How professional engineers can contribute to attraction and retention of minority groups into the engineering profession through equity, diversity, inclusion, and decolonization efforts

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Abstract

Diversity leads to innovation, better project delivery efficiency, and improved quality management in terms of technical engineering work. Current statistics show that there is still underrepresentation of minority groups such as females in the Science, Technology, Engineering, and Mathematics (STEM) fields, implying that diversity amongst engineering companies and within the profession is still low. In order to support diversity within the engineering workforce, inclusivity and equitable practises are key to encourage attraction and retention, along with understanding decolonization. Professional engineers have an ethical obligation to contribute both through personal and professional development of skills that will build inclusive organizational cultures and to influence equitable policies and practises.

KEYWORDS

engineering, equity, diversity, inclusion, decolonization, organizational culture, professional development, STEM

1 | INTRODUCTION

At the core of a professional engineer are two things—a skill set that allows a person to be an expert in their technical and academic fields as well as an ethical compass for moral, fair, and rational decision making. The ethical compass is guided by the Code of Ethics that a professional engineer abides by in order to hold their licence.[1] In the province of Alberta, the Association of Professional Engineers and Geoscientists of Alberta (APEGA) has five Codes of Conduct[2];

1. Professional engineers and geoscientists shall, in their areas of practise, hold paramount the health, safety, and welfare of the public and have regard for the environment.
2. Professional engineers and geoscientists shall undertake only work that they are competent to perform by virtue of their training and experience.
3. Professional engineers and geoscientists shall conduct themselves with integrity, honesty, fairness, and objectivity in their professional activities.
4. Professional engineers and geoscientists shall comply with applicable statutes, regulations, and bylaws in their professional practises.
5. Professional engineers and geoscientists shall uphold and enhance the honour, dignity, and reputation of
their professions and thus the ability of the professions to serve the public interest.

In order to be successful at all of these Codes of Conduct, a professional engineer needs to be able to work with other people—whether that is in project teams who are doing the work, the client who will utilize the work, stakeholders that will be affected by the work, the authority figures and leadership who are accountable and responsible for the work, the business units that contribute to the administration of the work, or even the public who want to understand the work.

Often a professional engineer acts not only as the technical expert for the professional application of the maths and sciences, but also as the project manager. Project management is a multifaceted job where there is balance between schedule, budget, and quality, managing expectations of multiple stakeholders, mitigating risks and troubleshooting unexpected events, and leading the project team. In order to be a successful project manager and leader, there are many skills, besides the technical ones, that are of benefit, such as, emotional intelligence, multitasking and organization, communication skills, managing expectations, the ability to hold difficult conversations, risk management, and financial literacy. Of these, relationship focus and communication are essential skills needed for a successful project manager and professional engineer.

When it comes to communication, success is when the message you send to another person is received and understood as originally intended. The difficulty is that there are many ways of communicating, such as by written word, by phone, through lecture style, through body language, by texting, or over social media. Since there are so many methods, it is no wonder that misunderstandings, misinterpretations, and confusion can arise.

Another cause of misunderstanding is that the person who is receiving the information, also needs to interpret and remember what it is they are receiving, and they do this in the context of their own experiences. A person is a function of their genetics, experiences, their values and beliefs, how they were raised, their environment, their community, and the people they surround themselves with. For someone who is raised in a different country, culture, or context, their idea of normal will be much different than yours. So, when conveying an idea, often the sender of information assumes that the person receiving the idea shares the same foundational knowledge, and this assumption may not be true.

It is well known that having a diverse work force is of benefit to any organization, team, and society for reasons which include the following:

- Diverse organizations are more successful at recruiting and retaining talent.
- An inclusive workplace maximizes talent and productivity.
- Diverse teams are critical for innovation.
- Diversity reduces groupthink and enhances decision-making.
- Inclusion is key to team performance.
- Inclusion boosts company reputation.
- Mixed-gender boards have fewer instances of fraud.
- Boardroom diversity strengthens environmental, social, and governance (ESG) performance.
- Diversity is associated with improved financial performance.
- Inclusion can help organizations thrive during economic recessions.

