

FACTORS AFFECTING THE BALANCING OF GENDER REPRESENTATION IN THE ENGINEERING INDUSTRY

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SUMMARY

Women continue to be underrepresented in the engineering industry; however, in New Zealand, the key factors contributing to this disparity have not been analysed. This study investigated the factors that affect gender imbalance in the New Zealand engineering workforce. Barriers inhibiting and initiatives positively influencing the career progression of men and women were identified. Empirical data was gathered in a mixed-method approach, both quantitative and qualitative. Analysis of the results identify women are often subject to serious discrimination and stereotyping. The researchers also determined factors which would help improve gender diversity within the engineering industry in New Zealand.

INTRODUCTION

The presence of gender disparity in the global engineering industry has often been noted, with women vastly less represented than men, particularly in leadership roles. A 2015 Engineering New Zealand (formerly IPENZ) study illustrated the ongoing disparity, with 9% of technical leaders and 8% of senior managers and board members being women engineers, although 16% of engineers within the participating organisations identifying as women (IPENZ, 2015). However, this data lacks an accurate representation of the industry as only 15 self-selected organisations in New Zealand participated. The extreme underrepresentation of women in leadership suggests measures are needed to improve diversity.

In 1991, 4.9% of engineers and architects were women (New Zealand & Statistics New Zealand, 2015), and 24 years later, the percentage of women engineers in New Zealand had increased by 11%. Initiatives to increase the number of women entering the engineering industry are currently underway with the University of Auckland's 'Women in Engineering 33% Project' undertaking efforts to improve the proportion of women enrolling in an engineering degree. The 2020 cohort of undergraduate students comprised of 27% women students, the highest ever proportion. Despite this, the distribution within the engineering industry does not yet represent that within undergraduate study.

International studies show the retention of women in engineering is lower than in other industries (Frehill, 2012; Hunt, 2016). The higher proportion of women leaving engineering suggests factors within the industry are pushing women to exit the field. The purpose of this study is to understand the factors that affect engineering graduates' career progression in New

Zealand, how these contribute to the persistence of gender disparity in the industry and how they can be addressed.

METHODOLOGY

This research project utilised a mixed-method approach combining quantitative and qualitative data to develop breadth and depth in its analysis of experiences within the engineering industry. The quantitative data was collected through a high-level survey on LinkedIn and a questionnaire. The questionnaire also contributed to the qualitative data, along with exploratory focus group interviews.

An extensive preliminary literature review was conducted to analyse gaps within previous research and discover common factors affecting women in workplace environments. The researchers then distinguished 12 factors to shape the questionnaire and focus group interviews. Both the questionnaire and focus group interviews were designed to be semi-structured to recognise additional factors influencing the participants' experiences in engineering.

For both the high-level survey and questionnaire, participants were University of Auckland Faculty of Engineering graduates between 2011 and 2017, and across all engineering specialisations and genders. The focus group participants were self-identifying women, and not specifically University of Auckland graduates, although participants graduated within the same timeframe.

High-Level LinkedIn Survey

To gain an overall impression of the career progression of the graduates, high-level data was collected using LinkedIn. Data was collected from the profiles of 300 men and 294 women.

Questionnaire

One thousand, three hundred and seventy-nine questionnaire links were sent out to the participants through LinkedIn, with 271 completing the questionnaire (137 women and 134 men), corresponding to a completion rate of 19.6%.

Focus Group Interviews

Of the 27 companies approached to conduct focus groups, six companies participated, with a total of 18 women. Due to restrictions associated with COVID-19, the focus groups were conducted primarily online. The deliberate semi-structured nature of the focus group interviews was to create an open discussion about the participants' experiences in the engineering industry. This allowed for additional issues to emerge. The questions asked were open-ended and did not mention the factors investigated in the literature review to limit potential bias.

