engineerscanada
ingénieurscanada

Indigenous Inclusion in Engineering

Executive summary

In 2019, as part of Engineers Canada's work on equity, diversity, and inclusion, Engineers Canada approved the Operational Imperative 9 sub-strategy on Indigenous access to engineering. This sub-strategy includes a goal of collecting data on Indigenous engineering students and professionals in Canada. To meet this goal, Engineers Canada has worked with Big River Analytics to design and undertake a survey of the membership of three regulators—Engineers Geoscientists Manitoba, Engineers and Geoscientists BC, and the Association of Professional Engineers and Geoscientists of Saskatchewan (APEGS)—who volunteered to participate in this pilot research project. The survey was designed to explore the characteristics and experiences of Indigenous engineers across the three jurisdictions from their formative years, that is, their upbringing and early education, right through to their professional experiences.

This report and project has been guided by the advice of Engineers Canada's Indigenous Advisory Committee, and builds on a previous report analyzing secondary data: "Indigenous engineering in Canada: Analysis of secondary data to support Engineers Canada's Operational Imperative 9 sub-strategy: Indigenous access to engineering" (2020).

First, in order to understand the professional experiences of Indigenous engineers, we undertook a regression analysis to identify any systemic differences in the pay between Indigenous and non-Indigenous engineers. Controlling for a number of demographic factors, we find that the average salary of Indigenous engineer respondents is seven per cent lower than non-Indigenous respondents. This suggests the existence of a pay gap. When we include gender in the regression, we find that the pay gap between Indigenous and non-Indigenous engineers is greater for engineers who are not cisgender men. In addition to analyzing the pay gap, we compare the current distribution of Indigenous and non-Indigenous engineers in senior or managerial roles. We find that non-Indigenous engineers are more frequently represented in positions of higher responsibility. When asked more specifically about challenges faced, Indigenous engineers identified low Indigenous representation in the workforce, especially for Indigenous women, as a challenge they face in their professional lives.

Turning our attention to the post-secondary experiences of Indigenous engineers, we find that the most commonly identified challenges facing Indigenous engineer respondents during post-secondary studies were financial challenges (75 per cent) and loneliness/isolation (70 per cent). The most commonly identified supports that Indigenous engineer respondents said would have been helpful in post-secondary are monetary support, followed by tutoring and academic support. Notably, every Indigenous engineer who participated in an Indigenous engineering access program when they were a student raved about the program's quality—for many, this program had a profound and positive impact on their journey to becoming an engineer. Finally, we observe from the survey responses that 95 per cent of Indigenous engineers surveyed have obtained a bachelor's degree as their highest educational credential level.

Lastly, winding back the clock to the years leading up to post-secondary, we understand that, collectively, Indigenous engineer survey respondents identify discrimination as the biggest challenge to pursuing math and science in high school (45 per cent). Subsequently, respondents note that science, technology, engineering, and math (STEM) outreach programs would have made it easier for them to pursue engineering. Indigenous engineers stressed that having a positive role model, such as a family member, mentor, or teacher that encouraged them to pursue engineering, was instrumental in their journey. Specifically, 29 per cent of Indigenous engineer respondents said that their main reason for pursuing engineering was because a teacher recommended that they should.

Based on these findings and on qualitative survey responses of Indigenous engineers, we provide considerations for how best to support increased Indigenous inclusion in the profession, improve supports, and reduce barriers to Indigenous engineers in their experiences in formative years and post-secondary education. These considerations can be categorized into the following focus areas:

1. Research, including supporting research investigation barriers to licensure, barriers to employment, and barriers in education.
2. Training, including efforts to facilitate cultural learning, anti-Indigenous racism training, and policy changes in the field and in academic spaces.
3. Networking, or more precisely, ensuring that mentorship and networking opportunities for Indigenous engineers are widely available and accessible.
4. Programming, for example, providing more financial support to Indigenous students, widely communicating about the effectiveness of bridge programs and Indigenous engineering access programs, and developing tutoring programs at the high school and post-secondary levels, among other programming avenues.

Acknowledgements

Engineers Canada would like to recognize the contributions of staff and partners who helped make this report possible. The project was led by Cassandra Polyzou, with guidance from Engineers Canada's

Indigenous Advisory Committee, significantly from Connor Scheu, P.Eng., Denise Pothier, P.Eng., and Randy Herrmann, P.Eng. The amazing team at Big River Analytics, led by Rebecca Wortzman, developed the methodology and the survey, and analyzed the data. The data could not have been collected without the partnership and collaboration of Marcie Cochrane, P.Eng. and Ailene Lim from Engineers and Geoscientists British Columbia, Elvia Torres-Morales, P.Eng., and Tina Maki P.Eng. from the Association of Professional Engineers and Geoscientists of Saskatchewan, and Lisa Stepnuk, P.Eng., and Nicole Everett from Engineers Geoscientists Manitoba.

The report was reviewed and developed with guidance from Yasemin Tanaçan-Blacklock, Shelley Ford, Jeanette Southwood, P.Eng., and Gerard McDonald, P.Eng. We would also like to thank Marie Claverie and Engineers Canada's translators for their work on the French translation of this report.

Terms and definitions

Association of Professional Engineers and Geoscientists of Saskatchewan (APEGS): APEGS is the licensing body that fulfils its regulatory mandate by ensuring high standards of engineering/geoscience practice in Saskatchewan, by setting high standards for admission into the professions, by disciplining engineers/geoscientists who fail to uphold the professions' practice and ethical standards, and by preventing the misuse of the title 'engineer' or 'geoscientist' by individuals who are not licensed members of APEGS.

Engineers and Geoscientists BC: Engineers and Geoscientists British Columbia (BC) is the business name of the Association of Professional Engineers and Geoscientists of the Province of British Columbia. Engineers and Geoscientists BC regulates and governs these professions under the authority of the *Professional Governance Act.*

Engineers Canada: Engineers Canada upholds the honour, integrity, and interests of the engineering profession by supporting consistent high standards in the regulation of engineering, encouraging the growth of the profession in Canada, and inspiring public confidence. For over 80 years, Engineers Canada has worked on behalf of the provincial and territorial associations that regulate engineering and license the country's more than 300,000 members of the engineering profession. Engineers Canada's vision is: Advancing Canadian engineering through national collaboration

Engineers Geoscientists Manitoba: Engineers Geoscientists Manitoba serves and protects the public interest by governing and advancing the practices of professional engineering and professional geoscience in accordance with *The Engineering and Geoscientific Professions Act of Manitoba.*

Formative years: Years up to and including high school, prior to post-secondary education for engineering.

Indigenous engineer (Indigenous professional engineer): A professional engineer who self-identifies as Indigenous. In this report, we use the term Indigenous as a collective noun that refers to First Nations, Métis, and Inuit who are the original inhabitants of the land today commonly called Canada. We included the option for survey respondents to identify as an Indigenous person from outside of Canada, but, for the purposes of this report, we count these respondents as non-Indigenous.

1.0 Introduction

1.1 Background

In 2019, as part of Engineers Canada's work on equity, diversity, and inclusion, Engineers Canada approved the Operational Imperative 9 sub-strategy on Indigenous access to engineering. This sub-strategy includes a goal of collecting data on Indigenous engineering students and professionals in Canada. To meet this goal, Engineers Canada has worked with Big River Analytics to design and undertake a survey of the member registrants of three regulators, Engineers Geoscientists Manitoba, Engineers and Geoscientists BC, and the Association of Professional Engineers and Geoscientists of Saskatchewan (APEGS), who volunteered to participate in this pilot research project. The survey was designed to explore the characteristics and experiences of Indigenous professional engineers (Indigenous engineers) from their formative years, that is, their upbringing and early education, right through to their professional experiences.

This report and project has been guided by the advice of Engineers Canada's Indigenous Advisory Committee, and builds on a previous report analyzing secondary data: "Indigenous engineering in Canada: Analysis of secondary data to support Engineers Canada Operational Imperative 9 sub-strategy: Indigenous access to engineering" (2020).

In Appendix A, we provide additional details on the methodology (A.1 – A.3) and a summary of the related research undertaken by Engineers Canada that contributed to identifying and planning for this project (A.4).