It is known that to attract and retain a diverse work force, having an inclusive work environment is key. Inclusivity is something that should be applied at an individual level through attitudes, behaviours, and actions.

Similarly, equity is the quality of being fair and impartial. This means that frameworks and policies within the workplace should be fairly and impartially established. Tools like Gender Based Analysis Plus (GBA+) can help a person look through the equity, diversity, inclusion, and decolonization (EDID) lens when evaluating current and incoming policies, programs, and initiatives, along with engineering projects during the concept phase. Applying a tool like GBA+ also ensures that risks associated with people are mitigated properly and that your organization is not open to human rights complaints, unprofessional conduct complaints, professional practise audits, or even liability complaints.

2  WHAT DOES THIS MEAN FOR ENGINEERING?

When it comes to diversity of workforce for the engineering professions, a lot of research has been done for under-represented groups, but especially for females. The world population in 2019 was 7.674 billion, with 49.584% being the female gender. In Canada, in 2019, the population was 37.589 million, with more than half of that being the female gender (50.3%). As of 31 December 2018, it was reported that 18.1% of people within the engineering professions across Canada were female. When it came to Alberta statistics, the provincial average was higher, at 20.3% females within the engineering profession. There have been theories that women and men differ in attitude towards maths, but studies have been done that show that boys and girls engage in the same neural...
system during mathematics development.[27] Knowing this, there must be other factors as to why more females do not enter the STEM fields.

Because of this low representation, there has been concentration on the attraction and retention of females into the engineering profession. Studies have tracked gender and retention rate within student careers, with a 2010 cohort indicating that women had a lower retention rate than males throughout their engineering academic career.[28] As such, this indicates that there may be multiple points throughout a female’s pre-career life that reinforce the idea that engineering is not an attractive career path, which leads to the leaky pipeline theory.[29]

A theorized contributing factor to the attraction of females into the engineering profession is around the perception of engineering. Engineering is hard to define exactly, especially when the legal definition varies from province to province within Canada. For Alberta, the legal definition is provided within the Engineering and Geoscience Professions Act[30] and states that the practise of engineering means:

i. reporting on, advising on, evaluating, designing, preparing plans and specifications for or directing the construction, technical inspection, maintenance or operation of any structure, work or process
   a. that is aimed at the discovery, development or utilization of matter, materials or energy in any other way designed for the use and convenience of humans, and
   b. that requires in that reporting, advising, evaluating, designing, preparation or direction the professional application of the principles of mathematics, chemistry, physics or any related applied subject, or
ii. teaching engineering at a university.

From a high school student’s perspective, the broad definitions of engineering make it hard to explain, and leads to beliefs that engineering can be a task, job, profession, or mindset. If it is hard to explain, it is hard to attract prospective students.

There are also stereotypes and impressions of what an engineer does; for example, there is a perception that engineers work alone and have to figure things out on their own, but in reality teamwork and working with others is an essential skill and a daily requirement for engineers.[31] There is also a stereotype that engineers are not good communicators, but research indicates that engineering students know that ‘some level of communication in defining a professional engineer’[32] is needed, but the difficulty is that engineering institutions do not directly teach communication skills and rather expect these skills to indirectly develop.

To help with the perception of engineering and to increase the attraction of diverse groups into the engineering profession, there have been intentional marketing and outreach campaigns to help create a better understanding of engineering: that it is geared towards positive impact to people,[33] that it is not only uses logic, but also creativity,[34] and that it is an inclusive profession.

