing—in 2020, malware and ransomware attacks increased by 358% and 435% respectively—and are outpacing societies' ability to effectively prevent or respond.	*WEF Global Risks Report (2022)*

Title	Description	Source
Mining Moon Materials for Lunar Living	NASA's desire to mine ice and minerals on the moon is driving new research on Earth into how astronauts could use moon materials to make machine parts, pave roads and construct living quarters. NASA wants to be ready to mine whatever it finds when it lands, probably on the South Pole of the moon, for upcoming missions, according to Jerry Sanders, an agency engineer and team leader on such mining efforts.	*NASA (2022)*
Virtual Reality in Eng. Education	Virtual reality has achieved an adequate level of development for it to be considered in innovative applications such as education, training, and research in higher education. Virtual reality offers both opportunities and challenges for the educational sector. While cost has been a deterrent, in recent years computer hardware and software development has made it more feasible to incorporate virtual reality technology into future teaching strategies.	*International Journal of Emerging Technologies in Learning (2022)*
Digital Inclusion of the North	In a universe increasingly crowded with satellites, Canada's Telesat is getting ready to launch its own powerful competitor fleet to SpaceX, OneWeb and other companies. The company announced a memorandum of understanding with the Canadian province of Quebec that could see about $400 million CAD in provincial monies pour into a set of powerful data-bearing satellites known as Lightspeed, targeted to rural communities in the far north.	*Forbes (2021)*
Aerospace Innovation	The aerospace industry is working to change the types of energy use and pivot to more environmentally-friendly sources. Research is being done in urban aerial mobility, specifically for systems with vertical take-off and landing mechanisms. The global market for urban aerial mobility is expected to grow from $7 billion US in 2020 to $322 billion US by 2030 and $1,474 billion US by 2040.	*OIQ - Profil de l'ingénieur d'aujourd'hui et de demain (2022)*
Growth of the Software Industry	The total operating revenue of the software development and computer service industries reached $95.5 billion in 2020, up 7.5% from 2019. The operating revenue of these industries has been growing significantly faster than the Canadian economy since 2013, and these industries were the largest professional services employer in 2020.	*Statistics Canada (2022)*

7.4.3 Signals Bank – *Economy*

Economic signals include levels and distribution of economic growth, industrial structures, competition and competitiveness, markets and financial issues.

Title	Description	Source
Extreme Wealth Continues to Concentrate	Data published by Credit Suisse in their annual global wealth reports and databooks reveal that only Canada's top one per cent wealthiest households (those with net worth of over $6 million) increased their share of total household wealth from 2010 to 2019—from 17.9 per. cent to 25.7 per cent—while the share of all other groups declined.	*Macleans (2021)*
Mobility of Talent	The global war for skilled talent has led to opportunities for some workers to move across jobs, industries and countries. Individuals and companies must evaluate their work opportunities from a broader and global lens, shifting to a mindset of career mobility and the continuous development of transferable skills.	*World Economic Forum (2022)*
Growing Litigiousness of Clients	"Clients and owners are becoming highly litigious and it makes the prospect of making an mistake stressful to say the least and could potential ruin me professionally and financially. A fear I live with every day." - Envisioning Survey	*Engineers Canada Envisioning Exercise (2022)*
Rise of Rural Entrepreneurship	Startup Canada and Rural on Purpose, an entrepreneurial support organization specializing in collaboration projects with rural communities, announced their formal partnership created to champion, connect, and support rural entrepreneurs across the country in order to create a more inclusive Canadian startup ecosystem. Joining forces, the two organizations seek to empower entrepreneurs and their communities by connecting them to each other and to a national resource network.	*Startup Canada (2021)*
Job Competition from Overseas	Non-Canadian engineers are increasingly being asked to work remotely on Canadian projects, If engineering employment is globalizing, this could mean that Canadian engineers must prepare for a global marketplace and keep a close eye on how training is developed abroad.	*Engineers Canada Envisioning Exercise (2022)*
Shift to Skills-Based Hiring	Faced with the need to deliver short to medium-term results, companies are increasingly hiring for skills backed with experience, and less for potential. This has led to a decline in graduate recruitment. Many companies are eliminating degrees from their hiring criteria in favour of skills assessment.	*World Economic Forum (2022)*
Decline in Company Loyalty	"Company loyalty is reduced, making it harder to attract EITs (survey respondent 320)" There are also many studies of the decline of company loyalty generally over the last two decades, which cite weak company culture and lower job security as factors.	*Engineers Canada Envisioning Exercise (2022)*
Engineers Can Embrace Change When AI & Automation Take Their Jobs	Industries continue to adopt new practices and tech emerges. Engineering is not different - engineers will need to adapt their work to accommodate technological changes, like Industry 4.0. Having strong soft skills will be essential in remaining adaptable to change	*Interesting Engineering.com*