1.2 Project objectives

This pilot project sought to develop and test the feasibility of collecting data from Indigenous engineers across Canada to inform Engineers Canada's equity, diversity, and inclusion initiatives. To pilot this approach, three engineering regulators volunteered to participate in the project:

1. Engineers Geoscientists Manitoba
2. Engineers and Geoscientists BC
3. Association of Professional Engineers and Geoscientists of Saskatchewan (APEGS)

In addition to learning about the design, feasibility, and requirements of primary data collection, the project also sought to answer research questions by collecting data on the representation and experiences of Indigenous engineers. A number of wide-ranging research questions, identified in collaboration with Engineers Canada and the participating regulators, informed the design of the survey, and fall under three broad research objectives:

1. Explore professional outcomes of Indigenous engineers, and how these compare to non-Indigenous engineers.
2. Gather data on Indigenous respondents' journeys to becoming licensed, specifically identifying challenges and opportunities.
3. Identify ways Engineers Canada and provincial and territorial regulators could better support Indigenous engineers both in their educational journey, licensing practices, and in their work as engineers.

Ultimately, the project is intended to collect information to inform how to make the engineering profession more inclusive and representative of Indigenous peoples. Specifically, the experiences of Indigenous engineers throughout each stage of their professional journey can help inform where additional, more in-depth or focused research is needed or where specific policies or programs could be developed or improved.

1.3 Report overview

The report begins with an overview of data collected. The remainder of the findings are grouped by each stage of the respondents' professional journeys: (i) professional experiences, (ii) post-secondary experiences, and (iii) formative years. The report concludes with a discussion of considerations for Engineers Canada and regulators to support increased inclusion of Indigenous engineers moving forward.

2.0 Findings

2.1 Data profile

This section provides an overview of the data collected through enumeration of the *Indigenous Inclusion in Engineering Survey*. This survey included questions on professional experiences, post-secondary experiences, and formative years for Indigenous engineers registered with APEGS, Engineers Geoscientists Manitoba, and Engineers and Geoscientists BC. The survey was also available to be completed for Indigenous and non-Indigenous engineering students, Members-in-Training (MIT) or Engineers-in-Training (EIT), and engineering technologists—although these respondents are not the focus of this report. Similarly, while non-Indigenous data was collected and used for comparison purposes in select pieces of analysis, the survey was designed for Indigenous engineer respondents. An overview of survey responses by respondent type and by regulator is presented in Table 2.1.1.

Table 2.1.1: Number of complete survey responses by regulator

Regulator	Total Responses	Engineer Responses	Indigenous Engineer Responses	Indigenous EIT/MIT Responses	Indigenous Engineering Student Responses
APEGS	594	456	34	10	0
			Total Indigenous Responses: 44		
Engineers Geoscientists Manitoba	200	165	20	5	1
			Total Indigenous Responses: 26		
Engineers and Geoscientists BC	124	102	4	4	0
			Total Indigenous Responses: 8		
Total	900	701	58	19	1

			Total Indigenous Responses: 78

Source: Big River Analytics Indigenous Inclusion in Engineering Survey - (Engineers and Geoscientists BC/APEGS/Engineers Geoscientists Manitoba).

Note: Totals are not the sum of responses from each regulator, as some respondents identified themselves as being registered with multiple regulators and 25 respondents (all of which were non-Indigenous) are not registered with a regulator. There were no respondents who identified as Indigenous engineering technologists.

Each regulator opted to distribute the survey to its membership through different methods, for example, email, surveys, and newsletters (see Appendix A). As a result, we saw varying survey uptake and response rates among each regulator's membership. Due to the relatively low response count of Indigenous engineers licensed with Engineers and Geoscientists BC, we pooled responses across findings related to engineers' professional experiences, post-secondary experiences, and formative years, rather than reporting on findings by individual regulators. In adopting this approach, we are able to increase the strength and precision of our analysis.

We found that distributing the survey directly to members, as APEGS did, yielded the highest response rate, suggesting that this method would be best to adopt if other regulators would like to participate in a national survey moving forward.

2.2 Professional experiences

Key findings:

- The average salary of Indigenous engineer respondents is seven per cent lower than non-Indigenous respondents, suggesting the existence of a pay gap.
- When we include gender in the regression, we find that the pay gap between Indigenous and non-Indigenous engineers is greater for engineers who are cisgender women, transmasculine engineers, Two-Spirit engineers, gender non-binary engineers, or engineers unsure of their gender identity—that is, not cisgender men (14 per cent).
- Respondents that report discrimination as a challenge in high school or post-secondary have lower salaries as engineers. Further studies should explore the impacts of discrimination in the workplace.
- A smaller proportion of Indigenous engineer respondents are in senior engineer or manager roles than non-Indigenous engineer respondents.
- Twice as many Indigenous respondents (eight per cent) do not work in engineering compared to non-Indigenous engineer respondents (four per cent).

In this section, we explore the professional experiences of Indigenous engineer respondents, including average salaries, position and seniority, and barriers to licensing, and compare them (where feasible) to those of non-Indigenous engineers.

2.2.1 Pay gap analysis

Based on our estimates, the average salary of Indigenous engineer survey respondents is seven per cent lower than non-Indigenous respondents.[1] Summary statistics on the income of Indigenous and non-Indigenous engineers are shown in Table 2.2.1.

Table 2.2.1: Salaries of Indigenous and non-Indigenous engineers

Engineer Group	25th Percentile	Mean Salary	75th Percentile
Indigenous Engineers	$90,000	$117,090	$140,000
Non-Indigenous Engineers	$90,000	$125,812	$160,000

Source: Big River Analytics Indigenous Inclusion in Engineering Survey - (Engineers and Geoscientists BC/APEGS/Engineers Geoscientists Manitoba).

Number of Indigenous respondents: 50. Number of non-Indigenous respondents: 551. Question: "What was your annual salary or self-employment income from your engineering job or business in 2020?" "Which of the following categories best matches your annual salary or self-employment income from your engineering job or business in 2020?" Note: Outlier respondents with salaries more than 2.5 standard deviations from the mean (higher than $3,621,355) were removed.

To further explore the Indigenous pay gap, we undertake and present results for two types of regression

analyses. Regressions allow us to compare the salaries of engineer respondents while holding constant a set of factors we believe influence an individual's pay. In regression analysis, explanatory variables are variables that measure other factors that could explain the primary relationship of interest, in our case the relationship between Indigenous identity and pay. For instance, age is a factor that can greatly influence the level of pay an individual receives, generally serving as a measure of an individual's experience. We include age as an explanatory variable in our regression models, which allows us to estimate the amount of the Indigenous pay gap that cannot be explained by age.

There are many factors that cannot be easily measured, but are likely to influence an individual's pay. For example, an individual's "people skills" might determine whether they are more or less likely to get a promotion or raise. As such, regression analysis allows us to understand the correlation between factors (for instance, the correlation between gender and pay) rather than conclude if a given factor is causing an outcome.

In our first type of regression analysis, we attempt to estimate whether there is an Indigenous pay gap, meaning, when holding other measurable factors constant, we still find that Indigenous engineers make less than their non-Indigenous counterparts. We do this by controlling for factors that are not related to being Indigenous; for example, age and gender. Once we add age and gender as explanatory variables, we estimate the Indigenous pay gap that cannot be explained by age and gender. A brief summary of our estimates are included in Table 2.2.2, with the full regression table, Table B.1, displayed in Appendix B.

Table 2.2.2: Summary of Indigenous pay gap regressions

Explanatory Variables	Estimated Pay Gap
None	6.3%
Gender	5.5%
Age	6.4%
Age Binomial	5.8%
Age Binomial and Gender	5.6%

Source: Big River Analytics Indigenous Inclusion in Engineering Survey - (Engineers and Geoscientists BC/APEGS/Engineers Geoscientists Manitoba).

Big River Analytics Regression Analysis. Number of Indigenous respondents: 49. Number of non-Indigenous respondents: 520.

Note: Summary of OLS regressions and methodology used are included in Appendix A, with the regression table in Table B.1, Appendix B. None of the estimates shown are statistically significant using a confidence interval of 95 per cent. Age binomial indicates both age and age squared are included, allowing age to have a smaller effect as one gets older.

The Indigenous pay gap, after accounting for the effects of age and gender, is estimated to be 5.6 per cent. The result is not statistically significant, meaning that the pay gap may be due to randomness in who responded to the surveys. All our models estimate that Indigenous engineers have comparably lower salaries. Therefore, there is likely still a pay gap between Indigenous and non-Indigenous engineers, and the lack of significance in our estimates is likely due to a small sample size of Indigenous engineers.

