Women in Engineering
June 2022

Identifying avenues for increasing female participation in engineering, by understanding the motivators and barriers around entry and progression

ENGINEERS
AUSTRALIA

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1 / Foreword

Engineering has a long history of being a male-dominated profession. In several disciplines and areas of practice such as biomedical engineering, much progress has been made on this front. However, in other disciplines such as mechanical engineering the number hasn't moved much in 30 or more years. I graduated in mechanical engineering in 1993 with only a few other females in my cohort of around 120. And the numbers haven't improved significantly since then and neither has the aggregate proportion of qualified professional engineers who are female, which is still low at 13% (and the proportion of female engineers who are working in an engineering role is at 11%).

We are all now very well aware of the reasons a more gender diverse workforce is beneficial. The reasons extend beyond equity and equal opportunity, to enhanced productivity and innovation that fresh perspectives resulting from diversity through any lens (gender, culture, socio-economic background etc.) brings. The dial is moving, but at such a slow rate, that it is beholden of our whole profession to act.

Engineers Australia commissioned this research in late 2021 to obtain insight into what factors are most influential when it comes to causing female engineers to choose engineering, and what factors caused those who didn't choose engineering, to not choose it. We want to use the insights to identify which factors are most influential so initiatives can be designed to amplify these effects. We surveyed equal numbers of men and women (both engineers and professionals from other fields). We did this initially to understand whether any differences in these motivating factors existed between genders. As the research was conducted over late 2021 and early 2022, the broader engineering skills shortage developed into what could now be described as a workforce crisis. While demand for engineering skills is difficult to forecast, indications are that Australia will require in the coming years, tens of thousands (if not hundreds of thousands) more engineers than we currently have. Skilled migrants play a critical role (and another significant piece of research we commissioned focuses on improving skilled migrant engineering workforce participation), but we cannot rely on that source of supply alone. We need to train significantly more engineers in Australia. We can therefore use these research findings more broadly, to identify ways to encourage more young people, of all gender identities, to choose to study engineering.

I am sure you will find the research report both fascinating and useful. The data both convincingly validates some of our commonly talked-about hypotheses and reveals some new and powerful insights. It's exciting to have these insights and this data at our fingertips, but what is even more exciting is what we plan to do with them. The next phase of this work will see initiatives designed and implemented to encourage more young Australians, in particular young women, to choose engineering as their field of further study and career, and in so doing, strengthen the pipeline of Australian engineers which we are so reliant on for the myriad of challenges and opportunities we have in front of us.

We look forward to working with many of our members and colleagues across Government, industry and higher education to strengthen the engineering workforce in Australia.

Jane MacMaster, FIEAust EngExec CPEng MRAeS
Chief Engineer, Engineers Australia

2 / Executive summary

Australia needs to increase the participation, and retention of women in engineering. Engineering is the largest employer of the STEM (Science, Technology, Engineering and Maths) professions. However, engineering has the lowest female representation of the STEM professions, with just 16% of Australian engineering graduates and 13% of the Australian engineering workforce female. This is in stark contrast to other STEM fields, such as biological sciences, where the gender representation tends to be far more balanced.

Engineers Australia commissioned this research in 2021/22 to understand the initiatives and influencing factors that effectively drive greater female participation in engineering. This requires an understanding of the fundamental motivators and barriers influencing girls to pursue (or not pursue) engineering as their area of study and potential career.

This research, led by independent accredited agency, Ergo Strategy, sought to:

1. Identify the motivators of female participation: Why do women choose to study and work in engineering?

2. Identify the barriers to female participation: What factors contribute to the low rate of female participation in engineering, and what stops women from remaining in the engineering profession?

3. Identify the initiatives for driving greater female participation: What touchpoints and initiatives have the strongest potential to enhance the motivators and address the barriers?

Participation in engineering can be conceptualised as a journey comprising three broad stages: initial consideration of and choice to study engineering; studying engineering at university; and going on to work in the engineering profession. This research investigates each of these stages.

Based on the research, Engineers Australia has identified key areas that need to be addressed:

- The main reason stated by women who didn't study engineering was lack of familiarity of engineering, there is little awareness of what engineering involves.
- A lack of positive perceptions of the engineering profession – seen as male dominated and challenging, and not impactful or fulfilling
- Poor STEM engagement throughout schooling – many girls don't feel supported to do well in STEM.
- Whilst generally a positive experience studying engineering at university, students feel less supported to do well in their studies, compared to other degrees.
- Most female engineers feel valued at work and are passionate about their work, however there are significant issues for women with workplace culture and unequal opportunities.

THE PARTICIPATION "FUNNEL"

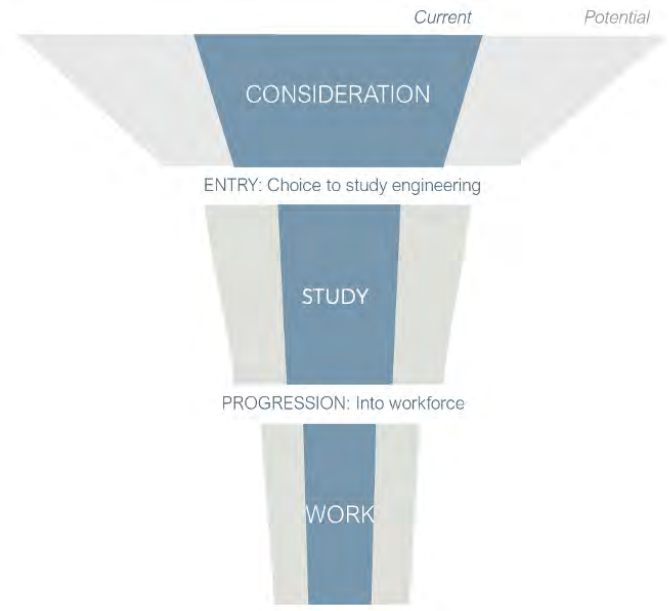


Figure 1.1. Schematic showing the "funnel" of participation in engineering, from initial consideration through to study and work.

CONSIDERING ENGINEERING

The research reveals that when it comes to female participation in engineering, the greatest problem lies in the initial stage of consideration – spanning the primary and high school years. This is therefore where our efforts should focus most because it represents the largest opportunity to significantly increase the number of women in engineering.

- Most girls do not even think of engineering as a career option, with only 7% of surveyed women in non-engineering fields saying that they had seriously considered engineering. This is driven by a lack of familiarity: there is little understanding of what engineers do, or of the breadth of the engineering profession and the career opportunities if offers.

- Engineering lacks positive perceptions: it is mainly seen as male-dominated and challenging. It is not perceived as impactful or fulfilling – which are important considerations for many women and girls.

- Many girls are not supported to do well in STEM subjects in primary and high school, which reduces their likelihood of pursuing the prerequisite subjects for engineering degrees. There also exists a damaging perception that one needs to be exceptional in STEM subjects, particularly maths and science, in order to meet the demands of engineering study.

- In this space, longer-term initiatives that address the systemic issues outlined above are critical. However, there is certainly still a place for "short and sharp" initiatives like school talks – the key is to ensure that women are represented in these initiatives, and that the messaging speaks to the key motivators of career choice. Initiatives also need to be early – targeting students from junior high school (and even earlier).

STUDYING ENGINEERING

Female engineering students and graduates generally report a positive study experience; however, there are opportunities to improve the quality of university engineering education overall.

- Women in engineering rate their overall studying experience as positively as their male peers. And despite the gender imbalance in their cohort, female engineering students still tend to feel a sense of belonging to a learning community.

- However, compared to other degrees, both female and male engineering students are less likely to feel supported to do well in their studies. Engineering courses are also rated relatively poorly for practical experience and teaching quality.

- Initiatives in this space should seek to help engineering students feel more supported in their studies across the duration of their degree (e.g., peer mentoring programs that extend beyond first year; tutorial formats that better support learning; programs and events that help students engage with industry). There is also a need to strengthen the practical elements of engineering education (i.e., extension of project-based and hands-on work beyond the mandatory internship).

Women in engineering tend to have high career satisfaction, and they are passionate about their work. However, there are significant issues around gender discrimination and inequality in the workplace that need to be addressed.

- Female engineers indicate similar average career satisfaction and optimism about their future prospects to male engineers. Furthermore, the vast majority feel valued and respected, and they find their work dynamic, challenging, and impactful.

- This is in spite of significant issues with workplace culture; only 55% of female engineers say they have equal opportunities to men, and nearly 1 in 5 say there is bullying or exclusion of women in their workplace. These issues appear to be the primary driver of women leaving the engineering workforce.

- Initiatives in this space should focus on combatting the non-inclusive culture prevalent in some engineering workplaces, particular larger firms (e.g., gender bias training; reverse mentoring). They should also empower women to progress their careers and to navigate the challenges faced in the workplace (e.g., female-focused mentoring and networking; career progression structures that help mitigate gender barriers).

3 / Introduction

Background

Women constitute just 16% of Australian engineering graduates – and only 13% of the engineering workforce. This is in stark contrast to other STEM fields, such as biological sciences, where the gender representation tends to be far more balanced.

Engineers Australia seeks to understand the initiatives and interaction points that will effectively drive greater female participation in engineering. This requires an understanding of the fundamental motivators and barriers influencing girls to pursue (or not pursue) engineering.

Equipped with this knowledge, Engineers Australia can work with schools, government, academia, and industry to increase the participation of young people in STEM and foster their interest in engineering. Through its networks and associations, Engineers Australia can also advocate for the large-scale changes that will help attract and retain more women into engineering.

Research objectives

The research commissioned by Engineers Australia and conducted by Ergo Strategy in 2021/22 had three objectives:

1. Identify the motivators of female participation: Why do women choose to study and work in engineering?

2. Identify the barriers to female participation: What factors contribute to the low rate of female participation in engineering, and what stops women from remaining in the engineering profession?

3. Identify the initiatives for driving greater female participation: What touchpoints and initiatives have the strongest potential to enhance the motivators and address the barriers?

4 / Methodology

Overview of research program

The research program consisted of a qualitative phase followed by a larger quantitative phase.

SUMMARY OF RESEARCH PROGRAM – QUALITITATIVE AND QUANTITATIVE PHASES

	Qualitative phase	Quantitative phase
Purpose	Exploration: Tapping into existing knowledge, and capturing the key variables and hypotheses to be tested in the quantitative phase	Validation: Testing hypotheses from the qualitative phase, and quantifying the impact of the various motivators, barriers, and initiatives (using a robust sample of respondents)
Method	• Review of relevant past research • 10x online interviews with key stakeholders • 4x online focus groups with women in engineering	• 15-minute online survey of 1,801 respondents (women and men in engineering, as well as women in non-engineering fields)
Timeframe	Conducted in November 2021	Conducted in February 2022

Table 3.1. Summary of research program – qualitative and quantitative phases.

There was strong alignment between findings from the qualitative and quantitative phases, with the latter largely confirming trends and hypotheses identified in the former. The present report focuses primarily on the quantitative results; however, qualitative insights are also included where they help to enrich understanding of the numbers.

Qualitative phase: Exploration

A qualitative phase was used to design the survey for the quantitative research phase – including the overall survey flow, as well as specific survey questions and code-frames. This included:

Review of relevant past research

A review was conducted of relevant past research, including papers prepared for Engineers Australia, the Australian Engineering Taskforce, the Australian Council of Engineering Deans, and the Champions of Change Coalition – on topics such as engineering education in general, as well as the more specific issue of female participation in engineering.

Stakeholder interviews

Interviews were conducted with 10 relevant stakeholders via Zoom videoconferencing. Each interview was approximately 30 minutes in duration. Stakeholders were experienced individuals in industry, academia, and other relevant organisations, who hold extensive knowledge of the present topic.

Stakeholders were asked for their views around the motivators and barriers around female participation in engineering, as well as the attributes of effective initiatives in this space.