RESEARCH FINDINGS AND DISCUSSION

High-Level Quantitative Data Summary

Through the high-level data collection, it was found that 18% of women who studied engineering left the industry within nine years of their graduation, compared to 11% of men. Of those who left engineering, 74% of women and 64% of men had another tertiary qualification, and 49% of women and 45% of men left within one year of graduation. This indicates the existence of the "leaky pipeline", even only a short time following graduation.

There are similar proportions of women and men who have studied an engineering (or a related science) postgraduate qualification, 20% of women and 17% of men, suggesting that women may not see postgraduate engineering qualifications as a way of differentiating themselves from men.

Programmatic Factors Quantitative Data Summary

Programmatic factors have been classified in this study as those influenced by administrative measures within companies. These factors included technical skill development opportunities, professional development opportunities, mentors, leadership opportunities, role models, workplace flexibility, networking opportunities, pay transparency and parental leave.

Participants were asked to identify how the programmatic factors had impacted their career progression. Their responses are shown in Figure 1. This figure shows most of the programmatic factors have positively impacted the career progression of men and women in the engineering industry. The factor most negatively impacting the career progression of engineers is also one of the least cited as impacting factors; Pay Transparency.

The least common impacting factor was Parental Leave cited by less than 5% of participants. It is likely the low proportion of those impacted by parental leave is due to the participant criteria, excluding those further into their careers who would be more likely to have encountered this.

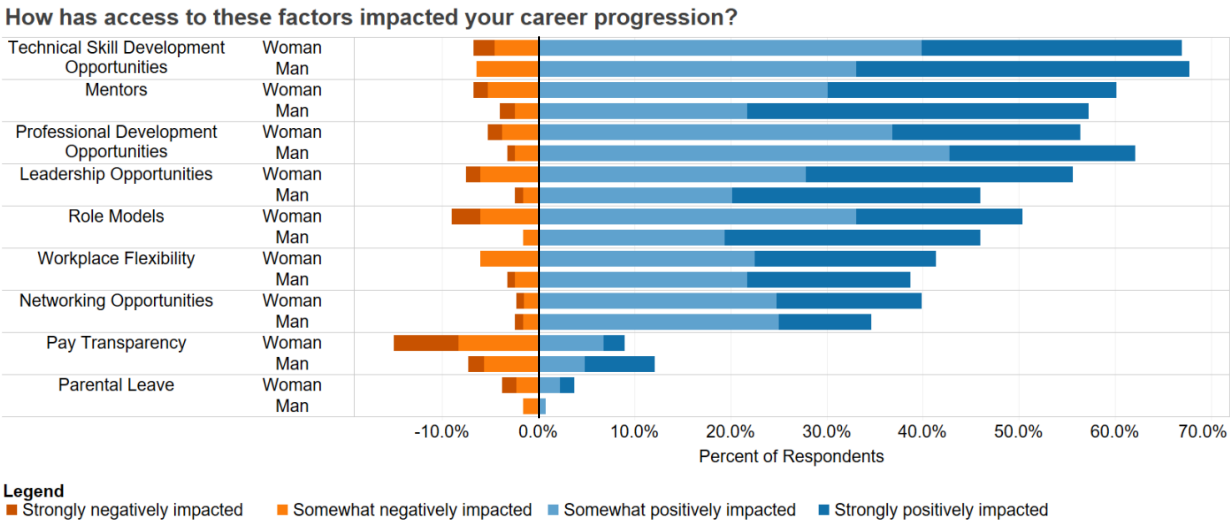


Figure 1: Impact of Programmatic Factors on Career Progression

Participants were asked to identify how accessible they have found the programmatic factors which impacted their career progression, as shown in Figure 2. Across most factors, about 15% of participants are dissatisfied with the level of accessibility. The factor which showed the greatest discrepancy between men and women was role models with more than 25% of women dissatisfied with their accessibility.

How satisfied are you with the level of accessibility of these factors in your professional engineering career?