To further explore the Indigenous pay gap, we separately estimate the pay gap for Indigenous cisgender men and for Indigenous people who are not cisgender men. We are unable to separately analyze the pay gap for cisgender women, transmasculine engineers, Two-Spirit engineers, gender non-binary engineers, and engineers who were unsure of their gender identity, as the number of respondents is too low. We are additionally unable to speak to the experiences of transfeminine engineers, as none responded to our survey. Only 172 engineers who identified among these genders shared their salary, 94 per cent of whom are cisgender women.[2] For technical reasons, categorizing engineers into those who are cisgender men and those who are not allows us to best capture the experiences of people of all genders in our analysis. Table 2.3.3 summarizes the results, with the full regression table, Table B.2, included in Appendix B.

Table 2.2.3: Summary of Indigenous pay gap by gender regressions

Explanatory Variables	Indigenous Pay Gap (Cisgender Men)	Indigenous Pay Gap (Excluding Cisgender Men)*
Gender	0.7%	12.5%
Age Binomial and Gender	0.1%	14.1%

Source: Big River Analytics Indigenous Inclusion in Engineering Survey - (Engineers and Geoscientists BC/APEGS/Engineers Geoscientists Manitoba).

Big River Analytics Regression Analysis. Number of Indigenous respondents: 49. Number of non-Indigenous respondents: 520.

Note: Summary of OLS regressions and methodology used are included in Appendix A, with the regression table in Table B.2, Appendix B. None of the estimates shown are statistically significant using a 95 per cent confidence interval. Age Binomial indicates both age and age squared are included, allowing age to have a smaller effect as one gets older. *Excluding cisgender men is cisgender women, transmasculine engineers, Two-Spirit engineers, gender non-binary engineers, and engineers who were unsure of their gender identity.

We find that the pay gap between Indigenous and non-Indigenous engineers is much greater for engineers who are not cisgender men. Adding age and an indicator for gender as explanatory variables to the regression, we find a pay gap of 14.1 per cent between Indigenous and non-Indigenous engineers who are cisgender women, gender non-binary, unsure of their gender identity, Two-Spirit, or transmasculine, compared to essentially no pay gap between Indigenous and non-Indigenous engineers who are cisgender men.

Having estimated the magnitude of the Indigenous pay gap, we move to our second regression analysis, which seeks to examine potential factors influencing this pay gap. The explanatory variables we introduce in these regressions, including job seniority, education level, and experience of discrimination, may be related to whether or not a person is Indigenous. For instance, a respondent may have faced discrimination on their journey to becoming an engineer because they are Indigenous. Including explanatory variables potentially related to Indigeneity means that we are no longer estimating the Indigenous pay gap. Instead, these regressions, summarized in Table 2.2.4 and shown in Appendix B, Table B.3, explore factors that may explain the Indigenous pay gap. The explanatory variables included in our regressions follow research by Wilson and Macdonald (2010) on the Indigenous pay gap, as well as standard variables used in pay gap regressions (EDGE Certified Foundation, 2020). Additionally, we tested for the relationship between pay and a number of additional explanatory variables, for example, whether an individual had an advanced degree (master's or PhD), or not.

In Table 2.2.4 we present estimates for the pay gap when accounting for the three explanatory variables with the strongest relationship to pay, in addition to age and gender, derived from our survey of engineers:

- Discrimination: we identify discrimination as a respondent self-identifying that they experienced discrimination as a moderate or significant challenge in high school or post-secondary.
- Financial Barriers: we identify financial barriers as a respondent self-identifying that they experienced working outside of class or financial challenges as a moderate or significant challenge in high school or post-secondary.
- Job Seniority: we identify individuals in senior roles, as respondents whose job title fits the role of Principal, Director, or Executive.

Table 2.2.4: Summary of Indigenous pay gap by gender regressions

Explanatory Variables,In Addition to Age and Gender	Unexplained Indigenous Pay Gap for Cisgender Men	Unexplained Indigenous Pay Gap Excluding Cisgender Men*
Discrimination	+5.3%	13.4%
Financial Barriers	0.1%	14.6%
Job Seniority	1.7%	13.8%
Discrimination, Financial Barriers, and Job Seniority	+11.5%	7.1%

Source: Big River Analytics Indigenous Inclusion in Engineering Survey - (Engineers and Geoscientists BC/APEGS/Engineers Geoscientists Manitoba).

Big River Analytics Regression Analysis. Number of Indigenous respondents: 49. Number of non-Indigenous respondents: 520.

Note: Summary of OLS regressions and methodology used are included in Appendix A, with the regression table in Table B.3, Appendix B. “+” indicates that being Indigenous has a positive correlation with salary. None of the estimates shown are statistically significant using a confidence interval of 95 per cent.
*Excluding cisgender men is cisgender women, transmasculine engineers, Two-Spirit engineers, gender non-binary engineers, and engineers who were unsure of their gender identity.

Notably, for cisgender men who did not identify discrimination as a barrier in their journey to becoming an engineer, being Indigenous is associated with a higher salary than non-Indigenous engineers. Despite this, there remains a pay gap for Indigenous engineers that are not cisgender men. Indigenous engineers who are not cisgender men, who are of similar age, who hold roles of comparable seniority, and who did not identify discrimination or finances as a barrier on their journey to becoming an engineer still show an unexplained Indigenous pay gap of 7.1 per cent (see final row in Table 2.2.4).

The unexplained pay gap for Indigenous engineers who are cisgender women, gender non-binary, unsure of their gender identity, Two-Spirit, or transmasculine is likely due to unmeasured factors not included in our regression analysis. For example, discrimination on the journey to becoming an engineer is significantly associated with lower pay, but we do not have an indicator for facing discrimination after becoming licensed. Further work is necessary to understand the determinants of the pay gap for Indigenous people who are not cisgender men.

Our pay gap analysis has challenges related to the number of Indigenous respondents to our survey, with many estimated regression coefficients appearing large and consistent in direction, but not statistically significant. While we suggest caution when interpreting the exact percentage estimates, several findings are made clear in our analysis. There is an Indigenous pay gap, and in particular there is a large pay gap for Indigenous engineers who are not cisgender men. Some of the pay gap is predicted by the fact that respondents who identify discrimination as a challenge in high school or post-secondary show lower salaries as engineers. However, among Indigenous engineers who identify as cisgender women, gender non-binary, unsure of their gender identity, Two-Spirit, or transmasculine, even those that do not report discrimination as a challenge on their journey to becoming an engineer still face an unexplained pay gap.

2.2.2 Engineering job type, challenges, and supports

In the remainder of this section, we complement our analysis on pay by exploring other factors and experiences that affect Indigenous engineer respondents, and how those experiences compare to non-Indigenous engineer respondents.

First, we examine the proportion of respondents in senior roles. In order to compare the proportion of Indigenous and non-Indigenous engineer respondents in senior roles, we ask respondents for their job title in 2020, and aggregate these job titles into common roles. Nearly all (98 per cent) the job titles fit into the role categories of engineer, team lead, senior engineer, manager, principal, director, or executive. The proportion of Indigenous and non-Indigenous engineers with each role is shown by the width of the figures in Figure 2.2.2. We find that representation in top positions (executives, directors, and principals) is similar among Indigenous and non-Indigenous respondents. However, very few Indigenous engineer respondents report mid-level roles of senior engineer, manager, or team lead and a disproportionate number of Indigenous respondents report lower-level job titles.

More specifically, the proportion of Indigenous engineer respondents that are in the top roles of executive, director, and principal is 20 per cent, higher than for non-Indigenous engineer respondents (15 per cent). Mid-level positions make up a small proportion of the jobs held by Indigenous engineer respondents. We see that senior engineers, managers, and team leads represent only 20 per cent of the jobs held by Indigenous engineer respondents. Non-Indigenous engineer respondents are more than twice as likely to be a senior engineer, manager, or team lead than Indigenous engineer respondents, with 46 per cent of non-Indigenous

engineer respondents reporting one of those roles. Indigenous engineer respondents disproportionately report lower-level jobs, with 58 per cent of Indigenous engineers respondents in engineer roles, compared to only 37 per cent of non-Indigenous engineer respondents.

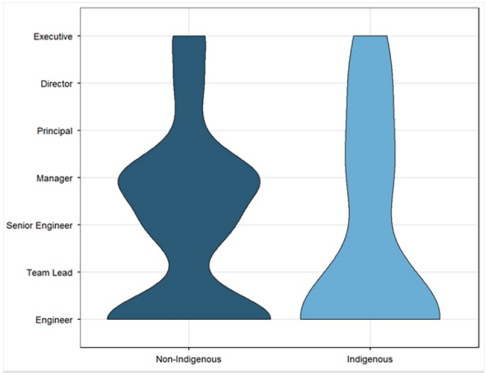

Figure 2.2.2: Distribution of Indigenous and non-Indigenous engineer respondents by job type
Source: Big River Analytics Indigenous Inclusion in Engineering Survey. Number of Indigenous respondents: 42. Number of non-Indigenous respondents: 440. Question: "What was your job title in 2020?" Note: The width of the figures correspond to the proportion of either Indigenous or non-Indigenous respondents with each given role.