Focus groups

A total of 4 focus groups were conducted via Zoom videoconferencing. Each session was approximately 90 minutes in duration. Participant attributes were as follows:

- Group 1: Women studying engineering (7 participants)
- Groups 2 and 3: Women working in engineering who completed their engineering qualification in the last 10 years (11 participants in total)
- Group 4: Women who completed their engineering qualification in the last 10 years, but not currently working in engineering (4 participants)

The focus on either currently studying, or recently completed qualifications was the ascertain the current motivators/barriers for women. We understand, due to societal, generational and technology changes, influences for young people have altered dramatically in the last couple of decades, therefore the focus groups were defined to the most recent decade of influence.

Quantitative phase: Validation

An online survey was developed and iterated using inputs from the prior qualitative phase. The survey asked respondents about their experiences across school, university, and work. Questions were also included to capture respondents' demographic and psychographic data, and their views toward potential initiatives for driving greater participation in engineering.

The survey was fielded through a variety of channels (including Engineers Australia databases and networks, as well as external research panels) during February 2022. A final Australia-wide sample of N=1,801 respondents was achieved. The median time taken to complete the survey was 17 minutes.

Survey respondents

Qualifying criteria

The table below summarises the qualifying criteria for survey respondents. Entrants to the survey who did not meet these criteria were not included.

SURVEY QUALIFYING CRITERIA

Criterion	Rationale
Current university student or graduate (if graduate, completed degree within the past 15 years)	Ensures focus on recent school, university, and work experiences
University degree in engineering if male, and in either engineering or a pre-defined benchmark field (see below) if female	Ensures focus on school, university, and work experiences for engineering and relevant benchmark fields
If engineering degree, must be 4+ year degree or equivalent (e.g., Bachelor of Engineering (Honours))	Ensures focus on the Professional Engineer cohort, excluding those who classify as Engineering Technologists and Associates (based on Engineers Australia definitions)
Currently lives in Australia, and has lived in Australia for all or most of their lives	Ensures focus on Australian (as opposed to overseas) school, university, and work experiences N.B. See Engineers Australia's recent migrant research (October 2021) for insights into the migrant experience

Table 3.2. Summary of survey qualifying criteria, including rationale for each criterion.

Respondent subgroups

Respondent subgroups are summarised in the tables below – including, where relevant, the rationale for their inclusion.

PRIMARY ANALYSIS GROUPS

Group	Rationale	% of total sample	N (number of respondents)	Margin of error
Women in engineering i.e., female engineering students and graduates	Primary focus of this research	38%	678	±3.8%
Men in engineering i.e., male engineering students and graduates	Benchmark to compare women in engineering. This provides valuable context for our results, allowing us to identify what aspects of engineering women over- and under-index in relative to their male counterparts	27%	490	±4.4%
Women in non-engineering fields i.e., female students and graduates of pre-defined benchmark fields	Benchmark to compare women in engineering. Again, this provides valuable context for our results, allowing us to identify where women over- and under-index in relation to women who did not study engineering	35%	622	±3.9%

Table 3.3. Summary of respondent groups used in primary analysis.

DETAILED ANALYSIS GROUPS: ENGINEERING

Group	% of total sample	N (number of respondents)
Female engineering professionals	24%	425
Female engineering students	10%	188
Female engineering non-participants (engineering-qualified but not working in the field)	4%	65
Male engineering professionals	19%	346

Male engineering students	5%	93
Male engineering non-participants (engineering-qualified but not working in the field)	3%	51
Non-binary engineering professionals and students	1%	11

Table 3.4. Summary of specific respondent groups within engineering.

DETAILED ANALYSIS GROUPS: WOMEN IN NON-ENGINEERING (I.E., BENCHMARK) FIELDS

Field of study	Rationale	% of total sample	N (number of respondents)
Science	Benchmark STEM field; more equal gender balance than engineering	8%	141
IT / computer science	Benchmark STEM field; like engineering, is male-dominated	2%	38
Maths / statistics	Benchmark STEM field; like engineering, is male-dominated	0.5%	9
Psychology	Benchmark STEM field; unlike engineering, is female-dominated	5%	96
Allied health (e.g., physiotherapy, occupational therapy)	Benchmark non-STEM field; comparable entry requirements to engineering (ATAR or equivalent, science and mathematics as assumed knowledge and/or recommended subjects); applied science focus; unlike engineering, is female-dominated	6%	116
Medicine / dentistry	Benchmark non-STEM field; applied science focus; more equal gender balance than engineering	1%	25
Commerce / business / economics	Benchmark non-STEM field; comparable entry requirements to engineering (ATAR or equivalent, mathematics as assumed knowledge); like engineering, has quantitative focus; more equal gender balance than engineering	10%	174
Architecture / design	Benchmark non-STEM field; comparable entry requirements to engineering (ATAR or equivalent, mathematics as assumed knowledge); like some engineering disciplines, has built environment focus	1%	23

Table 3.5. Summary of specific respondent groups from fields outside of engineering, used as benchmarks against engineering. All respondents in these groups were female.

As described in Table 3.5, non-engineering fields included as benchmarks were selected on the basis of: similar STEM, subject area or quantitative focus; similar entry requirements (ATAR or equivalent scores, prerequisites, assumed knowledge); and/or gender balance that is either similar to or contrasts with engineering.

Sample sources

Respondents were sourced via a range of channels, for two reasons:

1. To maximise sample size, ensuring a robust overall sample for statistical analysis.

2. To maximise sample representativeness. By sourcing respondents from external research panels (completely independent of Engineers Australia) as well as other sources open to Engineers Australia non-members, biases that may result from a pure Engineers Australia member sample are minimised. Use of external research panels also enables sampling of women from non-engineering fields.

BREAKDOWN OF SAMPLE SOURCES

Source	% of total sample	N (number of respondents)
EA member database	20%	366
EA non-member database	2%	42
EA social media channels (Facebook, LinkedIn, ambassador network)	30%	535
EA networks (Engineering for Australia Taskforce, Champions of Change Coalition)	2%	41
Other (EA EngNews, industry contacts)	0.4%	7
Total from Engineers Australia and associated networks' sources	**55%**	**991**
Total from external research panels	**45%**	**810**

Table 3.6. Summary of sources through which respondents were sampled.

5 / Glossary

GLOSSARY OF KEY TERMS AND SIGNIFIERS USED THROUGHOUT THE REPORT FOR THE QUALITATIVE RESEARCH RESULTS

Term	Aliases	Definition and explanatory notes
Women in engineering	"Female, engineering" "F, eng"	All women in the sample who are currently studying engineering or have completed an engineering degree (less than 15 years since degree completion)
Men in engineering	"Male, engineering" "M, eng"	All men in the sample who are currently studying engineering or have completed an engineering degree (less than 15 years since degree completion)
Women in non-engineering fields	"Female, non-engineering" "F, non-eng"	All women in the sample who do not hold an engineering degree, but are studying or hold a degree in a pre-determined benchmark field (less than 15 years since degree completion; see Methodology section for details)
Professionals	"Engineers" (if working in engineering)	Those in the sample with engineering degrees currently employed in the engineering or benchmark profession (less than 15 years since degree completion)
Students		Those in the sample who are currently enrolled in an engineering or benchmark degree at university (either exclusively, or as part of a double degree)
Graduates		Those in the sample who have completed an engineering or benchmark degree (less than 15 years since degree completion)
Women in science	"Female, science" "F, science"	All women in the sample who are currently studying science or have completed a science degree (less than 15 years since degree completion) This includes all science majors except those who classify their overall degree as being in "psychology" rather than "science". Does not include mathematics / statistics or IT / computer science (these are treated as separate degrees)
Women in health	"Female, health" "F, health"	All women in the sample who are currently studying health or have completed a health degree (less than 15 years since degree completion) Health is broadly defined to include allied health, medicine and psychology, due to their similar entry motivations (as ascertained through the present research)

Women in commerce	“Female, commerce” “F, commerce)	All women in the sample who are currently studying commerce, business or economics, or have completed a degree in one or more of these fields (less than 15 years since degree completion)
*	[Asterisk]	Where helpful for interpretation, asterisks throughout the report denote statistically significant differences between subgroups at the 95% level of confidence

Table 4.1. Glossary of key terms and signifiers used throughout the report.

6 / Entry into engineering

Overview

The low rate of female entry into engineering degrees stems from a simple fact: most girls do not even consider engineering as an option. Only 7% of women who pursued other fields say they seriously considered studying engineering. A further 16% say they considered it only briefly or in passing. This means that about 3 in 4 never considered engineering at all.

As shown in Figure 5.1, consideration of engineering is similarly low even among women who went on to study science. This indicates that engineering, unlike science, is not in the STEM consideration set for most girls. In fact, consideration of engineering is only high among women who went on to study IT or computer science – another male-dominated field (26% of them seriously considered engineering, and 47% considered it briefly or in passing).

CONSIDERATION OF STUDYING ENGINEERING (%)
Among women who ultimately pursued degrees in non-engineering fields

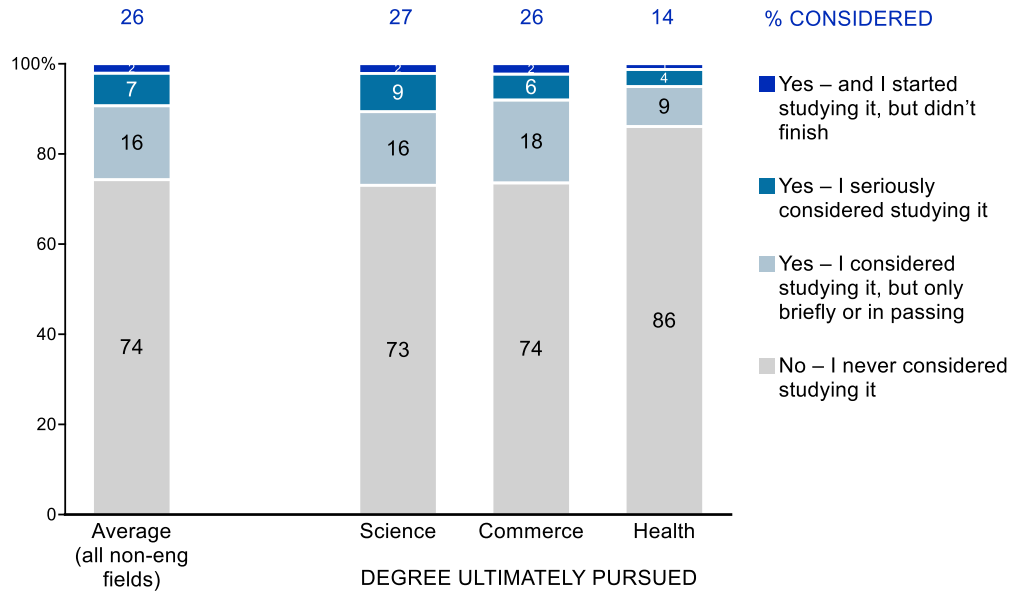


Figure 5.1. Consideration of studying engineering, among women who ultimately pursued degrees in non-engineering fields (%).
QB8 Did you ever consider studying engineering? | Base: F non-eng. All N=622, Science N=141, Commerce N=174, Health N=237

Lack of familiarity is the most selected reason for never considering engineering, with 51% of respondents indicating that they didn't know enough about engineering at the time or had never thought about it (see Figure 5.2).

Other reasons for not considering engineering are concerns around not enjoying or not being good enough at maths and science subjects, and concerns about engineering being too difficult. 72% of respondents who never considered engineering select at least one of these reasons. Concerns about the field being too male dominated are also common (selected by 29%).

In contrast, only a small proportion of respondents indicate concerns about the career prospects or opportunities in engineering.