When it comes to female attraction and retention, a contributing factor is that of gender stereotypes and expectations regarding women’s work[35] within an organization. Negative stereotypes and unfair expectations lead to unfair behaviours, policies, and actions towards women in the STEM workplaces. The following 10 examples[36] are just a sample of important issues facing women who are trying to progress in business and contribute to retention:

- Flexible work arrangements[37]: Working flexibly particularly benefits caregivers to children and the elderly and often women take on the majority of these care roles.
- Equal pay: On average, women still make less than men, particularly as they advance in their careers.
- Race and gender bias: Women of colour continue to deal with some of the workplace’s most entrenched hurdles.
- Access to hot jobs: Leaders may not always consider women for certain project roles and extra work has to be done in order to be considered.
- Role models: Being able to see yourself in a certain position is aided when you see some one like you in a similar role, but often there is not enough powerful examples of women role models.
- Sponsorship: When it comes to succession planning and business planning, having someone speak up on behalf of women is important—there needs to be leader sponsorship of women to advocate on their behalf.
- Sexual harassment: Women at all levels of employment and all levels of workplace may have experienced or witnessed harassment.
- Non-inclusive workplaces: A person knows when they are being excluded or talked about—many women report feeling dismissed or ignored.
- Double-bind: A woman’s ability to lead is often undermined by gender stereotypes.
- LGBT protection: Many LGBT women feel like outsiders in the workplace—this is an example of the effects of intersectionality.
All of these contribute to the multifaceted issue of retention of females in the engineering profession. Although many of these issues have an underlying root cause of policy, several are related to relationships and communication, especially the non-inclusive workplaces where women feel dismissed or ignored.\[^{38}\]

### 3 | RECOMMENDATIONS ON HOW PROFESSIONAL ENGINEERS CAN CONTRIBUTE TO EDID

So how can professional engineers contribute as individuals, leaders, and within their organizations to improve the diversity amongst the engineering workforce? It is important to acknowledge that this is both an internal personal development journey, as well as an external journey as a professional.

#### 3.1 | Starting an internal development journey

As an individual, the key contributing factor is having an attitude and belief in continual learning. A person must strive to improve and adjust as they learn more about themselves throughout their life journey, as such self-awareness is crucial to identifying where growth can happen in both personal and professional development. It is only through self-awareness that a person can reflect on their own bias and stereotypes, and be honest with themselves about past actions, behaviours, and thoughts that did not truly support EDID. One tool to help with self-awareness is that of the Johari Window,\[^{39}\] which is built upon having the courage to be very introspective, ask for honest feedback, truly listen and consider advice, and then use this information about yourself to drive personal development and growth.

Emotional intelligence is required to support diversity and inclusion.\[^{40}\] Emotional intelligence allows a person to be able to articulate the emotions they are feeling, either within the moment or shortly after. Emotional intelligence can also lead to being able to realize within the moment when intense emotion is happening and, with practise, be able to calm or control the reaction and later understand the cause of it. This skillset is incredibly helpful when intense negative emotions such as anger, shame, blame, guilt, fear, or sadness are present, as it allows for a more constructive, open-minded approach to conflict. It also eases difficult conversation, such as giving and receiving feedback. We need to understand our own and other people’s reactions, behaviours, and actions in order to create safe places where emotion can be safely expressed and processed in a healthy manner.

In order to drive personal development, self-motivation is required. If you are highly self aware and have a high emotional intelligence, without self-motivation to continually be introspective and develop, you will remain as you are. Personal development is only pursued on someone’s own time if they are motivated to read, practise, learn, and talk with others about what they are trying to understand and develop.

As a professional engineer, the introspective journey can be thought of as doing a root cause analysis on oneself, always seeking data and information and trying different actions and behaviours that can positively contribute to inclusive environments and equitable approaches. Gather data and information by looking for signs of inequity, unconscious bias in decision making, stereotypes, and even discrimination. Gather qualitative data through listening to stories from minority groups within your engineering network to confirm to yourself that there are barriers and injustices for minority groups.

If you choose a personal development journey that intends to help shift the dial for EDID, then another easy step is to surround yourself with EDID information: follow EDID social media feeds and sources, listen to related podcasts, and read EDID books and journal articles.

#### 3.2 | Shifting from personal to professional development to support EDID

When you are comfortable with your own personal development contribution to EDID, it is time to start engaging within the workplace. Perhaps your organization supports your professional development of the same skill sets you want to work on personally, such as emotional intelligence, self awareness, or unconscious bias training. Check with your Human Resources department for what resources and supports exist that contribute to EDID skill development, because learning together with colleagues is also a great way to start shifting the culture.