To better understand Indigenous respondents' professional experiences and identify ways to make the profession more inclusive, we asked respondents if there was anything they wanted to share about their experience working as an engineer. The most common challenge that Indigenous engineer respondents identified pertaining to their professional experience as an engineer is low Indigenous and low Indigenous women representation in the field. Further, some respondents feel that they are passed over for positions for which they are qualified because they are a woman and/or Indigenous, or feel they have to hide their Indigenous identity to avoid discrimination. One respondent notes that anti-Indigenous racism is particularly bad in the mining industry.

Relative to the proportion of respondents who experience discrimination and racism, a small proportion of respondents say that they have observed concerted efforts within the engineering industry to embrace Indigenous culture and be more inclusive of underrepresented groups. Another subset of respondents say that they had not faced discrimination due to their Indigenous identity.

"Not having an engineer in my family or even knowing an engineer made it much more difficult to find summer employment and full-time employment when I graduated. The majority of my graduating class had connections to engineers, engineering companies, or corporations that made their transition to engineering much easier than mine."

— Engineers Geoscientists Manitoba Indigenous engineer

Additional challenges that respondents identify are a lack of networking and mentorship opportunities without pre-existing connections, inadequate support from their regulator, a lack of Indigenous hiring policies in engineering, and difficulty managing a work-life balance.

We also asked respondents to describe their experience with mentorship opportunities. Indigenous engineer respondents spoke most positively about their mentorship opportunities. Respondents also shared positive sentiments about the impact that formal mentorship programs had on their engineering careers, and one respondent specifically spoke about the strength of the Engineers Geoscientists Manitoba's Women in Engineering and Geoscience Mentorship Program. The remaining respondents say that their mentorship experience has primarily been informal, on a project-to-project basis, or through peer networking.

Of Indigenous engineer respondents, five per cent indicate they faced challenges in the licensing process,

compared to nine per cent of non-Indigenous respondents.[3] We asked respondents to describe any challenges they faced in obtaining their licence, and what their regulator could have done to assist them. Three respondents shared their experiences. They describe having to wait for a supervisor to sign off on their final report (one respondent had to wait over a year), not having access to mentors, a lack of clarity on requirements and screening protocols for work experience reports, and a lack of knowledge about the requirement for multiple references as challenges they faced.

To identify ways in which regulators could effectively support Indigenous engineers, we asked respondents whether they feel their regulator has addressed their needs as an Indigenous professional. There were a total of 31 responses to this open-ended question, which we coded against four categories: yes, no, early stages, and no specific needs. The majority of respondents to this question provided a relatively succinct, yes or no answer to this question. Some respondents, however, provided a more detailed answer. We summarize what we heard from these longer answers in sub-bullets below each response category.

- Yes (10/31): the respondent feels the regulator has met their needs as an Indigenous professional.
- No (12/31): the regulator has not met their needs.
  - Respondents feel there has been no concerted effort to reduce systemic racism and discrimination towards Indigenous engineers.
- Early stages (2/31): the respondent feels their regulator is in the early stages of meeting Indigenous professionals' needs.
  - These respondents have seen the beginnings of efforts from regulators to increase Indigenous representation in the field but think that more action is required.
- No specific needs (7/31): the respondent does not have any specific needs as an Indigenous professional.
  - These respondents expressed a lack of understanding concerning why Indigenous engineers would have specific needs, or why additional programming or training would be required to facilitate more Indigenous representation in the field. Most of these respondents, however, noted that they are not visibly Indigenous.

2.2.3 Summary data - professional experiences

To better understand the professional experiences of Indigenous engineers, Tables 2.2.5 and 2.2.6 present summary statistics of other respondent characteristics. We find that half (49 per cent) of Indigenous engineer respondents work in the private sector, and five per cent are self-employed in the private sector. A larger proportion of Indigenous engineer respondents work in the public sector (37 per cent) relative to non-Indigenous respondents (29 per cent). Similarly, a larger proportion of Indigenous engineer respondents do not work in engineering (eight per cent) relative to non-Indigenous respondents (four per cent). Of Indigenous engineers who did not work in engineering in 2020, over half no longer worked in the engineering field, although they were still registered with their regulator in 2020 (60 per cent). Zero Indigenous survey respondents identified their professional status as "No, I am not registered with my provincial or territorial regulator," therefore no information was collected on why eligible individuals did not apply for their license.

Table 2.2.5: Proportion of Indigenous and non-Indigenous engineer respondents by employment type

Employment Type	Indigenous Engineer Respondents	Non-Indigenous Engineer Respondents
Public sector	37%	29%
Private sector (self employed)	5%	8%
Private sector (not self employed)	49%	59%
Did not work in engineering	8%	4%

Source: Big River Analytics Indigenous Inclusion in Engineering Survey - (Engineers and Geoscientists BC/APEGS/Engineers Geoscientists Manitoba).

Number of Indigenous respondents: 59. Number of non-Indigenous respondents: 626.Question: "In 2020, did you work in engineering in the public sector or the private sector?" "In 2020, were you self-employed?"

Note: Proportions may not sum to 100 per cent as proportions round to the nearest per cent.

Table 2.2.6: Proportion of Indigenous engineer respondents by reason for not working in engineering in 2020

Reason	Indigenous Engineer Respondents
Personal reasons (e.g., health reasons, family obligations)	40%
I could not find employment in the engineering field	20%

I no longer worked in the engineering field, although I was still registered with my regulator in 2020	60%
Other	0%

Source: Big River Analytics Indigenous Inclusion in Engineering Survey - (Engineers and Geoscientists BC/APEGS/Engineers Geoscientists Manitoba).

Number of respondents: 5.

Question: "Why did you not work an engineering job in 2020?”

Note: Of respondents who are still registered but no longer work in the engineering field, two of the three are cisgender women. All of the remaining respondents are cisgender men.

2.3 Post-secondary experiences

Key findings:

- »The most commonly identified challenges facing Indigenous engineer respondents during post-secondary were financial challenges and loneliness/isolation.
- »The supports that Indigenous engineer respondents most often identified as those that would have been helpful in post-secondary are monetary support, followed by tutoring and academic support.
- »The highest educational credential level for 95 per cent of Indigenous engineer survey respondents is a bachelor's degree.

This section explores the experiences of Indigenous engineers throughout their post-secondary education, including key challenges and opportunities and summary statistics of Indigenous engineers’ educational credentials. Figure 2.3.1 presents the proportion of Indigenous engineer respondents who faced challenges in post-secondary, and specifically whether these barriers were “moderate” or “significant” challenges. We find that the most commonly identified challenges facing Indigenous engineer respondents during post-secondary were financial challenges (75 per cent) and loneliness/isolation (70 per cent). Other challenges faced by Indigenous engineers include managing time between academics and work commitments, culture shock arriving at a larger city or town to study, and frustration with the atmosphere of privilege and poor ethics amongst peers.

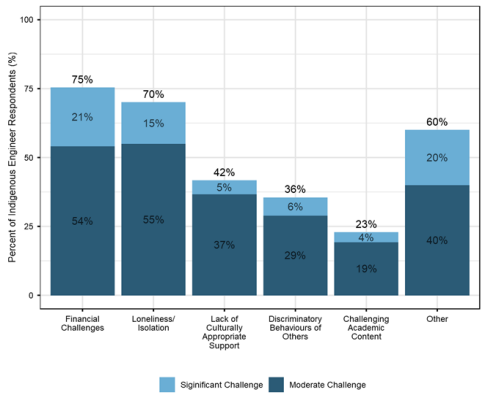

Figure 2.3.1: Proportion of Indigenous engineer respondents who faced challenges in post-secondary
Source: Big River Analytics Indigenous Inclusion in Engineering Survey - (Engineers and Geoscientists BC/APEGS/Engineers Geoscientists Manitoba). Number of respondents: 62. Question: "If applicable, please specify the degree to which you faced the following challenges in post-secondary." Note: Respondents could identify multiple challenges. The challenges do not sum together.