Title	Description	Source
Privatization to Accelerate Space Travel	Large scale infrastructure projects have, traditionally, been undertaken by governments with contracts being awarded to regions with voting blocks. These contracts are decades delayed and massively over budget. Recent entrants to the space exploration field (SpaceX) have shown how private sector can effectively fund R&D and deploy innovative solutions at a fraction of the price. Price is now the determining indicator.	*The Economist (2022)*
Precariousness of International Student Funding	International students pay three times the amount that Canadian-born students pay for university education in Canada. In 2021, 21 per cent of undergraduates and 29 per cent of graduate students were international students. In 2018, we contributed $19.7 billion to Canada's GDP and held 218,577 jobs. Meanwhile, the federal government's subsidies decreased by 40 per cent per student between 1992 and 2016.	*University Affairs (2022)*
Rare Earth Metals Industry	Canada has begun supplying the world with minerals critical to a greener economy with the country's first rare earth metals. Rare earths are a series of exotically named elements such as ytterbium, lanthanum and gadolinium. They are crucial to computers, LED displays, wind turbines, electric cars and many other products essential to a low-carbon world.	*Canada CBC (2022)*
Indigenous-Owned & Led Firms	Dillon Consulting recently launched SOAR Professional Services, a planning, engineering, environmental science and management consulting firm dedicated to supporting First Nations, Inuit and Métis communities and organizations across Canada. Based in Kingsclear First Nation, N.B., the new business is owned, led and staffed by Indigenous professionals.	*Canadian Consulting Engineer (2021)*
Continued Urbanization	People in search of better opportunities - such as jobs, services and education, have been moving from rural to urban areas across the world, and this accelerating trend is likely to continue in the future. The number of people living in cities has more than doubled over the last 40 years and is projected to reach 5 billion by 2050.	*European Commission (2022)*
$100 Billion Indigenous Economy	The Indigenomics Institute is currently unleashing a national Indigenous economic agenda to facilitate the growth of the Indigenous economy from its current value of 32 billion to 100 billion in five years. The Canadian Council for Aboriginal Business is contributing by actively working to raise Government and corporate procurement of Indigenous businesses to five percent via the Aboriginal Procurement Marketplace.	*Indigenomics Institute (2022)*

7.4.4 Signals Bank – *Environment*

Environmental signals include pressures connected with sustainability and climate change, more localized environmental issues (including pollution, resource depletion and associated biodiversity and welfare concerns).