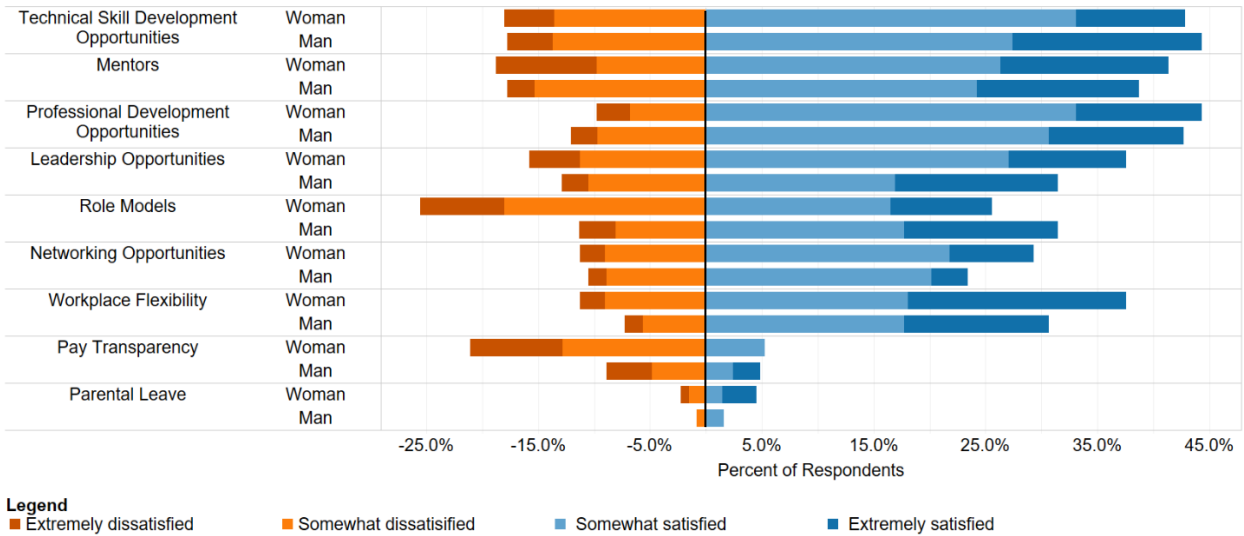


Figure 2: Accessibility of Programmatic Factors

Cultural Challenges Quantitative Data Summary

Questionnaire participants were asked to identify how frequently they experience cultural challenges in the engineering industry. Their responses are shown in Figure 3. This figure shows variation between the experience of men and women in the engineering industry, particularly regarding gender stereotypes.

Have you experienced these challenges in your professional career in the engineering industry?

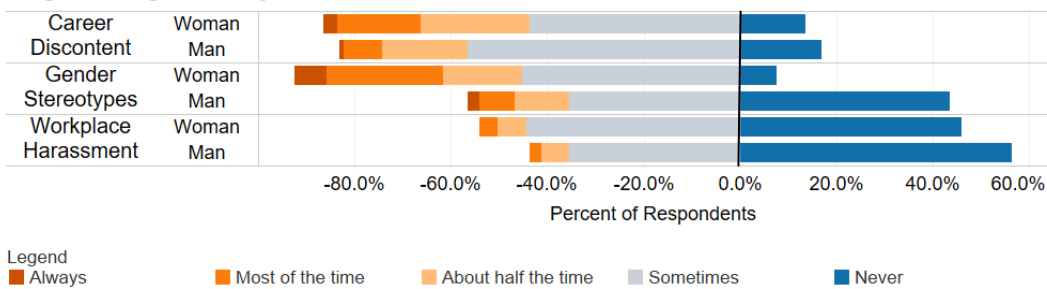


Figure 3: Cultural Challenges Impacting Career Progression

Barriers including Gendered Discrimination, Stereotyping and Harassment

Quantitative evidence suggests that women are frequently subjected to gendered stereotypes within the workplace, with 92% of women reporting having experienced gendered stereotyping in their career (see Figure 3). Many women in the focus groups and questionnaire comments raise their experiences with stereotyping.