Respondents were asked, in retrospect, which supports and services during their post-secondary experience,

if any, would have contributed to this experience being more successful. Figure 2.3.2 presents those supports and services that Indigenous engineer respondents identified as possibly helpful throughout their post-secondary education. Here, respondents first identify monetary support (instead of working) (38 per cent), followed by tutoring and academic support (34 per cent), social connections (26 per cent), and courses to better reflect Indigenous worldviews (22 per cent). Other potential supports or beneficial factors suggested by Indigenous respondents include access to mentorship from women, more Indigenous peers, mentoring and guidance, outreach and lectures on engineering, a more welcoming political climate, health and fitness supports and services, and scholarship application assistance.

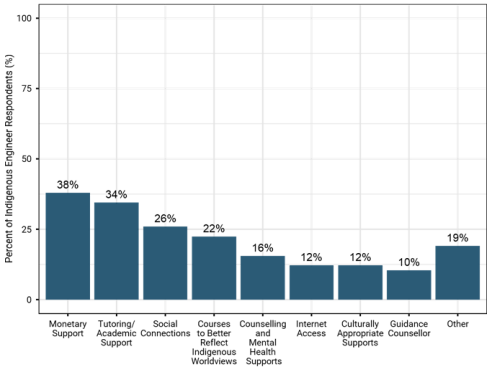

Figure 2.3.2: Proportion of Indigenous engineer respondents who would have benefited from supports in post-secondar

Source: Big River Analytics Indigenous Inclusion in Engineering Survey - (Engineers and Geoscientists BC/APEGS/Engineers Geoscientists Manitoba). Number of respondents: 58. Question: "What could have been different about your post-secondary experience that may have contributed to you being more successful during your post-secondary experience? Select all that apply." Note: Respondents could identify multiple supports. The supports do not sum together.

To move beyond the supports described in Figure 2.3.2, we asked survey respondents to share anything more about their post-secondary experiences. We coded their responses by both topic and category. The most commonly identified challenge that respondents discussed in the open-ended question was in relation to either their Indigenous or gender identity. Some respondents experienced racism, whereas others felt a feeling of isolation due to low Indigenous representation at their school. Respondents who grew up in a rural setting found it difficult to adjust to the post-secondary and urban environment, and noted that the engineering culture and challenging academic content was at times isolating. Several respondents also noted the financial burden of becoming an engineer, and the negative impact that burden had on both their formative years and post-secondary experience, including preventing them from participating in extracurriculars or social groups.

Finally, we asked Indigenous engineers who took part in an Indigenous engineering access program how they would describe the quality of the program.[4] There were 13 respondents who answered this open-ended question, all of whom described the program as excellent and instrumental in helping them become engineers. The following quote provides insight into the quality respondents attributed to Indigenous engineering access programs:

“I was very impressed by [the program]. I was fortunate to not need many of the supports provided (I did not have to relocate, my high school offered the pre-req courses, etc); but from my observations, aside from the supports provided (financial assistance, relocation assistance, tutoring, counselling support, high school course upgrading, etc)—which were impressive—the other benefit was providing members with a community of people with similar cultural backgrounds, and an easy way to make friends. I think that this may have been especially valuable to students who had to relocate to go to university, especially if they were coming from very rural areas.”

— Engineers Geoscientists Manitoba Indigenous engineer

Indigenous engineers who did not take part in an Indigenous engineering access program, even when one was available, described a lack of communication regarding the program or a lack of clarity around eligibility. More specifically, respondents said that they did not participate in the program because they either found out about the program once they had already begun their studies or were not sure if they could participate because they were Métis.

2.3.1 Summary data - post-secondary

Table 2.3.1 through Figure 2.3.4 presents summary statistics for other characteristics of Indigenous engineer respondents' post-secondary experiences. The highest educational credential level for 95 per cent of Indigenous engineer respondents is a bachelor's degree. The highest educational credential levels of the remaining minority are either a master's degree (three per cent) or PhD (two per cent). The most common bachelor's specializations of survey respondents are mechanical and civil engineering.

We asked respondents whether their post-secondary institution offered an Indigenous engineering access program, and if so, whether or not they participated. While 43 per cent of Indigenous engineer respondents had access to the program, only 25 per cent partook in the program. Similarly, we also asked respondents whether they took part in an engineering bridge program. Across each of the three regulators, 95 per cent of respondents did not take part in an engineering bridge program.

Table 2.3.1: Highest educational credential for Indigenous engineer respondents

Highest Educational Credential Level	Indigenous Engineer Respondents
Bachelor's	95%
Master's	3%
PhD	2%

Source: Big River Analytics Indigenous Inclusion in Engineering Survey - (Engineers and Geoscientists BC/APEGS/Engineers Geoscientists Manitoba).

Number of respondents: 60.

Question: "What are your educational credentials? Please select all that apply and include non-engineering educational credentials."

Table 2.3.2: Distribution of Indigenous engineer respondents by top specializations

Diploma (35)		Bachelor's (47)		Master's (2)		PhD (1)	
Civil	12	Mechanical	15	Civil	1	Mechanical	1
Chemical	7	Civil	10	Mechanical	1		
Mining	3	Chemical	7				

Source: Big River Analytics Indigenous Inclusion in Engineering Survey - (Engineers and Geoscientists BC/APEGS/Engineers Geoscientists Manitoba).

Number of respondents: 59.

Question: "What engineering specialization did you graduate with?"

Note: Only top specializations and their counts are presented. Not all counts across specializations are presented, therefore totals are greater than the sum of the specializations presented.

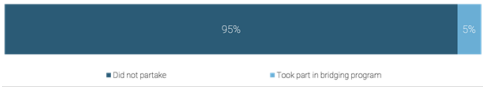

Figure 2.3.3: Proportion of Indigenous engineer respondents who went through an Indigenous engineering bridging program
Source: Big River Analytics Indigenous Inclusion in Engineering Survey - (Engineers and Geoscientists

BC/APEGS/Engineers Geoscientists Manitoba). Number of respondents: 60. Question: "Did you go through an engineering bridging program between college and university?

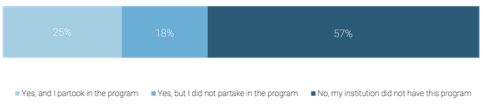

Figure 2.3.4: Proportion of Indigenous engineer respondents who attended an Indigenous access engineering program
Source: Big River Analytics Indigenous Inclusion in Engineering Survey - (Engineers and Geoscientists BC/APEGS/Engineers Geoscientists Manitoba). Number of respondents: 51. Question: "Did you attend a post-secondary institution with an Indigenous access engineering program?"

2.4 Formative years

Key findings:

- »Collectively, Indigenous engineer survey respondents identified the discriminatory behaviour of others as the greatest challenge to pursuing math and science in high school.
- »The largest proportion of Indigenous engineer respondents identified STEM outreach programs as a support that would make it easier for respondents to pursue engineering and the associated pre-requisite courses.
- »Close to one third (29 per cent) of Indigenous engineer respondents said their main reason for pursuing engineering was because a teacher recommended that they should.

To gather data on Indigenous respondents' journeys to becoming an engineer, and identify the key challenges and opportunities they may have faced, we asked survey respondents a series of questions about their formative years. For the purposes of this report, we define formative years as those years up to and including high school, prior to post-secondary education for engineering.

Respondents were asked the degree to which certain challenges made it more difficult for them to pursue engineering pre-requisite courses in high school. Figure 2.4.1 presents the proportion of Indigenous engineer respondents facing specific barriers to pursuing math and science courses.

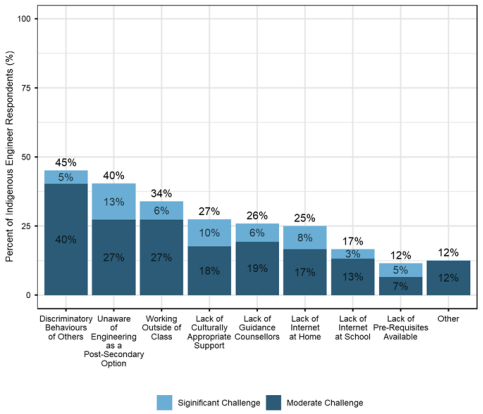

Figure 2.4.1: Proportion of Indigenous engineer respondents who faced barriers to pursuing math and

science in high school
Source: Big River Analytics Indigenous Inclusion in Engineering Survey - (Engineers and Geoscientists BC/APEGS/Engineers Geoscientists Manitoba). Number of respondents: 62. Question: "If applicable, please specify the degree to which the following challenges made it more difficult for you to pursue science and math courses in high school." Note: Respondents could identify multiple challenges, therefore proportions should not sum to 100.