REASONS FOR NEVER CONSIDERING STUDYING ENGINEERING (%)

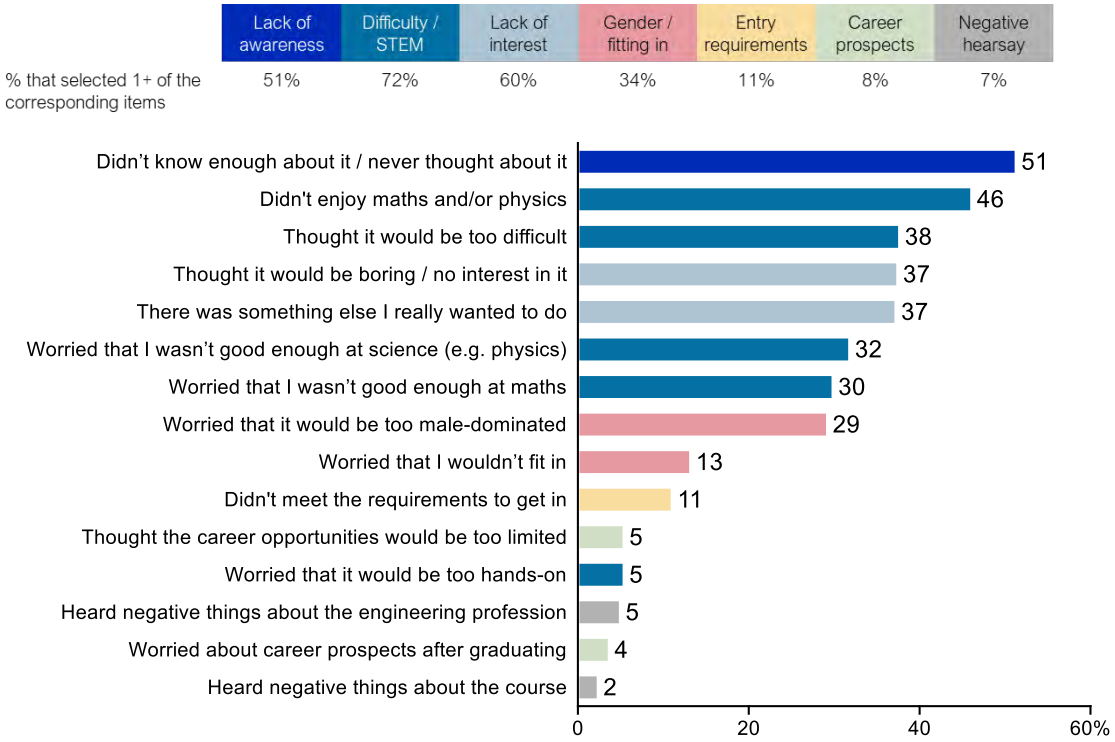


Figure 5.2. Reasons for never considering studying engineering (%). | QB11 Why did you never consider studying engineering? Please select all that apply. | Base: Women who said they never considered studying engineering in QB8 N=462

There is evidently work to do when it comes to perceptions of engineering. Currently, the little that girls typically know about engineering tends to be negative; it is seen as being too difficult and male dominated. Furthermore, it is rarely associated with the positive attributes that engineers themselves attach to their profession: creative, impactful, fulfilling, and exciting. This significantly limits the number of girls who can imagine themselves as engineers and who actively choose to study engineering at university.

Familiarity: The biggest barrier to consideration

Awareness of and familiarity with engineering as a potential career option is a logical first step to considering a career in engineering. Yet, as seen previously, this first step is also the biggest barrier: not knowing enough about engineering is the most common reason for girls to not consider it. Lack of familiarity may present an even greater barrier for engineering than for other degrees. Engineering is such a broad profession, covering many disciplines, industries, sectors and areas of practice and this complexity may contribute to engineering being a poorly understood profession.

> "[It's] hard to picture yourself in a profession that barely exists in your mind. I have no idea what an engineer's day-to-day would look like"

Familiarity drives consideration

Figure 5.3 shows there is a strong correlation between familiarity with engineering and consideration of studying it. Of women who say that they were not at all familiar with engineering at the time of applying to university, just 11% say that they considered studying it at some point (whether seriously or in passing). This consideration increases to 31% among those who were slightly familiar with engineering – and to 54% among those who were familiar.

To drive more girls to consider pursuing engineering as their area of further study and career, we need to increase their familiarity with it as a career option and as a profession more broadly.

> "In early high school I always thought 'engineer' meant mechanic, like a car mechanic or similar... [I] had no idea why people would want me to do that"

> "In hindsight... engineering actually would have been the perfect career for me! But I just didn't realise what an engineer did"

> "[It's] hard to picture yourself in a profession that barely exists in your mind. I have no idea what an engineer's day-to-day would look like"

CONSIDERATION OF STUDYING ENGINEERING (%), by FAMILIARITY WITH ENGINEERING
Among women who ultimately pursued degrees in non-engineering fields

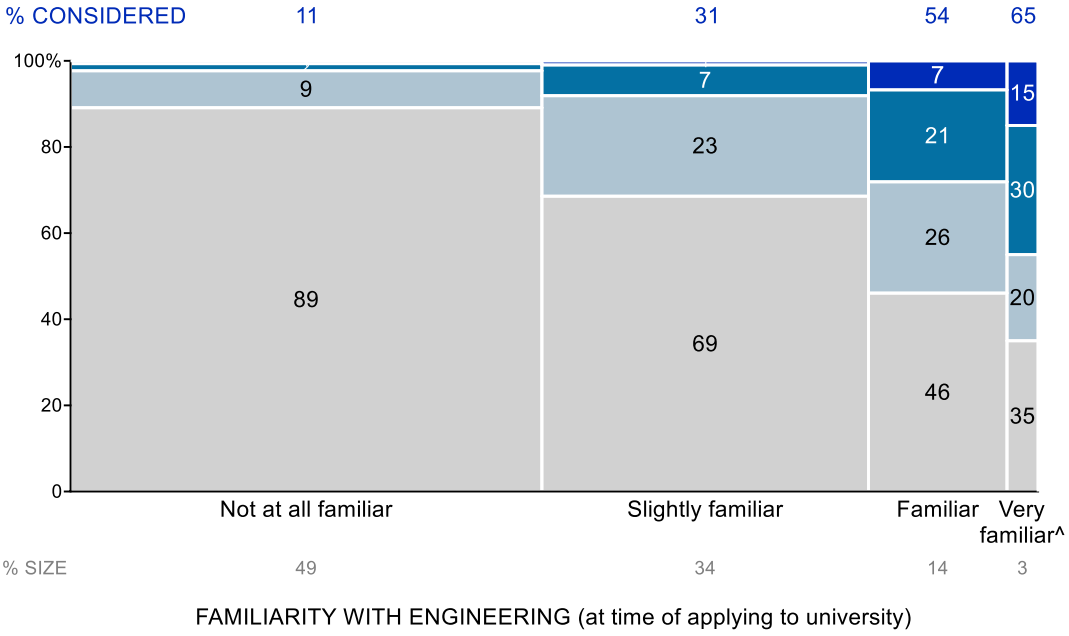


Figure 5.3. Consideration of studying engineering (%), cut by familiarity with engineering. | QB8 Did you ever consider studying engineering? QB7 How familiar were you with each of these fields of study, when you were applying to university? By this, we mean how well you understood what each field involved (topics studied, degree entry requirements, career opportunities, etc.). | Base: F non-eng. Not at all familiar N=303, Slightly familiar N=210, Familiar N=89, Very familiar N=20 | ^Caution: Small sample size

- Yes – and I started studying it, but didn't finish
- Yes – I seriously considered studying it
- Yes – I considered studying it, but only briefly or in passing
- No – I never considered studying it

The extent of the familiarity problem

Out of all degrees asked about in the survey, engineering has one of the lowest levels of familiarity among women (see Table 5.1). Only 18% of women who ultimately pursued other fields say that they were familiar or very familiar with what engineering involves at the time that they applied to university. This compares to 40% for biology and 29% for psychology.

In fact, familiarity with engineering is low even among women who ultimately choose to study engineering. Of the female engineering students and graduates surveyed, less than half (44%) indicate that they were familiar or very familiar with engineering at the time of applying to university. This figure is much higher (70%) among male engineering students and graduates – indicating that there is a problem of familiarity among girls specifically.

FAMLIARITY WITH FIELDS OF STUDY, AT TIME OF APPLYING TO UNIVERSITY (%)
Among women outside vs. in the field

Familiarity with field of study	Medicine	Biology	Law	Psychology	Architecture	Engineering	Economics	Computer science
Among women outside the field	46	40	30	29	22	18	15	14
Among women in the field	76	86	-	76	57	44	-	61

Table 5.1. Familiarity with fields of study, among women who did not vs. did ultimately pursue each field of study (outside vs. in the field respectively). | QB7 How familiar were you with each of these fields of study, when you were applying to university? By this, we mean how well you understood what each field involved (topics studied, degree entry requirements, career opportunities, etc.). [4-point scale: "Not at all familiar", "Slightly familiar", "Familiar", "Very familiar"] | Data shown is % that selected "Familiar" or "Very familiar". Not shown where valid data unavailable | Base: Female; did not ultimately pursue that degree; Engineering N=622 (asked of all respondents), Other degrees approx. N=300 each. Female; did pursue degree; Engineering N=678

Having engineers in the family is currently a strong driver of familiarity with engineering. 42% of women in engineering say that they had engineer(s) in the family or among their relatives or family friends. This is significantly higher compared to men (37%), indicating that personally knowing engineers is a stronger driver of familiarity for girls than boys – possibly because girls receive less exposure to engineering through other sources.

Not only are engineers in the family a common channel of exposure to engineering; they also highly impactful. Of all the engineering "exposure sources" asked about in our survey (including engineering-based school activities and outreach programs), having engineers in the family has the highest stated impact for encouraging more girls/women to go into engineering.

However, the majority of girls do *not* have a family member or close relative who happens to be an engineer.

It is therefore critical to increase familiarity with engineering through proactive initiatives, rather than relying on girls to hear about engineering from people around them. This is reinforced by the fact that compared to men in engineering, women in engineering are less likely to have received encouragement from a careers adviser to pursue engineering. The data also suggests that teachers are far less likely to encourage girls to pursue engineering than science.

Perceptions of engineering

In increasing familiarity with the profession, it is important that the right perceptions are built – those that make engineering more accessible and appealing to prospective female students. This involves understanding the factors that influence girls' choice of university courses, as well as what their perceptions of engineering currently look like. The we can determine what perceptions need to shift, to better align engineering with the motivators that matter.

Where engineering currently stands

Figure 5.4 shows the attributes that women currently associate with engineers, compared to other benchmark occupations. The most common associations with engineering are "male-dominated" (84%) and "challenging" (70%).

Critically, women are unlikely to associate engineering with positive attributes – such as "creative" (23%), "impactful" (22%), "fulfilling" (11%), and "exciting" (9%). This is particularly striking when comparing to perceptions of biologists, a benchmark STEM occupation which rates much higher on "impactful" (50%), "fulfilling" (33%), and "exciting" (31%). It is also worth noting that women are almost three times as likely to consider engineering "boring" (26%) compared to "exciting" (9%).

The attribute "lucrative" has a relatively weak association with engineering (21%, compared with 31% for doctors and 46% for lawyers). The same is true of "respected", which despite being the third most common association with engineering, lags considerably behind other occupations (40%, compared with 48% for biologists and 71% for doctors).