Professional engineers, as stated earlier, have a professional and legal obligation to “con duct themselves with integrity, honesty, fairness and objectivity in their professional activities”.\[^{30}\] Within this statement lies the idea of creating an inclusive workplace and equitable frameworks and policies in order to help make diversity successful. Fairness and integrity are at the root of inclusivity. Within the workplace, a professional engineer is also legally bound to “uphold and enhance the honour, dignity and reputation of their professions”.\[^{30}\] This
means role modelling inclusive behaviour and putting a stop to unacceptable behaviour and offensive humour when it occurs. If someone does not think something is funny, then that humour needs to stop, even if the organizational culture is to accept it. Often the target of humorous statements will not engage, and it takes the courage of those witnessing it to speak up.

If you are within a minority group, it is important you learn how to articulate what you are thinking and feeling. If dealing with a person or cohort of people that are not familiar with emotional intelligence and are not in the habit of reading body language, then they will not necessarily realize that their words, actions, and behaviours are not acceptable or not received well or as intended. A person needs to be able to articulate when something unacceptable has happened. It is also important, if you are able, to document the situation. It is well known that a person’s memory of a situation shifts with time[41] which is why it is important for investigations that multiple people document the situation shortly after an incident occurs. The same is true for unethical and unprofessional conduct, as these things are very hard to prove later on, especially in a non-inclusive culture.

In order to create an inclusive environment, where diverse teams drive innovation, professional engineers need to be open minded and humble enough to hear differing opinions. These opinions should have the intent of improving the process, not the tone of absolute direction, belittlement, or dismissiveness. Instead, a tone of curiosity and compassion is better received. Diversity is beautiful and thrives when functioning well. Inclusivity comes from a place of being self aware of what your normal is and constantly considering your assumptions when it comes to communicating with people of diverse backgrounds.

Building upon the earlier personal development goal of emotional intelligence and creating safe places in the workplace, the idea of introducing the ability to express and discuss feelings appropriately is important to discuss. Feelings may not be welcome within an engineering organization or culture, whether verbally expressed, physically shown, or even intensely felt. But the fact is, because there are humans involved in the workplace, feelings exist there. Feelings are a conscious subjective experience of emotions[42] and every gender experiences feelings. We need to learn how to co-exist, articulate thoughts and feelings, develop emotional intelligence, and creating safe places for open, honest, and neutral conversations; this is an vital part of personal and professional development and is crucial to shifting organizational culture within engineering companies.

### 3.3 Starting to effect organization culture change towards inclusivity and equitable practise

Organizational culture ‘consists of shared beliefs and values established by leaders and then communicated and reinforced through various methods, ultimately shaping employee perceptions, behaviours and understanding.’[43] An individual contributes to workplace culture in their own behaviours and through influencing the behaviour of others. It needs to start with calm and neutral conversations around EDID—and this is easiest with likeminded people, such as through employee resource groups (ERGs). Your workplace may have, for example, Professional Women Support Networks, Male Allyship Groups, EDID interest groups, and/or Professional Parent Support groups. Learning and sharing thoughts and ideas around EDID together is how culture begins to shift.

Another easy way to influence organizational culture shift is to model inclusive behaviour, which is especially important if you hold a leadership role or position of authority. Below is a list of ways to model inclusive behaviour[44]:

- Include and seek input from people across a wide variety of backgrounds.
- Listen carefully to the person speaking until they feel understood.
- Make a habit of asking questions.
- If you have a strong reaction to someone, ask yourself why.
- Address misunderstandings and resolve disagreements.
- Act to reduce stressful situations.
- Understand each person’s contribution.
- Examine your assumptions.
- Ensure all voices are heard.
- Be brave.

For your colleagues, create safe places for people to share their stories, hardships, and successes. As mentioned above, minority groups often feel that they aren’t heard or taken seriously. A true ally will create those safe places where open and honest conversations can happen without fear of repercussion or judgement.[45] If you are able to create safe places, the next step is then believing the stories that are being told to you—do not invalidate what you are hearing or ask questions that imply that the other person did not perceive what happened to them correctly. One of the best things you can do within the safe places you create is to learn how and when to appropriately express opinions. Sometimes the best intentions do the
worst harm. Be thoughtful in your language use and how you engage.