Overall, almost half (45 per cent) of Indigenous engineer respondents identify the discriminatory behaviour of others as a significant or moderate challenge. This is the challenge that was identified by the most respondents, followed by a lack of awareness of engineering as a post-secondary option (40 per cent), and working outside of class (34 per cent).[5] Additional moderate challenges identified by respondents are lack of information resources available and anti-Indigenous sentiments in the media.

“I faced many financial challenges to support my education; however, I continued on with my goal. Similarly, I also faced discriminatory behavior from others which was quite discouraging and hurtful.”

—Indigenous engineer

Respondents were asked, in retrospect, which supports and services during their formative years, if any, would have made it easier for them to pursue engineering and the associated pre-requisite courses. Figure 2.4.2 presents the proportion of Indigenous engineer respondents who would have benefited from specific support in high school.

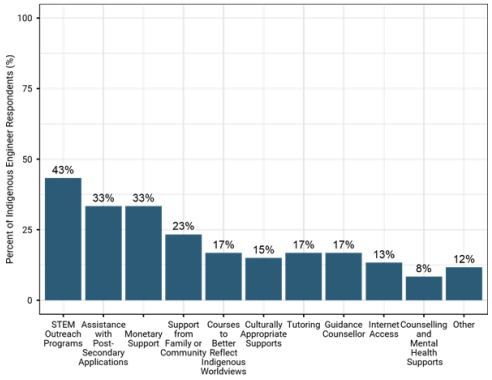

Figure 2.4.2: Proportion of Indigenous engineer respondents that would have benefited from supports in high school
Source: Big River Analytics Indigenous Inclusion in Engineering Survey - (Engineers and Geoscientists BC/APEGS/Engineers Geoscientists Manitoba). Number of respondents: 60. Question: "Which of the following high school supports and services, if any, would have made it easier for you to pursue engineering and the associated pre-requisite courses? Select all that apply." Note: Respondents could identify

multiple challenges, therefore proportions should not sum to 100.

The largest proportion of Indigenous engineer respondents identified STEM outreach programs (43 per cent) as a beneficial support for high school, followed by assistance with post-secondary applications (33 per cent), and monetary support (33 per cent). Supports identified in the other category include libraries and other information resources, elimination of racism, Advanced Placement (AP) courses, support in preparing scholarship applications, and engineering access programs.

To better understand Indigenous respondents' journeys to engineering and identify ways Engineers Canada and regulators could better support Indigenous engineers in their formative years, we asked respondents if there was anything they wanted to share about the years leading up to their post-secondary education. Respondents highlight the difficulty of academic material and a lack of support from high school teachers—especially with math and physics—as key challenges they faced during high school. Several respondents did not have access to a role model or mentor during high school, and that made it difficult for them to pursue engineering. In contrast, we find that respondents who did have access to a role model who encouraged them to excel academically or pursue engineering, such as a guidance counsellor or teacher, speak far more positively about their formative years. Racism is the next most commonly identified challenge Indigenous respondents faced during their formative years, according to our approach to coding open-ended responses (see Appendix A.2 for detailed methodology). Respondents describe the impacts of racism as feeling isolated and under a severe amount of stress.

2.4.1 Summary data - formative years

Table 2.4.1 through Table 2.4.4 present summary statistics for other characteristics of Indigenous engineer respondents' formative years. The majority of Indigenous respondents spent their formative years in a rural location (56 per cent), with 20 per cent of this group living in-community (specifically in a First Nation, on a reserve, or in a Métis settlement). Nearly all Indigenous engineer respondents attended public school, and none attended schools run by Indigenous governments, for example First Nations or Band Operated schools. One third of respondents said their main reason for pursuing engineering was because a teacher recommended that they should. While Indigenous engineer respondents did not have to relocate for high school, we see a higher proportion of relocation for post-secondary education for Indigenous engineer respondents relative to non-Indigenous engineer respondents.

Table 2.4.1: Proportion of Indigenous engineer respondents who lived in urban and rural areas during formative years, lived in-community during formative years

Location	Indigenous Engineer Respondents In-Community within Urban/Rural	
Rural 56%	In-Community	20%
	On a reserve or in a First Nation	(9%)
	In a Métis settlement	(11%)
	In an Inuit hamlet	(0%)
	Not in Community	69%
	Other	11%
Urban 44%	In-Community	0%
	Not in Community	100%
	Other	0%

Source: Big River Analytics Indigenous Inclusion in Engineering Survey - (Engineers and Geoscientists BC/APEGS/Engineers Geoscientists Manitoba).

Number of respondents: 63.

Question: "Did you live in-community for the majority of your formative years?"

Table 2.4.2: Proportion of Indigenous engineer respondents by reason for pursuing engineering

Rank	Avenue of Awareness	Indigenous Engineer Respondents
1	Recommended by teachers	29%
2	Other family members (excluding parents) were engineers	18%

2	Career fair	18%
3	I learned about engineering after starting attending post-secondary	13%
4	One or more parent was an engineer	2%
-	Other	39%

Source: Big River Analytics Indigenous Inclusion in Engineering Survey - (Engineers and Geoscientists BC/APEGS/Engineers Geoscientists Manitoba).

Number of respondents: 62.

Question: "How did you become interested in engineering before enrolling in an engineering post-secondary program?"

Note: Respondents could select multiple answers. Proportions do not sum together to 100.

Table 2.4.3: Proportion of Indigenous engineer respondents and non-Indigenous engineer respondents who relocated for high school and post-secondary education (PSE)

Relocation	Indigenous Engineer Respondents	Non-Indigenous Engineers Respondents
Relocated for High School	0%	1%
Relocated for PSE	69%	52%
Never had to Relocate	31%	47%

Source: Big River Analytics Indigenous Inclusion in Engineering Survey - (Engineers and Geoscientists BC/APEGS/Engineers Geoscientists Manitoba).

Number of Indigenous respondents: 59.

Number of non-Indigenous respondents: 611.

Question: "Did you have to relocate to pursue education for engineering?"

Table 2.4.4: Proportion of Indigenous engineer respondents by high school type

High School Type	Indigenous Engineer Respondents
Public	98%
Private	2%
Schools run by Indigenous governments	0%

Source: Big River Analytics Indigenous Inclusion in Engineering Survey - (Engineers and Geoscientists BC/APEGS/Engineers Geoscientists Manitoba).

Number of respondents: 66.

Question: "For high school, did you attend:"

3.0 Considerations

Finally, we draw on findings from the survey to provide considerations for how best to support increased Indigenous inclusion in the profession, improve support, and reduce barriers to Indigenous engineers in their experiences in formative years and post-secondary education based on the findings from this pilot project. While further research and planning would be required to pursue these actions, this list acts as a starting place for exploring next steps for Engineers Canada and the regulators.

Professional experiences

1. *Training:* Facilitate more cultural learning and anti-racism training for engineers to reduce racism and discrimination in the field as part of continuous professional development programs. Leverage existing resources developed by Indigenous organizations and/or other professional associations to support firms with resources to improve Indigenous recruitment and inclusion.
2. *Networking*: Provide more mentorship and networking opportunities for Indigenous engineers, and especially Indigenous women engineers, to ensure that opportunities are equally accessible to all engineers, not just those who have pre-existing networks.
3. *Research*:
    - »Further investigate why eligible individuals did not apply for their licence and reasons why

qualified individuals cannot find employment in engineering.

- Investigate experiences of broader training positions and roles such as Indigenous and non-Indigenous engineering students, Members-in-Training/Engineers-in-Training, and engineering technologists.

Post-secondary experiences

1. *Training*: Work with Engineers Canada's Indigenous Advisory Committee to explore cultural learning and anti-racism training for engineering instructors, faculty, and staff to reduce racism and discrimination at universities and in the profession.
2. *Increasing access and supports*:
    - Provide more financial support to Indigenous students, particularly those who commute long distances or relocate to attend their program.
    - Work to actively share information and increase awareness of bridge programs and Indigenous engineering access programs for potential participants.
        - *Research:* Explore program participation requirements and identify whether there are additional accessibility barriers Indigenous students face.
3. *Research:* Support research or organizations investigating the factors contributing to feelings of isolation and loneliness for post-secondary students, and explore opportunities to provide counselling and social support accordingly.

Formative years

1. *Training*: Extensive and comprehensive anti-racism—specific to anti-Indigenous racism—training, curriculum, and policies for K-12 educators in all school divisions. Invest in Indigenous mentorship and training opportunities for high school students, including by working with guidance counsellors to encourage and support youth in their post-secondary applications.
2. *Programming*: Work with Indigenous education experts to facilitate more STEM outreach and tutoring programs. Offer more services tailored to students who come from rural settings, such as community-building and social connectivity programs.
3. *Research*:
    - Investigate pre-engineering course availability at schools run by Indigenous governments across jurisdictions.
    - Investigate sources of discrimination and anti-Indigenous racism in the public and high school levels.