ASSOCIATIONS WITH ENGINEERING VS. OTHER OCCUPATIONS (%)
Among women who ultimately pursued degrees in non-engineering fields

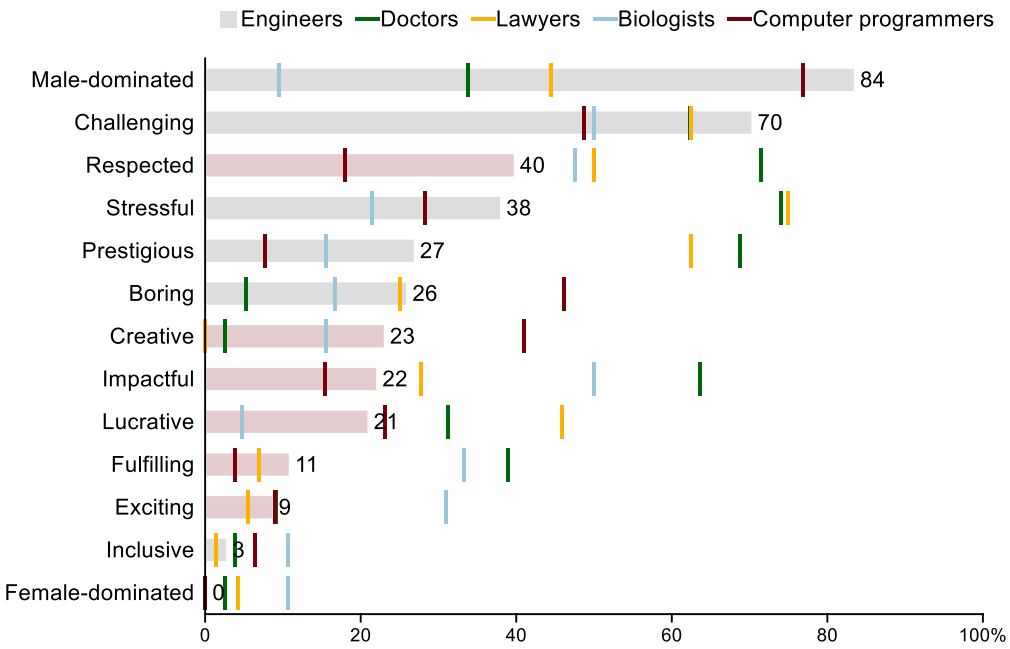


Figure 5.4. Associations with engineering vs. other occupations (%), among women who ultimately pursued degrees in non-engineering fields. | QD8 Thinking about engineers, which of the following do you associate with that occupation? Please select all that apply. | Base: F non-eng. Engineers N=622, Doctors N=77, Lawyers N=72, Biologists N=84, Computer programmers N=78 | N.B. This question asks about respondents' *current* perceptions, rather than asking them to recall what they may have perceived at the time of applying to university. However, the results are still a good indication of general perceptions among women and girls

It's important to note that the two most common associations with engineering have negative connotations. It is likely that a field that is regarded as "male-dominated" will not appeal to most prospective female students (and may actively discourage them from seriously considering the field). Meanwhile, "challenging" may be regarded as a positive for those seeking a challenging and mentally stimulating career (indeed, this is a key driver for women in engineering) – but it can also serve as a

barrier. Indeed, concerns about engineering being too difficult are among the top reasons selected by women as to why they did not choose to study engineering. Without perceptions like "impactful" and "fulfilling" to offset them, the reigning perceptions of engineering as a male-dominated and challenging field are a significant barrier to female entry to engineering study.

Problematic perceptions even among women in engineering

Even among female engineering students and graduates, only 69% agree that they thought engineering would suit their personality at the time they chose to study it. This compares to 84% of men in engineering, and 83% of women in science fields. Furthermore, only 48% of women in engineering agree that they thought there would be good opportunities for women in the engineering field (compared to 66% of women in science).

These findings point to a belief, held even by many women who pursue the field, that engineering is simply not suited to women.

This is particularly concerning because regression analysis shows that of the factors shown in Figure 5.5, perceived personality fit with a field is the most important contributing factor for women to pursue that field. Commensurate with this, women in engineering tend to say that they were less sure of their choice to study engineering, when compared to men in engineering and women in other fields (including science and IT).

PERCEPTIONS OF FIELD CHOSEN, AT TIME OF CHOOSING IT (%)

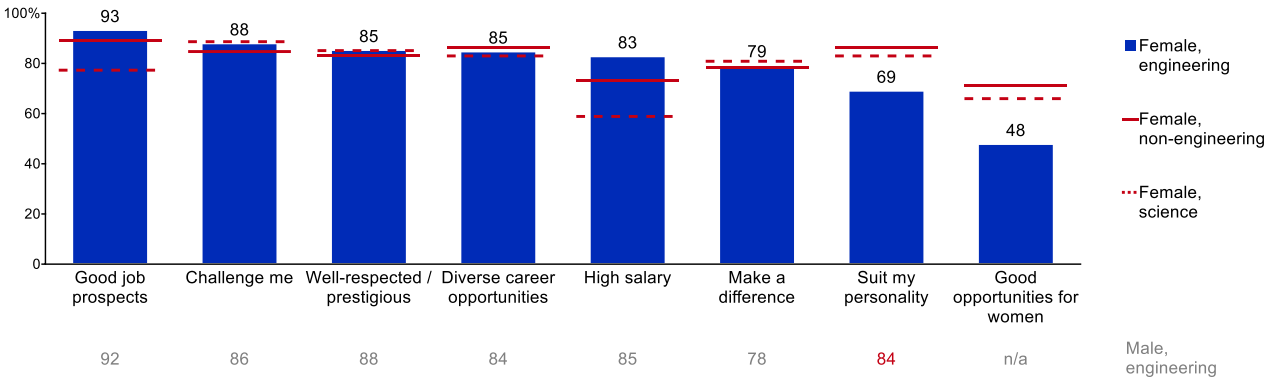


Figure 5.5. Perceptions of field chosen, at time of choosing it (%), shown among women in engineering compared to women in non-engineering fields generally and science specifically, as well as men in engineering. | QB4 Still thinking about your choice to study [field]… How strongly do you agree or disagree with each of the following? [5-point scale from "Strongly disagree" to "Strongly agree"] | Data shown is % that selected "Agree" or "Strongly agree" | Base: F eng N=678, F non-eng N=622, F science N=141, M eng N=490

More positively, the vast majority of women in engineering agree that engineering would offer good job prospects and high earning potential (women in science are significantly less likely to have thought the same about the science field). These factors may help offset concerns about engineering not being suited to one's personality and/or not offering good opportunities to women.

The importance of shifting perceptions

Positive perceptions of engineering like “impactful”, “fulfilling”, and “suits my personality” are currently lacking. These are also the attributes that tend to be important to girls when they are deciding on their university course preferences.

STATED IMPORTANCE OF FACTORS FOR UNIVERSITY COURSE CHOICE (% SHARE OUT OF 100)

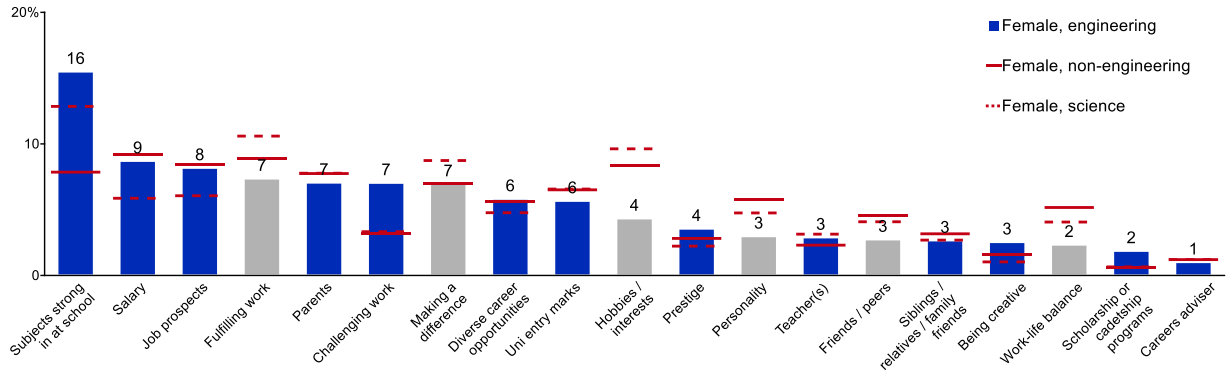


Figure 5.6. Stated importance of factors for university course choice (% share out of 100), shown among women in engineering compared to women in non-engineering fields generally and science specifically. | QB5 When you were applying to university (i.e. submitting your course preferences), which of these were important in guiding or influencing your choice? Please select all that apply. QB6 Please rank the top 3 most important factors for guiding or influencing your choice of what to study, with 1 being the most important. | Figures shown are share of importance based on combination of QB5 and QB6 | Base: F eng N=678, F non-eng N=622, F science N=141 | N.B. Grey bars denote factors where women outside of engineering placed greater emphasis when choosing courses than women in engineering

Figure 5.6 shows that for women who chose engineering, the subjects that they were strong in at school had the greatest impact on their choice by far. This is followed by considerations around salary, job prospects, and fulfilling work, as well as parental influence. Women in engineering also over-index on being driven by a desire for challenging work.

To attract more girls into engineering, there’s a need to consider what motivates women in non-engineering fields. The red comparison lines in Figure 5.6 represent women in non-engineering fields as an aggregate (solid lines) and women in the science field specifically as a STEM benchmark (dashed lines). It is evident that compared to women in engineering, women in other fields are more likely to be influenced by desires for fulfilling work, making a difference, and a career that aligns with their hobbies, interests, and personality. And while salary and job prospects are still important, they are also more likely to consider work-life balance an influential factor in their choice.

> “If people with the ability to study and work in engineering realise the massive positive impact, they can have I think it may help to encourage them to persevere with the challenges… that come with engineering”

This is reinforced by other data. The vast majority of women (in both engineering and other fields) agree with the following statements, and to a significantly greater extent than men in engineering:

- "I need to be passionate about the work I do"
- "It's important to me that my work makes a positive impact on society"

These quantitative results align well with the qualitative findings. Participants mentioned that a key driver for many women to go into engineering is the potential to make a positive difference to society and the environment – this is reflected in the greater proportion of women in certain disciplines of engineering (e.g., biomedical, environmental, renewables). Societal impact was also a focal point for the women in engineering who participated in the focus groups.

> "When I first started, the "exciting" engineering projects talked about were the biggest tower, the best bridge, that kind of thing. There needs to be more focus on projects that contribute to society"

These findings show that we need to effectively communicate the impactful and fulfilling nature of a career in engineering. These factors are highly influential in girls' choice of university courses and addressing them may also help to counteract the prevailing perceptions that engineering doesn't suit women's personalities or interests. Part of this involves communicating the breadth of disciplines and areas of practice within engineering (i.e., that engineering offers a wide range of roles across many sectors and industries, more than just civil engineering or construction).

> "I think we should educate more young girls about the variety of positions and industries that engineering allows. [Girls] don't really understand the options or the possible job descriptions"

It is also important to communicate the good job prospects and earning potential that engineering careers offer.

STEM education: Building good foundations

Interest in and aptitude for STEM subjects at school tends to correlate with interest in and aptitude for engineering at a university level. Additionally, mathematics and physics at the senior high school level (and depending on the discipline, other sciences such as chemistry) are typically either assumed knowledge or prerequisites for entry into undergraduate engineering degrees. Not having studied these subjects in Years 11 and 12 is therefore a significant barrier to studying engineering at university, despite the existence of bridging courses and other similar programs.

This points to the importance of supporting girls and boys alike to enjoy and do well in STEM subjects at school, which can ultimately foster interest and confidence in pursuing engineering. This research also

indicates that girls tend to believe they need to be *exceptionally* strong in maths and science subjects to go into engineering – this is a further barrier to entry.

Hand-in-hand: Maths, science, and engineering

Women in engineering overwhelmingly say that they did well in STEM subjects during their school years:

- 91% agree that they excelled at maths and/or science subjects in high school (compared to 59% of women in benchmark fields).
- 86% agree that they showed an aptitude for maths and/or science subjects from an early age (compared to 57% of women in benchmark fields).
- 79% agree that they felt supported at school to do well in maths and science subjects (compared to 62% of women in benchmark fields).

This aligns with the earlier finding that for women in engineering, subject strengths in school have the greatest stated impact on university course choice by far – with almost double the importance of the second most important factor (salary).