A concerning finding from the focus groups was that women often do not recognise negative experiences they encounter as barriers to their career progression in the workplace. When asked the question, “Have you experienced any gendered related barriers in the workplace?”, often women would not mention any, then later state significant challenges experienced which would be considered gendered barriers. Comments from participants:

"I did obviously get the whole sexual harassment and everything. That's what slowed down my career progression, so that's annoying ... and now I'm changing teams because of one incident."

"...contractors...they would have posters of naked females. It's kind of like become this almost normalised thing...." "She went to site, and they were actually taking a photo of her face and sticking it on one of those posters."

"I wouldn't say barriers, but things you have to deal with that other people don't. Just stuff such as female-male toilets on site, and that can be a hassle to get."

Women reported seeing these gendered experiences as inevitable, which creates a cycle where they are normalised within the industry. Participants made statements such as "it is just something I have to deal with" and "guys will be guys". This effort to normalise or justify behaviour speaks to the discriminatory culture of the industry which influences the treatment of women and their identity. The dismissal of gendered barriers may lead to women not confronting these issues, contributing to their ongoing persistence.

Negative behaviour, such as unconscious bias, from senior women to other women was observed in the qualitative data. This could contribute to a greater degree of normalisation of discrimination within the industry and the inevitability of the negative environment. Some participants raised this:

"A lot of women actually ... put down other woman. I thought, what would cause it and that would be inherent insecurity."

"The biggest barrier to women is ourselves, but half the time we are unconsciously bias against ourselves we just don't know it."

Open discussions within companies can bring to light instances where people feel uncomfortable or emphasise that there should be no institutionalised discrimination within the industry. Engineers at all levels will need to become aware of the discrimination and stereotyping to combat this. Fostering a more positive environment will benefit all those working in the engineering industry and should be prioritised through increased awareness.

Confidence Issues

Women in this study have outlined they felt required to change their personality to be perceived as self-confident and "be able to survive" in engineering:

"You have to have thick skin. You have to go on with their stereotypes, and you have to be able to talk back to them when they make insulting jokes....That's the part of engineering that I hate."

Some women state that it was their biggest obstacle within the industry; for some, they wanted to give up.

"Self-confidence and trust in myself, likely influenced by societal views of young women, have been the biggest hurdles for me to overcome, and I am still working on taking ownership and addressing them."

The frequency of gendered stereotypes makes it challenging for women to fit the mould of a "typical" engineer. Feelings of discontent can arise as they are not able to bring their full selves to work. This resonates with the "I look like an engineer" movement, started by Isis Anchalee, where women are using online presence to bring awareness to gendered stereotyping. This is helping the global engineering industry redefine 'what engineers should look like' and break stereotypical beliefs (Anchalee, 2015).

Building the confidence that many women have cited is how women cope with being the minority in this industry. Future industry progression should allow women to be comfortable in their own skin. Empowerment of women and all diversity within the industry, through role

models and mentors, can give people the confidence to progress their career and be confident in their abilities.

Supportive Managers and Teams

Many women cited their managers as having a significant impact on their career progression, often providing them with development opportunities and challenging them in varied roles, elevating their career enjoyment. Managers also contribute greatly to a positive or negative team culture, which can sometimes be independent of the company culture.

Supportive managers can contribute to increased workplace flexibility:

"The consultancy industry seems to be pretty flexible. I mean, the bosses that I've always had have always had families of their own...their wife, obviously, is in that same boat and they kind of understand a little bit."

Managers who treat women as engineers, not women, improve inclusion and comfortability in team environments:

"Some of the managers have not seen me as a female, just as an engineer. That helps a lot as they base their knowledge of you on the work you have done and how hard you work."

However, this is not always the case. Some women are unfairly put on administration tasks instead of workshop tasks, showing unsupportive managers are reluctant to see women as engineers, consequently negatively impacting women's career progression:

"Not getting experience in the workshops, pushing for nine years to get workshop experience, worked on it twice, but then put back onto documentation work. Girls are often stereotyped into documentation work rather than work in the workshop."