Title	Description	Source
Legal Right to a Healthy Environment	Canada is looking to adopt the UN resolution for the human right to a clean, healthy and sustainable environment. Critics of the bill state that as it is written, the bill is not consistent with the UNHRC and UNGA. Minority populations across Canada face higher risks when it comes to environmental harms that are often the result of environmentally racist policies.	*Canada CBC (2022)*
Engineering Species to Fight Climate Change	Scientists from the US and Israel have proposed a CO2 removal strategy that utilizes the powerful methods of synthetic and systems biology (SSB). The further development and deployment of SSB could enable the modification of plants to remove CO2 from the atmosphere irreversibly.	*Phys.org (2020)*
Fragile Future for Infrastructure Built on Permafrost	As permafrost thaws around the world, the steel, concrete and tarmac structures sitting on top are warping and crumbling. Engineers must now reckon with the hazardous fluctuations of once-solid ground. As they do so, they are coming up with innovative ways of cooling the Earth beneath their feet, to try and save human structures from the destabilising thaw.	*BBC (2021)*
Sea Level Rise Threatens Septic Systems & Public Health	Sea level rise and increasingly hot summers are creating health and safety hazards across the U.S. One example is the Tidewater region of Virginia, where sea level rise is causing frequent failures of home septic systems. And when septic systems fail, the results are catastrophic—polluting drinking water and threatening human health. The burden falls mostly on homeowners and local governments—a particularly tough challenge for less affluent rural communities.	*Brookings Institute*
Hotter and Deadlier Temperatures Globally	Sea level rise and increasingly hot summers are creating health and safety hazards across the U.S. One example is the Tidewater region of Virginia, where sea level rise is causing frequent failures of home septic systems. And when septic systems fail, the results are catastrophic—polluting drinking water and threatening human health. The burden falls mostly on homeowners and local governments—a particularly tough challenge for less affluent rural communities.	*The Economist (2022)*
Heroic Efforts to Rebuild Precarious Power Grids	The Ottawa region faced a historic storm in May of 2022 and the damage done to homes, infrastructure, and the environment was detrimental. The storm adversely affected every part of Hydro Ottawa's 1,100-square-kilometre coverage area. To clean up debris and restore power engineers across Canada and US were called in to do a year's worth of work in seven days.	*Ottawa Citizen (2022)*

Title	Description	Source
Growth of Hydrogen and Biofuels	An alternative solution to grey energy (energy made from fossil fuels) and blue energy (energy made from fossil fuels but where the manufacturing process includes the capture and storage of CO2 emissions). Green hydrogen is produced from water and other renewable energies. Chemical, mechanical and electrical engineers will be at the heard of the green hydrogen and biofuel portfolio of production.	*OIQ - Profil de l'ingénieur d'aujourd'hui et de demain (2022)*
High impact Weather Events & Natural Hazards	Exposure to natural hazards doubled in the last 40 years. In 2015, there were 19.2 million newly displaced people due to weather, water, climate and geophysical hazards in 113 countries – more than double of those by conflict and violence.	*European Commission*
Extreme Space Weather	Forecasting extreme space weather, such as different types of solar activity becomes increasingly important given their potential impact on the operations of critical infrastructures; e.g. solar flares, solar radiation storms or geomagnetic storms could affect radio, radar, ground- and space-based communications, GPS, satellite, aviation, rail transport and power-grid operations.	*European Commission*
"Chief Heat Officers" form Coordinated Climate Response	Several US cities and some across the world have created a new municipal role called "Chief Heat Officers" to address how cities respond to rising temperatures. Chief Heat Officers are tasked with breaking down silos across jurisdictions and sectors to look at the health and economic impacts of heat. Rapid urbanization in cities is leading to the exacerbation of urban heat islands.	*CNN*
Electrification of Transportation & Mobility	Electrification of transportation will be a major economic industry in QC in the next 10 years. QC plans to become a world leader in this field, from strategic metal extraction to the recycling of lithium-ion batteries at the end of life cycle. Electrical and logistical engineering will be some of the professions in high demand for the 2020-2030 decade.	*OIQ - Profil de l'ingénieur d'aujourd'hui et de demain (2022)*
Soil Degradation & Food Insecurity	Soil is the life support of our food and agriculture. We rely on soils for 95 percent of the food we consume. Yet on this course, by 2050, 90 percent of all soils are set to be degraded. Without change, degrading soils will put our ecosystems, our climate and food security in jeopardy.	*Food and Agriculture Organization of the United Nations (2022)*
New Building Methods for Harsh Northern Conditions	Building scientists are working with a rural Alaskan community to build and test homes and buildings that are engineered in a way that keeps the interior warm without forming condensation in the walls — mold and rot problems plague many Alaska homes. Moving from lab to community means that researchers building the technology to meet community wants and needs — creating synergies between the technical and cultural	*Brookings Institute*

7.4.5 Signals Bank – *Political*

Political signals include dominant political viewpoints or parties, political (in)stability, regulatory roles and actions of governments, political action and lobbying by non-state actors (e.g., pressure groups).