Furthermore, among women in benchmark fields, self-rated excellence in STEM during high school correlates with their consideration of engineering. Unsurprisingly, only about 10% of women who disagree that they excelled at maths and/or science subjects say that they considered engineering. This increases to 42% among women who strongly agree with the statement.

...And not just any maths or science: Advanced maths, physics, and chemistry

Consistent with engineering course prerequisites and content, the high school subjects of advanced maths, physics, and chemistry are most strongly associated with consideration and pursuit of engineering.

As shown in Table 5.2, 85% of women in engineering took advanced maths for their high school certificate or equivalent. The majority also took at least one of physics or chemistry (72% each). In contrast, women who pursued science, health or commerce degrees were far less likely to have taken these subjects.

SUBJECTS TAKEN FOR HIGH SCHOOL CERTIFICATE OR EQUIVALENT (%)

Familiarity with field of study	Advanced mathematics	Physics	Chemistry	Biology	History	Economics
Women in engineering	**85**	**72**	**72**	25	12	9
Women in science	**56**	27	**61**	**70**	21	9
Women in health	37	16	35	**49**	23	9

Familiarity with field of study	Advanced mathematics	Physics	Chemistry	Biology	History	Economics
Women in commerce	47	13	27	30	**31**	**33**
Men in engineering	**79**	**79**	56	16	10	13

Table 5.2. Subjects taken for high school certificate or equivalent. | QF5 Did you take any of these subjects for your high school certificate or equivalent (e.g. HSC, VCE, QCE, WACE, SACE, NTCET, TCE, SSE, IB)? Please select all that apply. | Base: F eng N=678, F science N=141, F health N=237, F commerce N=174, M eng N=490

Women in commerce are more likely to have taken humanities subjects (e.g., history and economics) than physics and chemistry. Meanwhile, women in science and health are more likely to have taken biology. As shown in Figure 5.7, however, biology has a relatively low association with consideration of engineering compared to chemistry and even more so, physics.

CONSIDERATION OF ENGINEERING (%), by SUBJECTS TAKEN

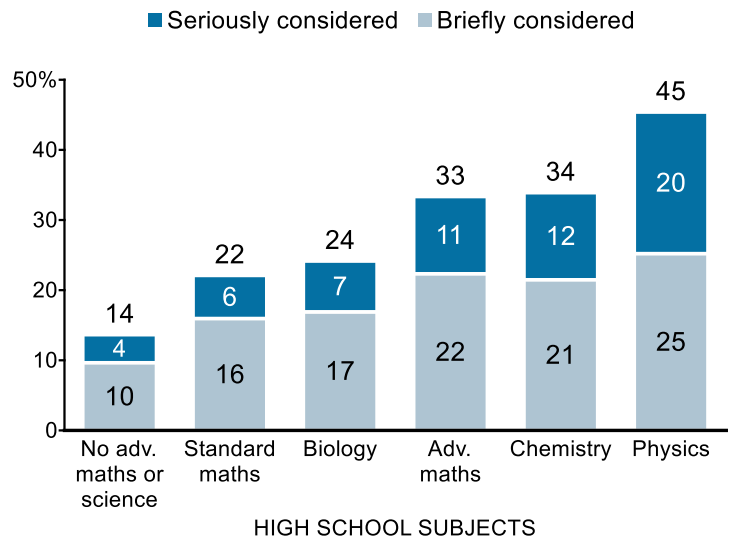


Figure 5.7. Consideration of engineering (%), shown for each subject taken for high school certificate or equivalent. | QB8 Did you ever consider studying engineering? | Base: F non-eng. No adv. maths or sci N=176, Std maths N=326, Bio N=290, Adv. maths N=282, Chem N=242, Phys N=119. Groups not mutually exclusive

These findings highlight the importance of supporting girls to pursue advanced mathematics, chemistry, and physics. In this regard there is a parallel between these subjects and engineering: they all tend to be perceived as male-dominated and inherently difficult. Increasing the number of girls in these subject streams will translate to a greater number of girls who meet the prerequisites for undergraduate engineering courses – and who feel confident that they have the STEM ability to succeed in engineering.

> "Many girls schools in my state don't offer high-level maths and physics classes in Years 11 and 12. The girls have to travel to boys' schools to study these units"

A pedagogical problem: The role of schools

Qualitative research suggests that STEM education tends to be limited and under supported for female than male students. Some respondents mentioned that teachers tend to give greater support to male students in STEM subjects, driven by an inherent bias that boys are better (or have the potential to do better) in maths and science subjects, while girls are more suited to English and humanities subjects.

> "We're not encouraged to learn the hard sciences... from Year 7 onwards, there's an implicit gender bias and it's like 'girls are good at English and boys are good at maths"

An additional finding from the quantitative research is that on average, public school students appear to receive less support to do well in STEM, compared to private and selective schools. About 75% of women who completed their secondary education in a private or selective school agree that they felt supported at school to do well in maths and science subjects. This compares to only about 65% of women from public schools. A similar pattern is observed among men. In contrast, whether the school is co-educational or single sex does not seem to significantly influence ratings of STEM support.

The implication is clear: more needs to be done to improve STEM education in schools (particularly public schools), and damaging gender stereotypes need to be removed.

When good isn't good enough: The belief that engineering demands STEM excellence

There exists a perception that one must *excel* in maths and science subjects (as opposed to enjoy or do well in them) in order to go into engineering.

This perception appears to be particularly prevalent in women and girls. 91% of women in engineering agree that they excelled at maths and/or science subjects in high school – significantly higher compared to men in engineering (83%) and women in science (77%).

Furthermore, among women who considered engineering *and* said that they excelled at maths and/or science subjects at school, concerns about the difficulty level of engineering are still among the most common reasons for not choosing engineering. Among these women, 29% agree that they were worried they weren't good enough at science to do engineering, and 25% say they were worried they weren't good enough at maths – despite self-reporting that they excelled at these very subjects. It is also

possible that internalised stereotypes (e.g., "girls aren't good at maths") cause some girls to underestimate their abilities.

> "Really work hard on debunking the idea that the only good engineer is the person who's the best at maths – modern engineering is much more intersectional"

> "It's important to focus on the curiosity, problem solving and teamwork as much as the math and science components. Mostly we engineer in teams and in our community, not just on paper or on the computer"

> "Engineering... should not be pitched to young women as a challenge. Engineering work can be undertaken by any gender with equal interest and abilities. The conversation that "you don't have to be a maths wiz" should not be pitched [exclusively] to young women, because it has an underlying assumption that women are not good at maths. Rather, engineering should be pitched in a positive manner [to] young women (and men) who are interested in maths, science [and] solving real-world problems"

Evidently, women and girls tend to feel that they must be disproportionately strong in STEM subjects to pursue engineering. This is likely driven by the prevailing perceptions of engineering as a challenging and male-dominated field, which makes it seem especially intimidating to girls. It is worth noting that this perception is even more deleterious to increasing female participation in engineering because the number of girls pursuing advanced maths, physics and chemistry for their high school certificate is already low compared to boys. Of this low number, a significant proportion misguidedly perceive themselves as being not good enough to pursue engineering – further reducing the pool of entrants to engineering study.

They say timing is everything

Timing is critical when it comes to the journey of considering and pursuing engineering – and it is therefore a crucial component of effective initiatives in this space. It is important that we engage with students as early as primary school in engineering as they learn to problem solve.

TIMELINE OF UNIVERSITY COURSE DECISION-MAKING

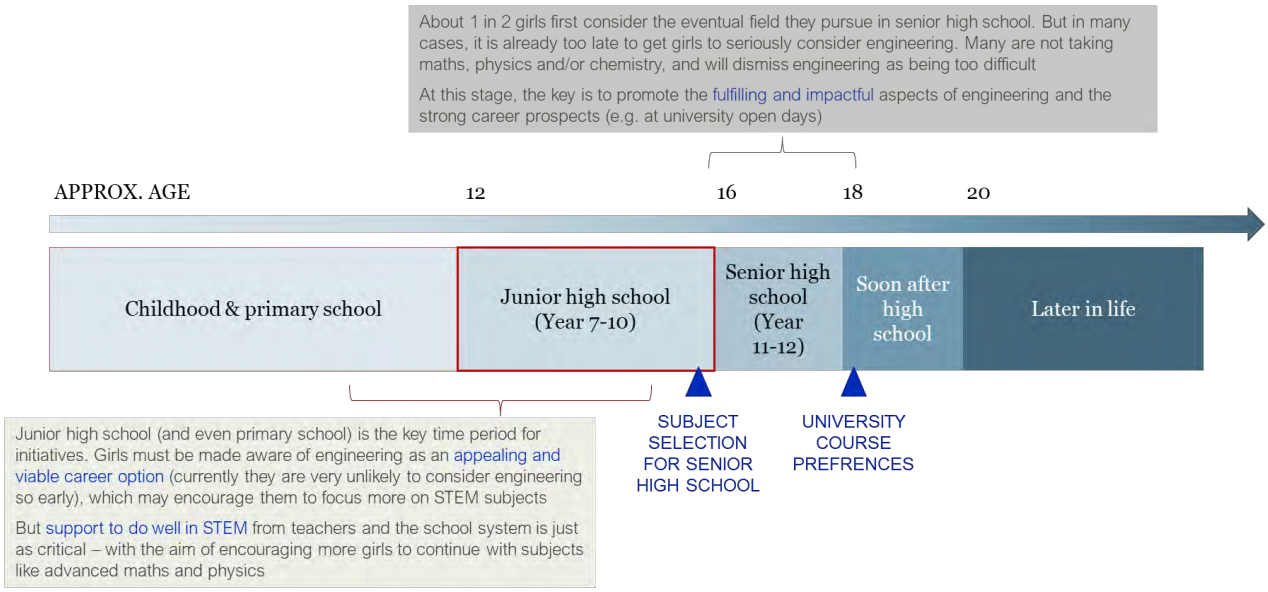


Figure 5.8. Schematic showing the timeline of university course decision-making.

Women in engineering tend to have first considered pursuing engineering in senior high school. This is late compared to women in other STEM. Just 21% of women in engineering first considered engineering before they reached senior high school, compared to 35% of women in science first considering science before that point.

Early consideration of a field (i.e., before or during junior high school) is also associated with stronger conviction to pursue the field. Those who first consider a field in earlier in life are more likely to be committed to it, as opposed to regarding it as just one of multiple potential options.

Furthermore, as previously identified, whether one takes subjects such as advanced mathematics, physics, and chemistry for their high school certificate or equivalent is closely connected to whether they consider and/or pursue engineering. Students typically select their subjects for Years 11 and 12 in Year 10. Hence, for those who have not selected advanced maths and science subjects, it is generally too late by Years 11 and 12 to encourage them to seriously consider engineering. Initiatives promoting engineering, as well as STEM interest more generally, need to begin in Years 7-10 – and even earlier.

The quantitative phase of this research had little focus on respondents' experiences prior to high school. However, qualitative research, including phase 1 interviewees, points to the importance of the primary school stage. Interviewees mentioned that many primary school teachers are not confident in STEM subjects themselves, hence limiting the interest they share with their students. Early science education also tends to focus on "naming" (e.g., taxonomy and categorisation) rather than processes and mechanisms, such as problem solving (which are more closely aligned with engineering). Furthermore, interviewees described how deficits early on cause lasting damage: girls who are not supported to do well in STEM subjects at an early age tend to grow increasingly distant from STEM as they progress through secondary education.