Once again, this links to gendered bias where people are unjustly treated due to gender, another reason why women may feel a lack of self-confidence as an engineer. Companies should seek to equip managers with tools to support and encourage women with their career development without pigeonholing them into stereotypical roles.

Role Models

Access to role models was reported as the fifth highest factor impacting career progression. However, accessibility of role models for women in the workplace was found to be a concern with 26% of women dissatisfied with their accessibility compared to 11% of men (see Figure 2). From this graph, we can also see that 16% of women are dissatisfied with the accessibility of leadership opportunities, showing possibly why so few women are role models in companies. Through the focus groups, it was clear that women in leadership roles in engineering companies are limited.

Qualitative data shows that the presence of role models in companies allows women to be inspired, knowing this could be a future role for them in the industry:

"More female role models to look up to and be inspired by at the upper management levels of companies in the engineering industry would assist younger women's career progression in the engineering industry."

"Would be really helpful to have role models...I believe I can get there, but it would be encouraging if there were someone in those roles to see that I can do it."

Seeing women leaders in the workplace allows women to feel more confident in themselves in the early stages of their career. Providing women with leadership opportunities or mentorships into a leadership role would help improve the number of women in these roles, diversifying the

company, and subsequently increase the number of role models for young engineers to look up to.

One may assume that networking would be a good gateway to meet women role models when you cannot find role models within your company. However, evidence suggests that there aren't role models or even women engineers present at industry networking events:

"I do find that it's not really women in construction as such, it's more women that hang curtains and things. Which is construction in a way but not civil construction."

This limits the accessibility of role models in the engineering industry as a whole, showing a lack of connection to support women within the profession.

Mentors

Mentoring has a strong positive impact on the careers of both men and women in the engineering industry. On average, 60% of graduates are positively impacted by mentors (see Figure 1), and 18% are dissatisfied with their accessibility (see Figure 2). This shows the lack of mentors is present within the industry. Qualitative evidence illustrates that mentorships provide both women and men with support and a healthy work environment. Implementing mentors within the workplace can be highly beneficial for the growth of self-confidence and retention of women in the industry:

"... a senior engineer took me under his wing. Without that one person, I would have left within one year because the rest of the environment wasn't quite as welcoming..."

"I have struggled multiple times during my career due to gender bias, and it very nearly made me want to give up. Reaching out and asking for mentorship outside of my company is what helped me get back my confidence."

Mentors for male engineers focus on more career-orientated advice, than the development of an individual's confidence. Mentors from the same team, company, industry and even outside the engineering industry have provided engineers with valuable insights into the experiences of others and equipped them with tools to navigate a career in the industry.

Some focus group participants wanted to be mentored by a woman. However, there is a lack of women mentors due to insufficient role models in their respective company. In this situation, potential outside company mentoring as an initiative was mentioned where there would be a larger pool for women mentors that can help progress women's careers:

"Considering that many people don't have female leaders in house, it would be very beneficial to have a program connecting all the other female leaders in other companies."

Women participants also have emphasised the value of mentorships with members of leadership within the company to help them progress to leadership positions in the near future. This relates more closely to women who have already progressed their career from the graduate, intermediate stage; improving the levels of role models within the engineering industry.

Career and Pay Transparency

Men and women highlighted the negative impact of a lack of pay transparency in the engineering industry. Figure 2 shows 21% of women dissatisfied with the level of pay transparency, compared to 8.8% of men. Many women have cited that pay inequality or transparency is of concern:

"Pay equity (or the lack of) is a serious concern. It is blatantly obvious how different the pay scales are between genders and how little employees can do about it."

Some women are not surprised if men get paid more than they do, suggesting that pay transparency would help women see if they are valued within the company, potentially reducing gender inequality at the same time.

Career progression transparency influences the career of both genders; however, predominately men mentioned this in the questionnaire. Engineers want to know how they will advance from their current job:

"Clearer definition about what is required to progress. More structured framework."

An increase in clarity around pay and career progression may prove beneficial to all those in engineering, with a formal structure facilitating evaluation and accountability concerning equality within a workplace.