4.0 Conclusion

To meet its goal of collecting data on Indigenous engineering students and professionals in Canada, Engineers Canada has worked with Big River Analytics to design and undertake a pilot survey of the members of three regulators, Engineers Geoscientists Manitoba, Engineers and Geoscientists BC, and APEGS. Three broad research objectives guided this research project, and we identified findings for each.

Our objective was to explore professional outcomes of Indigenous engineers, and how these compare to non-Indigenous engineers. Controlling for a number of demographic factors, we find that Indigenous engineers—particularly those who are not cisgender men—are underpaid relative to their non-Indigenous counterparts. We also find that non-Indigenous engineers are more frequently represented in positions of higher responsibility.

We also sought to gather data on Indigenous respondents' journeys to becoming an engineer, specifically identifying challenges and opportunities. We find that the most commonly identified challenges facing Indigenous respondents during post-secondary were financial challenges (75 per cent) and loneliness/isolation (70 per cent). Notably, every Indigenous engineer that participated in an Indigenous engineering access program when they were a student raved about the program's quality and impact on their journey to becoming an engineer. When considering respondents' formative years, we see that discrimination was a big challenge to pursuing math and science in high school. In contrast, having a positive role model, such as a family member, mentor, or teacher that encouraged them to pursue engineering, was instrumental in their journey.

Finally, we planned to identify ways Engineers Canada and provincial and territorial regulators could better support Indigenous engineers both in their educational journey and in their work as engineers. Consequently, we provide a set of considerations based on our findings, which we categorize into four focus areas: (i) training, (ii) networking, (iii) research, and (iv) programming.

Ultimately, this survey project is intended to collect information to inform how to make the engineering profession more inclusive and representative of Indigenous peoples. We trust that this research will serve as a basis for future work across the country.

5.0 Appendices

Appendix A - Detailed methodology

A.1 Project approach

Phase 1: Survey design

Engineers Canada and Big River Analytics worked with Engineers Geoscientists Manitoba, Engineers and Geoscientists BC, and APEGS to identify variables of interest for the survey, determine an approach to survey enumeration, and develop a data analysis plan. Through a series of planning sessions, a number of survey variables focused on demographics, education, and the post-secondary experiences of Indigenous engineers were identified. Survey topics and variables were refined and prioritized to ensure high quality data collection. Big River Analytics designed a survey questionnaire titled the *Indigenous Inclusion in Engineering Survey* to meet survey objectives.[6] Particular care was taken to ensure the data collected could be used to make comparisons with other secondary data sources where appropriate.

Through the planning process, it became clear that a simple random sample was not possible given a set of particular constraints with distribution. Instead, the survey was distributed through convenience sampling, and then post-stratification was conducted using data provided by regulators to support the analysis. Additionally, survey respondents were invited to recommend the survey to someone they know, or know of, who is an Indigenous engineer. In technical terms, we conducted convenience sampling through a “snowball sample” approach. This “snowball sample” or “respondent-driven sample” method is a replicable approach that allows for consistency across regulators with varied data quality. It is proven to be more effective at enumerating rare or hard-to-find populations as long as those populations are well-connected (Thompson 2006).

Phase 2: Survey enumeration

Survey enumeration took place between September 30 and October 30, 2021. Regulators promoted the survey to their respective memberships through newsletters, social media, and other communication channels. Each regulator used different distribution channels, as presented in Table A.1.

Table A.1: Regulator distribution channels

Regulator	Distribution Channel(s)
APEGS	Direct email to entire APEGS membership list
Engineers Geoscientists Manitoba	Social media channels (Facebook, Twitter)E-News NoticeEmail to members who self-declared as IndigenousEmail to all members who opted in to receive communications from Engineers Geoscientists Manitoba
Engineers and Geoscientists BC	Social media channels (LinkedIn, Twitter)Email to Engineers and Geoscientists BC volunteers, announcement to at Engineers and Geoscientists BC volunteer meetingeNews (distributed to all Engineers and Geoscientists BC registrants)

Phase 3: Data analysis

After compiling and cleaning the survey data, the data analysis plan was implemented to produce and analyze findings, adapting methodology as needed when facing data constraints. As part of our examination of professional outcomes to Indigenous engineers, a pay gap analysis was undertaken, including a regression analysis that allows us to account for other factors influencing salary. Response data for open-ended (i.e., free-form and text-entry) questions were analyzed by categorizing responses by topic.

A.2 Qualitative data analysis

The *Indigenous Inclusion in Engineering Survey* includes both closed-ended (i.e., multiple choice and likert scale) and open-ended (i.e., free-form and text-entry) questions. Our approach to data analysis to open-ended questions is as follows:

1. Gather free-form responses
2. Review responses and identify statements
3. Group statements into topics
4. Match statements to one of two categories:
    - »Challenges
    - »Supports and opportunities

5. Summarize and match findings by topic to associated quantitative findings

Seven topics were identified during our analysis. The topics include:

- Academic material and engineering culture
- Family, social, and community support
- Networking, mentorship, and training
- Extracurriculars, counselling, and mental health supports
- Identity, representation, and discrimination
- Financial and material resources
- Other

For each topic, we include a response count to facilitate a breakdown of challenges, and supports or opportunities by topic. To avoid repetition, we exclude responses to quantitative follow-up questions in topic summaries that are already included in a table or visualization.

A.3 Pay gap analysis regressions methodology

The estimating equation for P.Eng. pay analysis regressions is as follows:

$$Yi = \beta 0 Indigenous i + \beta 1 Xi + \beta 2 Indigenous i \times Ci + \varepsilon i$$

Yi is the natural log of the annual salary reported by the engineer repondent *i*. Respondents that preferred not to identify their exact salary had the option to answer one of the following salary ranges:

- less than $30,000
- $30,000 to less than $50,000
- $50,000 to less than $75,000
- $75,000 to less than $100,000
- $100,000 to less than $250,000
- over $250,000

No engineer respondents chose the “over $250,000” option. To compare the salary amounts to the salary ranges, a respondent is assigned the mean of the salary range they select. Imputing the salary range to a single number introduces measurement error. This measurement error in the output variable will not bias results, but will reduce the power of our regression and the significance of the coefficient estimates. Additionally, seven outliers more than 2.5 standard deviations from the mean (a salary of more than $3,621,355) were removed.

Indigenousi is the binary variable of interest, which equals one if the i^{th} engineer respondent identified as Indigenous.

Xi is a vector of control variables. These variables are chosen in accordance with research by Wilson and Macdonald (2010) on the Indigenous pay gap, and with standard variables used in pay gap regressions (EDGE Certified Foundation, 2020). The controls include:

- Not cis man, a binary variable that equals one if the respondent did not identify as a cisgender man;
- Age, which equals the age of the respondent;
- Senior Job, a binary variable that equals one if the respondent’s job title fits the role of Principal, Director, or Executive;
- Advanced degree, a binary variable that equals one if the respondent has completed a master’s Degree or PhD;
- Financial Barriers: a binary variable that equals one if the respondent identified having to work outside of class or financial challenges as either a moderate or very significant challenge in high school or post-secondary; and
- Discrimination, a binary variable that equals one if the respondent identified discrimination as either a moderate or very significant challenge in high school or post-secondary. Note that non-Indigenous participants also had the option of identifying discrimination as a challenge, and discrimination does not solely mean discrimination on the basis of Indigeneity.

Ci is a subset of control variables *Xi*, which we interact with *Indigenousi*.

A.4 Summary of planning activities and related Engineers Canada project

This project is related to additional initiatives, research, and planning activities contributing to Engineers Canada meeting their strategic objectives to enhance Indigenous access to Engineering. In order to explore the collection of data on Indigenous students and engineering professionals, Big River Analytics started by evaluating existing secondary data. Specifically, Big River Analytics evaluated the 2016 Census of Population, the Labour Force Survey, and the 2017 Aboriginal Peoples Survey (APS) as secondary data sources to determine if they were well suited to providing information on Indigenous engineers. This phase of work culminated with the report “Indigenous engineering in Canada: Analysis of secondary data to support Engineer’s Canada Operational Imperative 9 sub-strategy: Indigenous access to engineering” (2020). Key findings concluded that:

- Indigenous people are underrepresented in engineering occupations relative to their representation in the population and labour force at the national and provincial and territorial levels.
- Secondary data, like the 2016 Census of Population, cannot be used to estimate the number of professional engineers.
- Other secondary data sources, like the 2017 Aboriginal Peoples Survey, are not suited to analyze the representation or experiences of Indigenous engineers.
- There are large data gaps that limit our understanding of who Indigenous engineers are, what their experiences have been, and ultimately, how to make the profession more inclusive and representative of Indigenous peoples.