Title	Description	Source
Freshwater Vulnerability + Conflict	As the global climate warms and water scarcity mounts, fresh water is more valuable than ever before. Water diversions to accommodate regions experiencing prolonged drought and privatization of water will increase tensions.	*Great Lakes Now (2021)*
Multipolarity of Geopolitical Power	Multipolarity refers to the geopolitical situation that arises when there are several power centers. Political scientists use the term to describe what happens when no one nation-state has overwhelming power over the others.	*Rising Powers for Global Governance (2021)*
Upgrading Canada's Continental Defence in the Far North	Canada has committed to invest $40b in continental and northern defence. North America has increased interest in upgrading and investing in Northern defences as the North Pole is the most likely route Russian forces would take to attack or invade North America.	*Government of Canada (2021) and CBC (2022)*
Connectivity for Northern Ontario	The Northern Ontario Transportation Plan includes more than 60 actions that will get more people moving, improve travel options for people in remote communities and support economic growth in the North.	*Ontario Ministry of Transportation (2022)*
Settlement of Specific Claims and Liabilities	Canada is working with the Assembly of First Nations, First Nations and other interested parties in a spirit of co-operation and renewal to find fair and practical ways to improve the specific claims process. As of September 2022, 571 specific claims are in progress with 1,054 specific claims settled and resolved.	*Government of Canada (2022)*
Streamlining Immigrant Licensing to Tackle Worker Shortages	Health Minister Michelle Thompson says the only way Nova Scotia will be able tackle health-care worker shortages is through immigration and, for that reason, the government wants to streamline the licensing process for people moving to the province from outside Canada.	*CBC (2022)*
Anticipatory Regulation in an Age of Disruption	In an age of fast-paced technological changes and uncertainties, NESTA invites regulators to consider a set of "anticipatory regulation" principles that aim to empower regulators to better manage evolving risks and take advantage of emerging opportunities.	*NESTA (2019)*
Standardization of Drone Regulation & Airspace	In an age of fast-paced technological changes and uncertainties, NESTA invites regulators to consider a set of "anticipatory regulation" principles that aim to empower regulators to better manage evolving risks and take advantage of emerging opportunities.	*Singularity Hub*