> "[Need] early engagement (primary and lower years of high school). By the time you talk to girls in year 10-12 it's too late - most have self-selected into humanities streams because they have not had good quality STEM education in their younger years"

Recommendations for driving entry to engineering

Issues for initiatives to address

INTERPLAY BETWEEN DRIVERS OF THE PURSUIT OF ENGINEERING

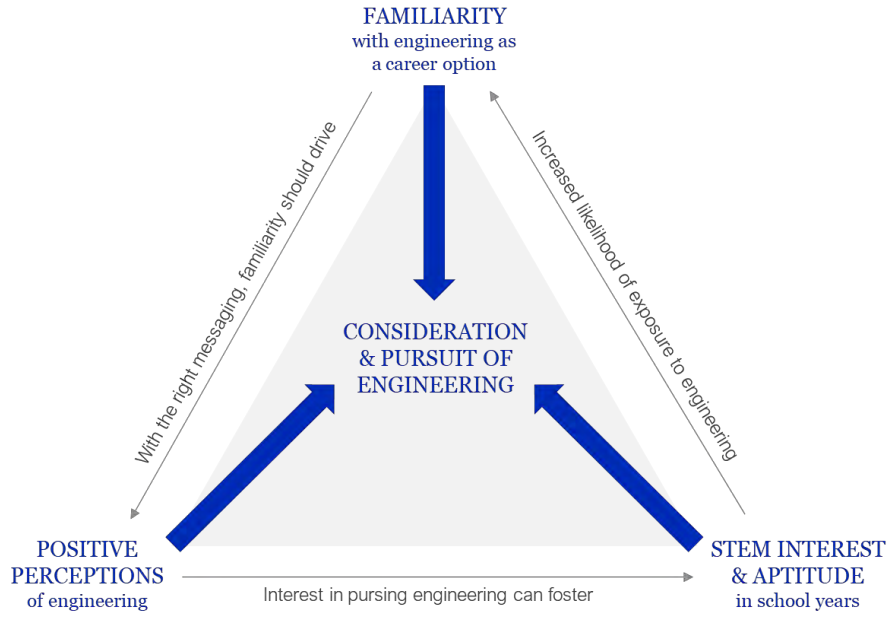


Figure 5.9. Schematic showing the interplay between drivers of the pursuit of engineering.

Figure 5.9 shows the interconnections between three of the main drivers of studying engineering. Familiarity with engineering as a profession, if established in an optimal way, leads to positive perceptions of engineering as a dynamic, rewarding, and impactful career option. This has a bidirectional relationship with interest and aptitude in STEM, where interest in engineering can foster greater interest and effort in maths and science subjects at school – which in turn increases the chance of students becoming further exposed to engineering and equips them with the fundamental skills and knowledge assumed of engineering degree entrants.

Hence, effective initiatives may target a particular driver, but have positive flow-on effects that help to further drive uptake of engineering.

Critical: The role of systemic initiatives

The barriers to female entry into engineering are systemic in nature. They relate to fundamental perceptions (or lack thereof) of the engineering profession within society, as well as the reality of the profession still being male dominated. They also relate to deficiencies in STEM education provided throughout primary and high school, particularly for girls, and the absence of engineering concepts and content from most school STEM curricula.

Consequently, the most impactful initiatives in this space are those that address these systemic issues in deep and sustained ways. For instance:

- Improving education and support for girls in STEM subjects, including in Years K-10. This involves "educating the educators" – better equipping teachers to teach STEM in an engaging way. Improving STEM education will promote greater female uptake of STEM subjects at a senior high school level, engender greater interest in engineering, and ultimately promote confidence in girls that they can meet the STEM demands of engineering.

- Fostering familiarity with the engineering profession through school education. The curriculum tends to have considerable focus on the different disciplines within science, and several science subjects are offered at the senior level; mathematics is also typically a fundamental (and compulsory) subject for most of primary and secondary schooling. In comparison, there is little to no focus on engineering. Better integrating engineering into STEM education at school will build familiarity with the profession, whilst delivering the curriculum requirements of mathematics and science, alongside problem solving and creativity.

- Raising the profile of engineering in the general community. Greater familiarity with and positive perceptions of engineering among several groups – from teachers and career advisors to parents and guardians – will lead to greater external encouragement of girls to study engineering. Qualitative research shows that in some cases girls are actively *dis*couraged from pursuing engineering – they may be pushed to instead study science or health degrees that are more well-known and seen as more gender-appropriate.

> "Parents and schools need to be on board with girls choosing engineering as a profession. This is critical for when they get to later high school so that the option of engineering is already there – not just the usual topics of nurse, teacher, doctor, hairdresser"

Still impactful: The role of "short and sharp" initiatives

Although systemic initiatives are best-placed to address the barriers of female entry into engineering, there are simpler, smaller-scale initiatives (e.g., school talks, excursions, engineering challenges) that also have an important role to play. These initiatives also tend to be scalable – able to reach large groups of both female and male students.

86% of women agree that hands-on activities providing first-hand experience of engineering are important for encouraging girls to pursue engineering (see Figure 5.10). Meanwhile, 79% agree that sustained focus on engineering at school through regular engineering activities or education is important. These appear to be key "ingredients" of a successful initiative.

Hands-on activities, for instance, can take the form of school engineering challenges and workshops, as well as excursions to university engineering faculties or industry sites with an interactive element. Schools in some states (e.g., NSW) require students to complete a short work experience placement (e.g., in Year 10), which can present an opportunity for extended first-hand exposure to engineering. These are initiatives that Engineers Australia can play a role in facilitating.

Meanwhile, sustained school activities and education include the more systemic refinements to school curricula mentioned previously, as well as initiatives like engineering and other STEM-focused clubs and programs.

> "Robogals do a great job teaching girls about engineering in an engaging manner. Providing funding to these kinds of STEM programs and start-ups allows them to bring through a new generation of passionate female engineers."

The majority (72% of women in engineering) also agree that talks at school from engineer guest speakers are important for encouraging girls to pursue engineering. Indeed, of those who personally experienced a school talk, 58% of women in engineering agree that it would have a strong impact in encouraging more girls to study engineering – comparable with the perceived impact of more sustained initiatives such as engineering education within the school curriculum (66%) and engineering clubs or programs (69%).

PERCEIVED IMPORTANCE OF INITIATIVES FOR ENCOURAGING WOMEN [if female respondent] / PEOPLE [if non-female respondent] TO PURSUE ENGINEERING (%)

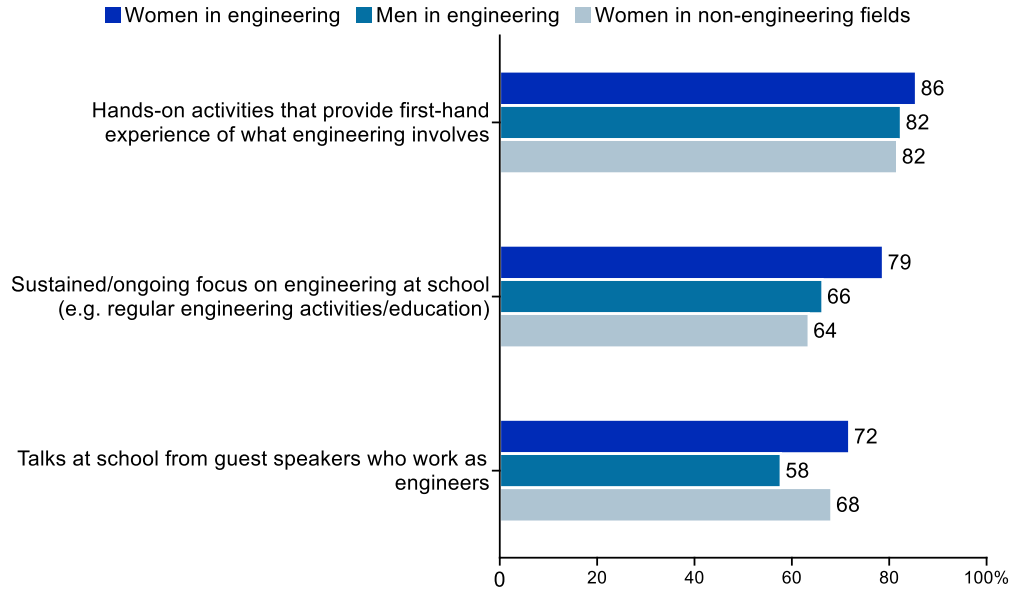


Figure 5.10. Perceived importance of initiatives for encouraging women [if female respondent] / people [if non-female respondent] to pursue engineering (%). | QE4 How important do you think each of these elements are for initiatives, programs and events aimed at encouraging [girls or women / people] to pursue engineering? [5-point scale: "Not important", "Slightly important", "Moderately important", "Very important", "Extremely important"] | Data shown is % that selected "Very important" or "Extremely important" | Base: F eng N=678, M eng N=490, F non-eng N=622

Despite the potential positive impact of these initiatives, however, only a small proportion of students experience them (shown in Figure 5.11). Just over 10% of women remember receiving a school talk from an engineer, while only about 20% went on a school excursion to an engineering-related industry site or museum.

The relatively small proportion who have experienced the "simple" initiatives shown in Figure 5.11 highlights an opportunity to expand reach: by rolling out these initiatives to more schools (as well as optimising their content).

PROPORTION THAT PERSONALLY EXPERIENCED INITIATIVES, PRIOR TO UNIVERSITY (%)

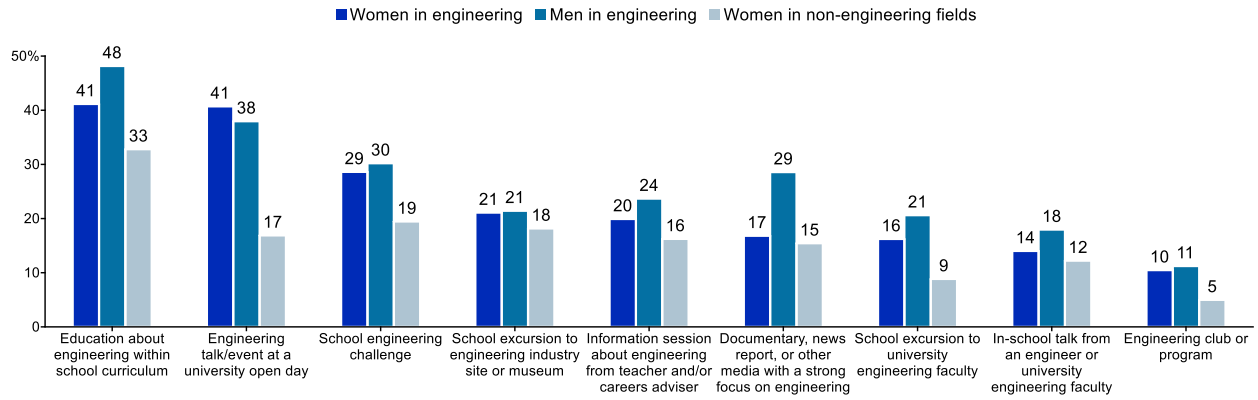


Figure 5.11. Proportion that personally experienced initiatives, prior to university (%). | QB12 We're interested in how people hear about engineering. Which of these did you experience, prior to studying at university? Please select all that apply. | Base: F eng N=678, M eng N=490, F non-eng N=622

It is also worth noting that some initiatives are more likely to be experienced by those who are already more predisposed toward engineering and/or STEM. For instance, students typically attend a university open day talk about engineering if they have a pre-existing interest in engineering – reflected in the fact that 41% of women in engineering report going to such a talk, compared to only 17% of women other fields. Similarly, women in engineering are more likely to have participated in a school engineering challenge compared to their non-engineering counterparts, reflecting that high school students who are invited (or volunteer) to participate in such challenges are typically those who perform particularly well in STEM subjects, or who are in more supportive STEM education environments.

This has implications for how these initiatives should be designed: university open day talks should focus on the specific interests and concerns of students who are already interested in engineering and STEM. There is also an opportunity to include more students in activities like engineering challenges to help foster their interest in STEM – rather than exclude them further from the field.

Doing school outreach right

Female representation is critical

> "You can't be what you can't see"

> "You can't send a 50-year-old male engineer to a girls' school – they need to be relevant"

> "I chose to become an engineer when I had a female engineer speak at my school. Having someone to look up to is all it takes"

As shown in Figure 5.12, women overwhelmingly believe that when it comes to school talks, it is vital to hear from female speakers. They do not have to be established professionals: 87% of women in engineering believe it is important to hear from young women who are studying engineering or still early in their engineering careers.