As a result of these findings and the limitations of secondary data analysis, Engineers Canada moved into a second phase of work focused on the collection of primary data. Working alongside the Indigenous Advisory Committee, Engineers Canada established as a first research priority the development and enumeration of a pilot survey that would collect data on the number of Indigenous engineers in three jurisdictions, and explore characteristics and experiences of this group. This report presents the results of the primary data collection and analysis project that ensued.

Appendix B - Regression tables

This appendix displays regression tables detailing the Indigenous pay gap analysis discussed in Section 2.3. The regressions shown are ordinary least squares estimates of the estimating equation discussed in Appendix A.3. First, we show Table B.1, a regression table of models used to identify whether or not there is an Indigenous pay gap. Second, we show Table B.2, which identifies the Indigenous pay gap separately for cisgender men and engineers who are not cisgender men. Finally, Table B.3 presents determinants of pay among engineers, and estimates the remaining unexplained Indigenous pay gap by gender.

It is important to note that the dependent variable in these regressions has been log-transformed. Therefore, in order to interpret the coefficients, one must transform the coefficient into a percentage:

$Percent\ Effect = 100 \times (e^{\beta} - 1)$

where β denotes the coefficient of interest.

Table B.1: Indigenous pay gap analysis: regressions of log salary on Indigeneity

Variable	(1)	(2)	(3)	(4)	(5)
(Intercept)	11.642***(0.022)	11.683***(0.026)	11.195***(0.093)	9.808***(0.306)	9.863***(0.317)
Indigenous	-0.065(0.072)	-0.057(0.070)	-0.066(0.074)	-0.060(0.072)	-0.058(0.072)
not cis man		-0.126**(0.045)			-0.054(0.038)
age			0.010***(0.002)	0.072***(0.014)	0.070***(0.015)
age × age				-0.001***(0.000)	-0.001***(0.000)
Num.Obs.	601	601	569	569	569
R2	0.001	0.014	0.058	0.094	0.096
R2 Adj.	0.000	0.011	0.054	0.089	0.090
AIC	916.9	910.9	733.6	713.6	713.9
BIC	930.1	928.4	751.0	735.3	739.9
Log.Lik.	-455.440	-451.427	-362.814	-351.795	-350.925

F	0.732	4.390	17.335	19.429	15.022
Note: Stars denote significance level: + p < 0.1, * p < 0.05, ** p < 0.01, *** p < 0.001. Robust standard errors are used.					

Table B.2: Indigenous pay gap analysis by gender: regressions of log salary on Indigeneity by gender

Variable	(1)	(2)
(Intercept)	11.680***(0.026)	9.866***(0.316)
Indigenous	-0.007(0.102)	0.001(0.103)
not cis man	-0.115*(0.048)	-0.040(0.039)
Indigenous × not cis man	-0.126(0.135)	-0.153(0.135)
age		0.070***(0.015)
age × age		-0.001***(0.000)
Num.Obs.	601	569
R2	0.016	0.098
R2 Adj.	0.011	0.090
AIC	912.2	714.6
BIC	934.2	745.0
Log.Lik.	-451.098	-350.310
F	3.143	12.266
Note: Stars denote significance level: + p < 0.1, * p < 0.05, ** p < 0.01, *** p < 0.001. Robust standard errors are used.		

Table B.3: Determinants of Indigenous pay gap by gender: regressions of log salary on Indigeneity by gender

Variable	(1)	(2)	(3)	(4)
(Intercept)	9.865***(0.322)	9.857***(0.316)	10.027***(0.306)	9.994***(0.309)
Indigenous	0.052(0.099)	-0.001(0.103)	-0.017(0.099)	0.037(0.095)
not cis man	0.013(0.041)	-0.038(0.040)	-0.037(0.039)	0.030(0.043)
Indigenous × not cis man	-0.196(0.130)	-0.157(0.136)	-0.131(0.129)	-0.193(0.126)
discrimination	-0.151**(0.051)			-0.172***(0.051)
Senior Job			0.263***(0.049)	0.260***(0.049)
financial barriers		0.021(0.042)		0.073+(0.042)
age	0.071***(0.015)	0.070***(0.015)	0.063***(0.014)	0.063***(0.014)
age × age	-0.001***(0.000)	-0.001***(0.000)	-0.001***(0.000)	-0.001***(0.000)
Num.Obs.	569	569	569	569
R2	0.115	0.099	0.130	0.150
R2 Adj.	0.106	0.089	0.120	0.138
AIC	706.0	716.3	696.4	687.0
BIC	740.7	751.1	731.1	730.4
Log.Lik.	-344.984	-350.160	-340.195	-333.496
F	12.167	10.258	13.963	12.352
Note: Stars denote significance level: + p < 0.1, * p < 0.05, ** p < 0.01, *** p < 0.001. Robust standard errors are used.				

6.0 References

Association of Professional Engineers and Geoscientists of Saskatchewan (APEGS). 2020. “2020 Annual Report”. https://www.apegs.ca/assets/2020-apegs-annual-report.pdf

EDGE Certified Foundation. 2020. “EDGE Unexplained Gender Pay Gap (UGPG) Analysis.” https://edge-cert.org/wp-content/uploads/2020/07/EDGE-GenderPayGap-Methodology_v1.1_1July2020.pdf

Engineers Canada. 2019. “Engineers Canada Strategic Plan 2019-2021.”

https://engineerscanada.ca/srv/drupal-engineerscanada-website/src/sites/default/files/board/engineers-canada-strategic-plan-2019-2021.pdf

Engineers Canada. 2020. “About Diversity in Engineering.” Engineers Canada. https://engineerscanada.ca/diversity/about-diversity-in-engineering

Engineers Canada. 2021. “Indigenous engineering in Canada.” Engineers Canada. https://engineerscanada.ca/indigenous-engineering-in-canada

Engineers Geoscientists Manitoba. 2021. “Registrant Statistics”. http://www.enggeomb.ca/Statistics.html

Statistics Canada, 2016 Census of Population, Statistics Canada Catalogue no. 98-400-X2016357 and no. 98-400-X2016266

Thompson, S.K. 2006. “Adaptive Web Sampling.” *Biometrics*, no. 62, 1224-1234. https://doi.org/10.1111/j.1541-0420.2006.00576.x.

United Nations. 2007. “United Nations Declaration on the Rights of Indigenous Peoples.” United Nations. https://www.un.org/development/desa/indigenouspeoples/wp-content/uploads/sites/19/2018/11/UNDRIP_E_web.pdf

Wilson, Daniel and David Macdonald. 2010. “The Income Gap Between Aboriginal Peoples and the Rest of Canada.” *Canadian Centre for Policy Alternatives*. http://www.policyalternatives.ca/srv/drupal-engineerscanada-website/src/sites/default/files/uploads/publications/reports/docs/Aboriginal%20Income%20Gap.pdf

Endnotes

[1] Excluding respondents who reported a salary over $3.6 million. Detailed methodology can be found in Appendix A.

[2] The totals for genders in our basic regression are: 398 cisgender men, 161 cisgender women, four gender non-binary engineers, four engineers unsure of their gender identity, two Two-Spirit engineers, and one transmasculine engineer.

[3] Source: Big River Analytics Indigenous Inclusion in Engineering Survey - (EGBC/APEGS/EGM). Number of Indigenous respondents: 58. Number of non-Indigenous respondents: 603.

[4] Indigenous engineering access programs provide support for current and potential Indigenous students throughout their engineering post-secondary education. For example, the University of Manitoba’s Engineering Access Program (ENGAP). Services this program offers include: academic supports in both preparatory and university courses; personal and academic counselling; and, a limited amount of financial assistance in the form of a bursary may be available to some students who have no other means of funding, or who exemplify the greatest need.

[5] The challenges “Lack of internet at home” or “Lack of internet at school” were not applicable for those whose formative years were pre-internet. Without an option for challenges to be non-applicable in the survey, the proportion of Indigenous engineer respondents who face this challenge include both those with formative years pre-internet, and those who did not have access to internet when it was publically available.

[6] Full questionnaire available upon request.