Title	Description	Source
Decline in Engineering Licensure in Graduates	Engineers Canada's annual "National Membership Information" 2020 report data indicated that: "Based on the number of newly licensed CEAB graduates in 2019, we estimate 42 per cent of Cohort A (2015) proceeded along the path to licensure." This means that less than 50% of the people who have acquired the required foundational engineering education are actively seeking their professional engineering license.	*Engineers Canada (2020)*
Anti-Government Sentiment	Canada loses top 10 spot on Global Peace Index due to 'anti-government sentiment' Canada's deterioration was attributed to significant increases in 'political terror' and 'violent demonstrations' indicators, with the former doubling in a year. "The pandemic pushed many countries towards economic and political crises, while also heightening levels of anti-government sentiment and distrust of authority," the report stated.	*National Post (2022)*
Cross-Border Research, Conflict & Collaboration	In a world in which humans are a major geologic force, political boundaries and decisions can impact the function of the Earth system. For example, hydroelectric projects like the Grand Ethiopian Renaissance Dam may benefit one country, while disrupting water and sediment supplies downstream. Similarly, the outsourcing of manufacturing expands CO2 emissions, pollution, environmental degradation elsewhere.	*Nature.com (2022)*
Disconnect Between Canada's Building Code & Climate Targets	Energy used in buildings accounts for roughly 15% of Canada's greenhouse gas emissions and a quarter of total energy consumption. To curtail this pollution, the Pan-Canadian Framework on Clean Growth and Climate Change (PCF) calls for all new buildings in Canada to be Net-Zero Energy Ready (NZEr) by 2030	*Efficiency Canada (2020)*
Pathways for Assessing Refugee Credentials	Many individuals who leave their countries of origin do not have access to the educational and professional records and proof of qualifications. WES created a policy that offers an alternative assessment for refugees who lack verifiable documentation.	*World Education News + Reviews (2016)*
Sustainable Development for a Thriving Arctic & Northern Region	The Arctic and Northern Policy Framework demonstrates a vision of a strong, self-reliant people and communities working together for a vibrant, prosperous and sustainable Arctic and northern region at home and abroad, while expressing Canada's enduring Arctic sovereignty.	*CIRNAC (2022)*
Protecting Land & Water through Legal "Personhood" Status	The Innu Council of Ekuanitshit and the Minganie Regional County Municipality declared the Muteshekau Shipu (Magpie River) a legal person, which may provide greater certainty for this river's future. Granting legal personhood to natural entities is part of a global movement to recognize the rights of nature in law. Indigenous communities worldwide are leading the way in upholding the rights of rivers, forests and mountains.	*The Conversation (2021)*
Asymmetry in Software Engineering Regulation	Eng. regulators have long been challenged in their regulation of software engineering. When it emerged, there was debate as to whether or not this was engineering work and the length of this debate led to no regulation of an emerging field. By the time the regulators decided they did want to regulate, it was almost "too late" – unlicensed practice was established and has proliferated ever since.	*EC Foresight Event Design Team (2022)*

7.4.6 Signals Bank – *Values*

Value signals include attitudes to working like (e.g., entrepreneurialism, career aspirations, deference to authority), demands for mobility, preferences for leisure culture and social relations.

Title	Description	Source
Desire for More Inclusive Atmosphere	Respondents to the Envisioning exercise indicated the need for an authentically inclusive atmosphere that truly promotes and retains diversity of identity and thought, including diversity of gender, POC, Indigeneity, and LGBTQ+.	*Envisioning Exercise (2022)*
Technological Stewardship	The principles of Technological Stewardship invite engineers to Seek purpose, Take responsibility, Expand involvement, Widen approaches, Advance understanding, Realize diversity and Deliberate values, in order to ensure that applied technology actually benefits humans.	*CEEA Engineer of 2050 Report (2022)*
Lifelong Learning to Upskill Workers	Beyond the bulk of learning happening during and immediately after university - lifelong learning will become increasingly important to identify and address one's educational needs in order to maintain competence and advance knowledge.	*CEEA Engineer of 2050 Report (2022)*
Building Diversity through an Anti-Racist Culture (Not Quotas)	Postsecondary institutions that are hoping to build diversity in their leadership need to focus on developing an anti-racist culture rather than quotas. Focusing on quotas can lead to disappointment and disillusionment in a competitive hiring environment, and instead recommends using methods such as a triage approach that prioritizes equity audits and taking the time to identify the areas that most lack diversity.	*Chronicle of Higher Ed (2022)*
Declining Volunteerism in the Field	Declining spirit of volunteerism and capacity to volunteer is leading to a dearth of mentorship opportunities and is also threatening the volunteer process by which the field is regulated.	*Stat Can (2013) and Charity Village (2021)*
Advancing Gender Diversity	For many women engineering students, their first encounter with collaboration is to be treated in gender stereotypical ways, creating an unwelcoming environment that leads to a lack of belonging, and eventually, to a lack of retention.	*HBR (2016)*
The Power of Reverse Mentoring	"Reverse mentoring engages [junior employees] in the mentoring process, equips them with leadership skills, and gives visibility and opportunities for further professional development," she said. "The younger generation may not be as experienced as their older counterparts, but they are able to bring fresh new insight to problems or concepts, which more-senior leaders may not have thought of before."	*Society for Human Resource Management (2022)*
Increased Emphasis on Accessibility	Growing use of the acronym 'IDEA' (Inclusion, Diversity, Equity, and Accessibility) in place of DEI. This changing terminology is a signal of the industry developing a greater understanding of the language it should employ and the related, but distinct, issues that require focus.	*Circa (2021)*