Even men are equally or indeed more likely to say that students should hear from women, not men – even though they were not prompted to think about initiatives for female students specifically. This suggests that female speakers (and certainly, panels with speakers of all genders) will have broad appeal, rather than appealing exclusively to girls and driving boys away.

MOST IMPORTANT SPEAKER TYPE FOR STUDENTS TO HEAR FROM (%)

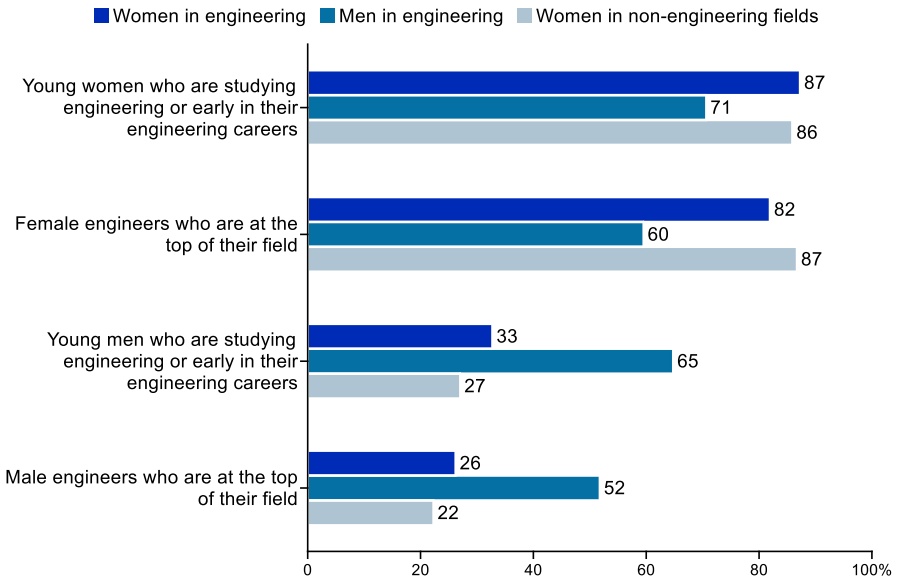


Figure 5.12. Most important speaker type for students to hear from (%). | QE5 Who do you think is most important for students to hear from? Please select all that apply. | Base: Those who rated school talks as at least "slightly important" in the previous question. F eng N=675, M eng N=477, F non-eng N=610

Timing and content

School talks need to start early – from junior high school or even earlier, to prompt early consideration of engineering and STEM engagement more broadly.

It is also important that the focus and content of school talks be tailored to their specific audience.

RECOMMENDED FOCUS AREAS FOR SCHOOL OUTREACH

Audience	Overview	Recommended focus areas
Primary school and junior high school (Year 10 and under)	Outreach prior to senior high school should focus on introducing engineering as an exciting and fulfilling career. Currently girls are unlikely to consider engineering so early on, so getting it into their consideration set is key. Sparking interest in STEM and encouraging continued effort in STEM subjects is also important	• Depicting engineering as a vibrant, fulfilling, and viable career path • Including interactive activities and examples to spark interest in STEM and engineering in particular
Senior high school (Years 11-12)	Outreach aimed at Year 11-12 students (including university open days) should target those who are studying STEM subjects and already have interest/aptitude in maths and/or science – in most cases it is too late to convert girls in other subject streams. It should therefore address the barriers for those who consider engineering but ultimately decide against it (identified in the present research)	• Emphasising that it is enough to be *good* at and interested in maths and science – you don't necessarily need to be getting top marks • Presenting the good job prospects for engineering graduates – including salary and opportunities to work across many different roles, industries, locations, and the in-demand skills developed through an engineering degree • Detailing the variety of disciplines within engineering – appealing to different interests and values • Highlighting the fact that the majority of female engineering students and graduates are highly satisfied with their choice to study engineering, and are passionate about their field (no less so than men)

Table 5.3. Recommended focus areas for school outreach.

Building the “brand” of engineering: Key messages to communicate

All initiatives seeking to promote engineering, regardless of their scope and audience, should communicate messages that speak to the drivers of career choice (what truly resonates with prospective students), whilst helping to soften the barriers (what stops them from seriously considering engineering).

The present research tested six different messages for encouraging people to enter engineering. Out of these, the message focused on the positive impact of engineering (“Shape a better tomorrow”) had the greatest appeal. This is consistent with other findings, both quantitative and qualitative, that point to the need to build perceptions of engineering as an inherently impactful and fulfilling career. It is also worth noting that the message resonates strongly with both women and men in engineering, indicating that it is by no means a message that should be targeted solely towards women; it has broader appeal and is suitable for large-scale campaigns that promote the engineering profession.

RESONANCE OF MESSAGES (%)

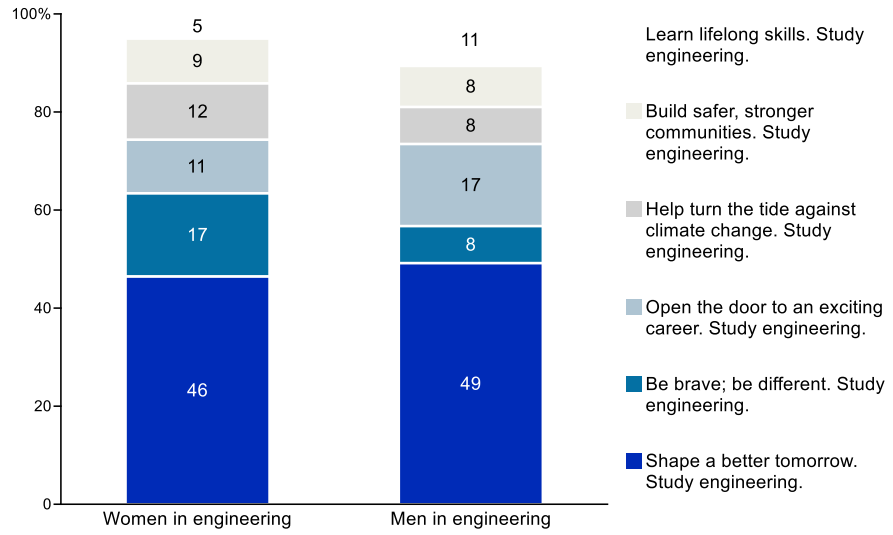


Figure 5.13. Resonance of tested messages (%). | QE6 Which of these messages resonates most with you personally? | Base: F eng N= 678, M eng N=490

The key messages – in order of priority

KEY MESSAGES TO COMMUNICATE ABOUT ENGINEERING

Priority	The headline	The detail	Rationale
1.	**Engineers make a difference**	Through a career in engineering, you can do work that tangibly impacts society and the environment – helping to shape a better tomorrow. You can be proud of and passionate about your work	• This speaks to the fact that for women in other fields (particularly other STEM), "fulfilling work", "making a difference" and "hobbies/interests" are among the biggest influence of course choice. These factors are also extremely important for women already in engineering: 90% agree that it's important that their work positively impacts society • It is critical to build these perceptions because they are currently very lacking: Only 11% see engineering as fulfilling, 22% impactful, 9% exciting. It tends to lag far behind other professions, including biology, on these perceptions • This counters the damaging perception that engineering doesn't suit women at a personality or interest level. Only 69% of women in engineering say they thought it "suits my personality", compared to 84% of men – and this is one of the strongest drivers of conviction to pursue the degree
2.	Great (and diverse) opportunities in engineering	Engineering graduates have strong job prospects and great earning potential. Their problem-solving skills create demand across many industries. And there are diverse disciplines, sectors, and types of roles to choose from	• Considerations around practical elements like salary and job prospects have lower stated influence than fulfilling work among women in other STEM – however, they are still among the top influencers of course choice for women overall • At the time of choosing engineering, 93% of women say they thought it had good job prospects (85% diverse career opportunities, 83% high salary). These perceptions need to be strengthened among the general public • This can also be linked to the transferrable skills (e.g. problem-solving) that are developed through an engineering degree. An engineering degree is not just a pathway to becoming an engineer, but an asset that opens up a range of opportunities • There is currently a limited understanding of the breadth of disciplines and roles within engineering. Girls need to know that engineering is not just nuts and bolts, or highly technical, maths-heavy work – but that there are disciplines focused on social and environmental outcomes, and roles that demand teamwork, creativity and project management skills

3.	Not just for STEM prodigies	Interest and aptitude in science, maths and how things work are important, but you don't necessarily need to be at the top of your class in order to be a great engineer	• Concerns about engineering being too difficult and not being good enough at maths/science are the top stated barrier to choosing engineering (apart from a lack of familiarity). Even women who say they excelled at STEM in high school tend to be concerned about the difficulty level • Commensurate with this, about 70% of women (both engineers and non-engineers) agree that reassurance that you don't have to be a "maths whiz" is important for getting more girls into the profession • Engineering is already perceived as challenging (70%) – this is the strongest association after "male-dominated". Although most women in engineering are motivated by wanting to be challenged, there is no need to further build the "challenging" perception, as it will only further drive girls away for fear of the difficulty level • This does not, of course, mean that the importance of STEM interest and aptitude should be downplayed. It is important that we attract people who will be capable of meeting the demands of an engineering degree
4.	Women in engineering love it	Women studying and working in engineering are passionate about engineering, optimistic about their future prospects, and would recommend it to other women and girls	• The perception of engineering as "male-dominated" is undoubtedly very strong (84%, and a stated barrier for about 1 in 3 women) • Rather than trying to deny this reality, the focus should be on the positive experiences of women in engineering (supported by the present research), to help allay prospective female students' fears that the experience in engineering will be negative simply because of their gender – and to help them see engineering as a field where women like them can thrive

Table 5.4. Key messages to communicate about engineering.

7 / The study experience

Overview

University does not appear to be a place where women in engineering experience significant disadvantage – at least at an overall level. Both female and male students report high levels of satisfaction with their studying experience and their choice to study engineering. The majority of students also say they intend to work in the engineering field after graduation, though this intention seems to be weaker on average among women.

Female engineering students are as likely as their male peers to say that they feel a sense of belonging to a learning community. Their perceptions of their study experience tend to be on par with those of male students.

An exception to this is that female students are more likely to agree that they feel excluded by their peers and/or educators (12%, compared to only 5% of male students). This suggests that although female and male students' experiences tend to be on par overall, gender discrimination is still present. The data also suggests that social exclusion has a particularly deleterious impact on subsequent workforce participation.

However, the key issue at the university stage is that compared to other fields of study, engineering courses are seen as deficient in several areas: they do not offer enough practical experience and have poorer teaching quality and student support. These issues do not appear to be gender specific. Initiatives in the university space should aim to improve these aspects of engineering pedagogy, empowering students to be more confident about entering the workforce.

Key metrics

Satisfaction with study experience and choice

When asked to rate the overall experience of studying engineering at university, women give an average rating of 7.1 out of 10. This is equivalent to the average rating among men (7.2).

In fact, when asked about satisfaction with their choice to study engineering at university, women give a significantly higher rating on average (8.0) than men (7.7).

These ratings are comparable to those given by women in other degree fields. As shown in Figure 6.1, women in engineering are more satisfied with their choice of degree than women in any of the other degree fields surveyed, including science and commerce. This corresponds with the high career satisfaction among female engineers, described later in this report.