If you wish to be more active, consider becoming an EDID champion, ally, or sponsor. To play these roles, you must be comfortable speaking neutrally within the moment, when there is active stereotyping, bias, discrimination, or even racism occurring. This is something that can be practised with other likeminded people—create mock situations so you can craft and practise what you would say in the moment to highlight, confront, and diffuse a situation. In the actual situation, if you are able to, engage with the person who was the target afterwards to create a safe place for that person to express their feelings and work through the situation.

An ally can also contribute by creating awareness—sharing learned information perhaps as a keynote speaker, as a workshop facilitator, through career talks, or simply by actively engaging with your network on EDID topics. It is vital, as you become more and more active in the EDID realm, that you are incredibly conscious of terminology and consider interpretation of how you are sending your ideas and messaging, as well as to stay up to date on EDID research.

Within an organization, create, build, and support internal employee resource groups to again create those safe places of likeminded people where people can go for empathy, guidance, mentorship, shared learnings, and at times healthy emotional release. Often ERGs invite guest speakers, hold workshops, host sharing or practise circles, and celebrate and recognize each other. ERGs have also done volunteer work together and often identify internal champions, allies, sponsors, or advocates.

In terms of your technical practise, a professional engineer is often the project manager as well. When project scoping, use GBA+ in all stages, from concept design, to assessing risk, to establishing frameworks, and throughout project delivery. As a project leader, team selection and fit, people management, and people development are tasks associated with this role. As such, GBA+ can also be applied to hiring practises and performance management as a quality check that unconscious bias is not inadvertently introduced. Part of an organizational leader’s duties can often be to contribute to policy development and to directly influence organizational change. These are all opportunities to be an EDID champion and be the voice for those who are not at the table, as well as to help gain leadership buy-in if it does not already exist. As a leader, you can also advocate for dedicated resources for EDID work, such as full-time staff members, dedicated dollars for team development and training, and use of outside consultants to help audit and build inclusive and equitable frameworks.

Finally, as a project leader, one of the biggest ways to influence EDID is through role modelling. Set the tone and example within meetings and at public events. Be in tune and aware of your team—are there personalities that clash? Is there unconscious bias? Are there emotions not being healthily expressed? Is there unintentional damage being done within the current culture? Ensure that these discussions are happening and that there are consequences to offensive behaviour, zero tolerance for racism and discrimination, and that feedback is provided if unconscious bias is spotted. Your words matter as a leader and as someone in a position of authority, so be thoughtful.

3.4 Starting a truth and reconciliation journey to understand decolonization

Decolonization, indigenization, and indigeneity are all terms used as part of truth and reconciliation efforts and are adjacent to equity, diversity, and inclusion work. To move to a space of inclusion, understanding the journey of Indigenous Peoples within Canada is crucial. This means understanding the inequity and injustices towards Indigenous Peoples and the resulting complex barriers, attitudes, behaviours, and negative experiences. Since it is very complicated, it is recommended to start with becoming informed. This can be done in a variety of ways, from reading history and truth and reconciliation books and articles, to listening to podcasts, to taking the University of Alberta’s Massive Open Online Course (MOOC) called Indigenous Canada, to taking part in a KAIROS blanket exercise.

4 CONCLUSIONS

Diversity leads to innovation, better project delivery efficiency, and improved quality management in terms of technical engineering work. Current statistics show that there is still underrepresentation of minority groups such as females in the STEM fields, showing that diversity amongst engineering companies and within the profession is still low. In order to support diversity within the engineering workforce, inclusivity and equitable practises along with understanding decolonization are key to encourage attraction and retention. Organizations must spend the time to determine how to improve their culture and to be places of high emotional intelligence with a philosophy of continual learning and improvement and effective communication and leadership. Efforts must be taken not only by
leaders and people within authority positions, but also at the individual level. Professional engineers have a legal obligation to conduct themselves with integrity—this means being active in building inclusive and equitable workplaces and organizational cultures.

PEER REVIEW
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