Title	Description	Source
Neurodivergence in the Workplace	Employers large and small are beginning to face a major demographic shift: the sharp increase in the neurodiverse workforce, made up of workers with autism, ADHD, dyslexia, Tourette's syndrome, and other learning and mental health differences.	*HBR (2022)*
Alternatives to Gross Domestic Product	Economists increasingly believe it is important to do more to measure the economic well-being of the families who make up the economy and to deemphasize Gross Domestic Product growth, the one-number-fits-all measure of economic progress that currently dominates popular discourse.	World Economic Forum (2020)
Backlash on Eco-Colonialism	Backlash that's starting to happen against the environmental movements that were once seen as champions of Indigenous rights. When there is foreign interference, especially from high-profile celebrities, it violates the rights of First Nations to economic independence and prosperity	The Globe and Mail (2022)
Communicating Across Disciplines & Worldviews	Engineers will need to understand people with other mindsets and priorities, such as entrepreneurs / businesspeople, environmentalists, sociologists, activists and communities.	Envisioning Exercise (2022)
Businesses Driving Disability Inclusion	500 CEOs and their companies have joined by making a commitment to action for disability inclusion. They are now beginning to work together as a collective, to drive system change. The Valuable 500's mission is to use the power of business to drive lasting change for the 1.3 billion people around the world, living with a disability.	Valuable 500 (2022)

7.5 Scenarios

How to read these scenarios

Scenarios are plausible, provocative alternative views of the future. They are meant to magnify change happening today and challenge our assumptions about tomorrow. Because no one can predict the future, we can say with certainty that it will be different than our expectations.

Scenarios then help us look beyond our assumptions and consider what we might have missed when we think about the future. They invite us to look beyond the immediate context of engineering accreditation and consider how broader changes in the external environment around us might impact stakeholders across the field of engineering.

Keep an open heart, open mind, and open will. These scenarios are intended to expand our perception of how change might happen over time. They are not predictions or articulations of preferred future scenarios.

Be aware of instances in a scenario where you disagree with the content, or when strong feelings come up – those ideas are challenging your current assumptions. In some places they may confirm ideas you have about the future, while in others they may contradict what you expect to happen.

Place less emphasis on when something may occur. Some of the developments in the scenarios may happen faster or slower than described, while others may already be occurring, but in isolated and subscale examples or applications.

Strive to hold competing visions of the future in your thoughts at the same time. One lesson of scenario planning is that having multiple views of the future can prevent us from being caught off guard by our assumptions, help us recognize change faster and be prepared to act sooner.

7.5.1 Scenario: *Adaptation, Reputation*

ADAPTATION, REPUTATION
"All current trends continue"

HEADLINE

"Lockdown Lifted in Vancouver/Richmond/Delta for Wildfire Evacuation; Power Grid Threatened"

YOUR BREAKFAST

Urban-farmed vertical microgreen and seaweed salad with lab-engineered salmon protein, on a croissant. Coffee's gone extinct due to climate change and pests, but you've grown to like mushroom tea with adaptogens.

In a world with many centers of political and social power, Canada's population now stands at 50 million, of which 25 million are either immigrants or children of immigrants. Sustained efforts to work towards becoming a more multicultural and reconciled nation have paid off, with Canada ranked as the most preferred destination in the world for many skilled immigrants. Across Canada's burgeoning cities, creating a sense of belonging, value, and coherence from diverse parts has become a part of doing business, and the field of engineering is no exception. As a group, engineers are far more diverse, racially, culturally, and gender-wise, than they were two decades ago, and formerly marginalized groups report feeling a greater sense of belonging and inclusion. Among these are the growing number of Indigenous engineers, whose combined academic training and Indigenous cultural background are bringing new approaches to the profession. Value shifts towards DEI and sustainability have also eased the workplace power transition from Boomers and Gen X, to Millennials and Gen Z.