Workplace Developmental Opportunities

Both men and women highlighted technical and professional skills development opportunities impacted their career progression. Some participants found the resources are "endless". However, Figure 2 suggests that potentially more accessibility to these opportunities are needed. Although technical skill development opportunities are beneficial to career progression, as the questionnaire data is similar between men and women, this is not considered a factor that affects the balancing of gender representation in the engineering industry. However, using professional development opportunities as an initiative will help drive the balancing of gender representation.

Some women have noted professional development training, diversity courses, and interpersonal skills training could improve the industry. They specifically raised diversity and interpersonal skills training to neutralise gendered bias and reduce barriers:

"... interpersonal skills training teaches you how to [deal with confrontation] in a way which is comfortable..."

Confrontation and Human Resources

Some focus group participants mentioned their reluctance to deal with confrontation within engineering. Multiple women said within the qualitative data that they are hesitant to confront others who may have made them uncomfortable:

"Just the confrontation is quite daunting, but, you know, as a female, he could have reacted in two different ways."

Participants raised their uncertainty of how their colleagues will react and perceive them if their unfair comments are called out. Women want to know whether their colleagues are open to them calling out on their potential unconscious bias without creating unnecessary conflict.

Women find the current systems for dealing with instances of discrimination or harassment inadequate. Multiple instances arose where women mentioned pulling their complaints from human resources. Some felt human resources were not on their side, were not handled in the way they would have liked, or the process was too long:

[when talking about HR] "First, when I talked to one lady, she was so empathetic. I didn't want to go on with her because she was not on my side what-so-ever.... But then I decided not to make it formal...I didn't want to go through with it because I have so much on my plate right now."

"It ended up getting built up into an HR level and blowing up.... You become very aware of the situation and how people perceive of you within the company."

This hesitation in approaching human resources has resulted in some women ignoring instances of discrimination, contributing to the sense of inevitability.

To better deal with these problems, greater promotion of interpersonal skill development is recommended. It would be beneficial for those in the industry to be made aware of their unconscious bias. Learning skills to better deal with confrontation and communication in the workplace would also prove beneficial for women, so they feel comfortable approaching their colleagues when inappropriate comments are being made.

CONCLUSION

The presence of gender disparity in the engineering industry in New Zealand is ongoing, with many approaches currently being used to address this problem. A combination of quantitative and qualitative data has been used to assess engineers' career progression and their experiences in the early stages of their careers. Through this research, key initiatives that have proven useful in advancing women's career progression in the industry have been identified, alongside challenges to this progression.

The prominence of gender stereotypes in the engineering industry is a significant challenge. Their prevalence contributes negatively to the career progression of women across all disciplines of engineering in New Zealand. Women continue to feel out of place in the industry and can feel a need to change their personality to fit in, or become accustomed to uncomfortable experiences in the workplace, seeing these as inevitable. These challenges require a cultural shift within the industry to overcome.

Mentors and role models have been vital in overcoming the barriers women face to their career progression. Having mentors to encourage and support women throughout the early stages of their career has prevented a number of women from leaving the industry. The presence of women in leadership roles also acts as inspiration for those progressing in the industry, showing what could be possible for them in the future. Providing a supportive environment with encouraging management teams and room for women to develop into leadership roles is crucial to enabling gender equality in the industry.

Companies that facilitate career and pay transparency are beneficial as it allows employees to know they are valued. Industry-wide implementation of diversity and interpersonal skills training can be valuable to everyone by allowing them to recognise their own stereotyping and unconscious bias. This training can also help women be more comfortable talking about workplace issues with their colleagues or human resources.

Addressing gender disparity in the engineering industry in New Zealand and supporting women in their career progression will require contributions from those working at all levels of the industry. Programmatic factors can be utilised to improve the careers of all those working in the industry, and increased awareness of those that affect women is key. Cultural challenges will require ongoing work to overcome, particularly entrenched stereotypes and bias.

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