In many ways, the profession of engineering has thrived. The proliferation of technology means that engineering is a part of almost everything people make and touch. Engineers have also played a central role in climate adaptation for many projects, including the city of Calgary's Re-Engineering Water initiative, which allowed its population to keep growing despite the 60% shrinkage of the glacier that kept its water supply steady. Engineers have helped communities adapt to hard-to-predict shifts in resource availability and climate conditions and mitigate the further public health crises that followed COVID-19, these days referred to as Pandemic 1.

In the lull between Pandemic 1 and the hypermeasles pandemic (P2) that followed it in 2032, foundational Canadian engineering education recentered itself around ethics, sustainability, and systems thinking. This choice has paid off, as Canada has kept pace with international engineering standards, and Canadian engineers have remained competitive in a much more global and often remote talent marketplace. In a world used to intermittent lockdowns, remote work and remotely operated equipment and vehicles have become integrated into many engineering practices.

Even as engineering has grown, regulation has taken a different path. Strident provincial government disagreement in the early 2020s about whether or not software and other types of engineering should be regulated led to divergence in the definition of the field, as well as power struggles between regulators and industry voices. The provincial system of regulation became less relevant, with far fewer Gen Z engineering graduates pursuing a P.Eng./Ing., fewer volunteers, and more friction between regulators and other parts of the engineering system. Regulation survives, but most "engineering" in the broader sense takes place outside its purview. This is also true of most foundational engineering education, which has evolved to skirt the accreditation process and offer a smorgasbord of skills-based certificates centered around a small core skill set.

Hiring is highly reputational and skills-based. In addition to Indigenous communities' alternate system of licensure, a private online user review system has sprung up, much like Google Reviews, with larger companies' accountability coming through an insurance model based on number of quality-related lawsuits and best-practice guidance issued by industry organizations. Issues with data ownership, quality control, and accountability linger for individuals and small firms.

Decentralized, Challenging, Competitive, Inclusive, Freeform

7.5.2 Scenario: *Company Towns*

COMPANY TOWNS
"Working within existing constraints"

HEADLINE

“Third Lunar Residential Colony Breaks Ground”

YOUR BREAKFAST

Breadfruit-flour pancakes with Microbiomics™ whipped cream and farmed cricket protein powder. New varietals combined with predictive weather modeling and other agricultural adaptations mean that coffee still exists.

Change and adaptation have been the bywords of the last two decades. An atmosphere of volatility has reigned, as regional wars continue to ignite, and climate change continues to accelerate despite the United States’s re-entry into the Paris Agreement. Technology, powered by a quantum computing revolution that has led to significant advances in climate modeling and agriculture, has also surged ahead, keeping food yields steadier than expected and contributing to climate resilience.

Engineers are in high demand and have become an important part of climate adaptation, with nuclear power as a significant part the solution matrix. The profession, however, has lost the right to self-regulate. Citing disagreements and slowdowns, and the urgency for more engineers to address climate adaptation, the National Engineering Act of 2028 created a government-appointed national board of regulators to replace the provincial system, a move that has made licensure more portable and engineering more nimble.

Taking advantage of the growing popularity of modular educational certificates and other flexible learning programs, alternative engineering education and licensure pathways have sprung up as part of an international engineering certification movement. Engineers certified in this way can form international remote-work teams that take on large, career-making projects and can be more resilient to localized economic or political crises.

In response, in 2030 the National Board of Regulators announced a revamp of the P.Eng./Ing. certification process into P.Eng./Ing. Levels, from 1 – 6. Working with provincial educational systems, the board made it possible to earn a P.Eng./Ing. Level 1 by the end of high school in most provinces, with engineering skills education now an option to begin in middle school. Taking advantage of relatively stronger currencies, large American and European corporations have begun recruiting Canadian students out of high school into their own credentialing programs, with training offered in exchange for a number of subsequent work years.

Many younger employees working off their edu-debt now live in “company towns." Attempting to stanch what has become a significant brain drain, in 2031 the National Board of Regulators made licensure easier to obtain, raising questions about quality control. In recent years, there has been a small but notable increase in engineering failures that some worry will become larger as “legacy” P.Eng./Ing. Holders retire. For large-scale engineering , such as the colonies on the moon and the new semi-autonomous mining colony on Mars, the companies running those operations require their engineers to have obtained their own company’s certification.

The profession has also become in general more welcoming to gender, racial, and other types of diversity, but the strong momentum towards DEI and Truth and Reconciliation in the early 2020s led to models of equity that often feel more “required” than felt; underlying tensions have not been resolved, and Indigenous representation in engineering continues to be thin.

Familiar, Unstable, Top-Down, Vigilant, Piecemeal

7.5.3 Scenario: *Waning and Seeding*

WANING AND SEEDING
"The system no longer functions"

HEADLINE

“Who Owns the Arctic? Military Standoff with Inuit Groups Over the Far North”

YOUR BREAKFAST

Hard-to-obtain Military Field Rations contain real meat, an increasingly rare commodity, as well as freeze-dried coffee and banana-flavored oatmeal. These last for five years and are portable wherever you need to go.

In the 2020s, private wealth continued to concentrate, fueling a backlash against government power and egalitarian social movements, which in turn led to the federal and provincial election of a series of political leaders from the newly resurgent Libertarian Party, starting in the mid-2020s. Since then, governments have lasted an average of 26 months, with extreme political swings. Each new government spends much of its time “undoing the damage" of its predecessor.

The demand for engineering skills has never been greater. Accelerating climate change has led to more unpredictable environmental conditions across Canada, and a Canadian military step-up has unfolded, caused in part by increasing pressure exerted on the US-Canada border by climate and political refugees from elsewhere in the Americas. Problems are multiplying, are more complex, and change more quickly than ever before. Canada continues to prioritize building infrastructure connecting Arctic regions to the populous south. Engineers have an enormous part to play.

It’s too bad that the profession of engineering has not been able to recover from the repeal of regulation in 2027. In the mid-2020s, a multi-regulator effort to step up engineering regulation, enforced licensure, mandatory quality assurance programs and stricter accreditation processes led to slowdown, frustration, and increasingly, industry sidestepping and workarounds. Engineering clients as well as newly “regulated” engineering fields such as software engineering began to lobby against what they called “regulation paralysis.”

In 2027, with the Libertarian party voted into power, one of the first acts of the new legislature was to repeal the acts that govern many professions, including engineering, as part of a plan for economic growth and recovery from the Depression of 2024-2026. In the years that have followed, in part because of decreased trust in institutions, many small systems of quality control have sprung up, but there is no longer a centralized mechanism or legal infrastructure.

Following the partial defunding of Canada's higher education system that occurred during the Depression, the only traditionally accredited engineering education left in Canada occurs at its military academies, which have created a pipeline of military-ready engineers. The professional core of "Golden Age" engineering in Canada has hewed closely to the military, contributing to large-scale geoengineering projects. Some have not worked as planned, but some, like the US-led, Canada-supported "space bubble" project at the Lagrange point between earth and the sun, are promising.

In Europe and parts of Asia and Africa, the engineering profession has undergone a renaissance. Visionary, compassionate, and creative engineering solutions have been at the heart of many successful climate mitigation and society-strengthening projects. Many aspiring Canadian engineers have emigrated.

As the climate shifts and politics in the Canadian south remain volatile, many in Canada are dispersing northward, where small settlements led by and with existing Inuit and First Nations populations have begun to seed new models of Canadian society.

5
WORDS

Insular, Fractured, Challenging, Unpredictable, Urgent