SATISFACTION WITH CHOICE OF DEGREE AND RATING OF STUDY EXPERIENCE (AVERAGE RATING / 10)
Among female students and graduates of engineering vs. benchmark degrees

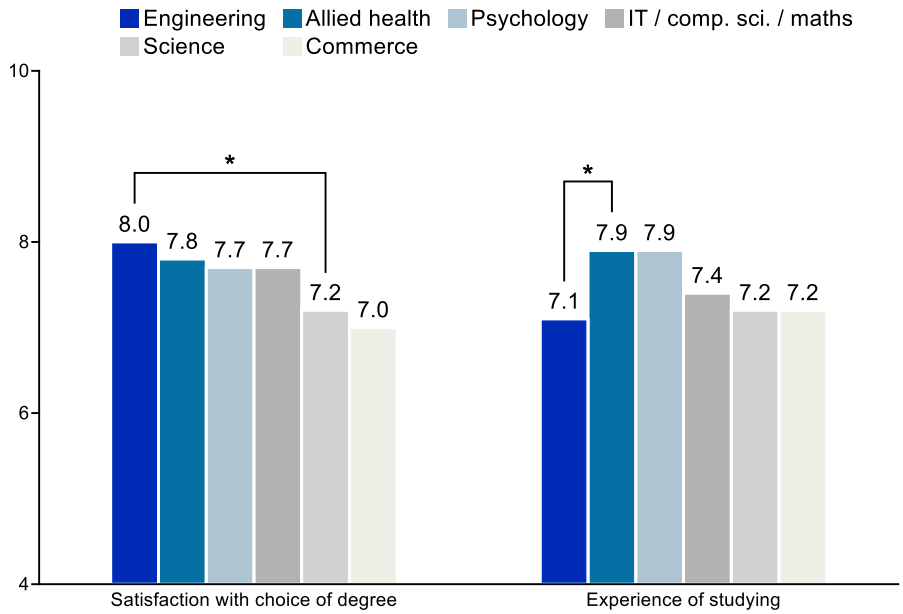


Figure 6.1. Satisfaction with choice of degree and rating of study experience (average rating / 10), shown among female students and graduates of engineering compared to benchmark degrees. | QC1 Overall, how would you rate your experience of studying engineering at university? QD7 Overall, how satisfied are you with your choice to study engineering? | Base: F non-eng students and graduates. Science N=141, IT / computer science + Maths / statistics N=47, Psychology N=96, Allied health N=116, Commerce / business / economics N=174

However, Figure 6.1 also shows that when it comes to the actual study experience, engineering is rated relatively poorly. While it is on par with other STEM degrees and commerce, it lags significantly behind allied health and psychology. This highlights room for improvement in the quality of engineering education – the specifics of which are discussed later in this report.

Likelihood to enter the engineering profession

Most engineering students surveyed express that they are likely or very likely to work in the field after graduation (see Figure 6.2).

Based on separate analysis of workforce participation among engineering graduates (conducted using Australian Census data), it seems that the proportion of respondents indicating that they are *very* likely to work in the field is a more realistic representation of actual outcomes than summing the proportion who say they are likely *or* very likely.

Taking this "very likely" figure, then, it seems that female engineering students are less likely to go into the field post-graduation than their male peers (62% vs. 72%). However, in this respect they are still on par with female students in benchmarked degrees.

LIKELIHOOD TO ENTER FIELD OF STUDY AFTER GRADUATION (%)
Among current students

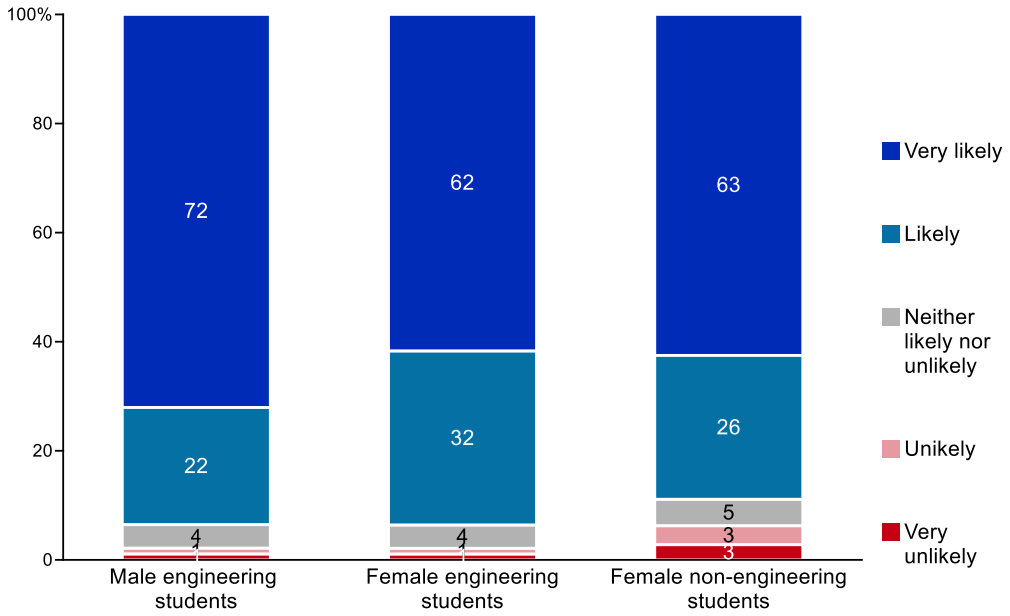


Figure 6.2. Likelihood to enter field of study after graduation (%), shown among current students. | QC5 How likely are you to work in the [field] field after you graduate? | Base: Current students. M eng N=93, F eng N=188, F non-eng N=144

Engineering students tend to be optimistic about their future career prospects (average optimism rating of 7.9 out of 10 among women, compared to 8.1 among men and 7.4 among women in benchmark fields). Again, however, there are signs of greater reservation among female than male engineering students; 23% of females rate their optimism as a 10 out of 10, compared to 33% of males.

On average, women studying engineering appear to be somewhat less confident about entering the engineering profession than their male peers. This can potentially reflect women's (well-founded) concerns about their career prospects in a male-dominated field.

The internship

The internship, one of the defining features and the most popular way of meeting the practical experience requirement of an undergraduate engineering degree, is viewed positively by both female and male engineering students, with 85% of women and 87% of men saying it was a positive experience overall.

Women are somewhat less likely to have felt respected and included during their internship (80%, compared to 86% of men). This is perhaps unsurprising given the male-dominated nature of the field – which also underlies the fact that only 47% of women engaged with female role models during their internship.

AGREEMENT WITH STATEMENTS ABOUT ENGINEERING INTERNSHIP (%)

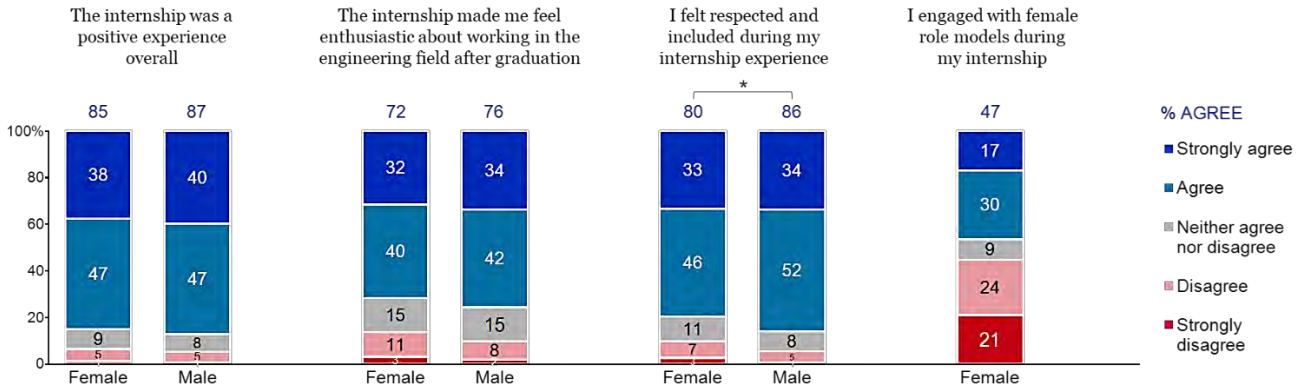


Figure 6.3. Agreement with statements about engineering internship (%). | QC4 How strongly do you agree or disagree with each of the following? [5-point scale from "Strongly disagree" to "Strongly agree"] | Data shown is % that selected "Agree" or "Strongly agree" | Base: Those who have completed an internship as part of their engineering degree. Female N=535, Male N=342

Areas for improvement

As seen earlier, ratings of the overall experience of studying engineering lag significantly behind allied health and psychology – indicating room for improvement. The reasons underlying this gap are revealed in Figure 6.4, which shows the specific attributes on which engineering under-indexes compared to other degrees.

AGREEMENT WITH STATEMENTS ABOUT STUDY EXPERIENCE (%)
Among current students

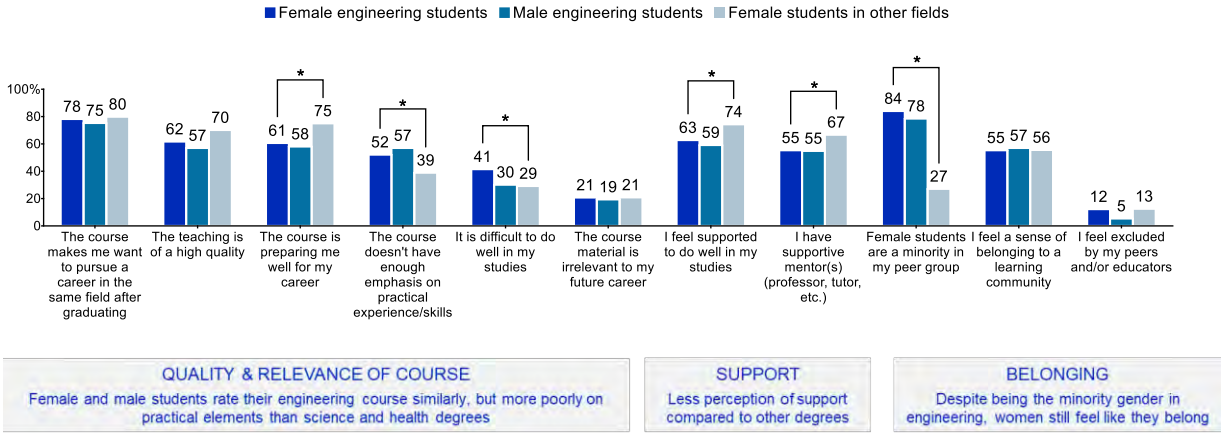


Figure 6.4. Agreement with statements about studying experience (%), shown among current students. | QC2 How strongly do you agree or disagree that each of the following is reflective of your experience studying [field] at university? [5-point scale from "Strongly disagree" to "Strongly agree"] | Data shown is % that selected "Agree" or "Strongly agree" | Base: Current students. F eng N=188, M eng N=93, F non-eng N=144

Issues for engineering courses in general

As seen in Figure 6.4, there are numerous factors which engineering students rate their degree less favourably compared to students in benchmark fields. These can be grouped into two broad categories:

1. Course relevance and practicality: "Preparing me well for my career", "Emphasis on practical experience/skills"

2. Student support: "I feel supported to do well in my studies", "I have supportive mentor(s)"

This is corroborated by external data; results from the 2020 QILT (Quality Indicators for Learning and Teaching) Student Experience Survey show that engineering lags other STEM degrees in terms of student support, teaching quality and learning resources (though skill development and learner engagement are rated similar or better for engineering).

> "In my experience, universities rely on the workforce to teach practical skills to students via internships which allows [them] to handball their responsibilities for fundamental practical engineering as they focus on research"
>
> "[We need better support] at university. A lot of practical lab demonstrators are rude and unhelpful. Most of the course content is self-taught despite lectures being held 2-3 times a week"

Supporting evidence from double degrees

The above findings are reinforced by the experience of double degree students and graduates. This cohort tends to rate their engineering degree more poorly compared to their other degree. For example, engineering/science double degree students and graduates (aggregated across all genders) rate the overall experience of their engineering degree as 7.3 out of 10 on average – compared to a 7.8 rating for the science degree.

As shown in Figure 6.5, engineering tends to be rated lower for teaching quality and student support – and higher for negative attributes such as "difficult to do well in my studies" and "not enough emphasis on practical skills".

AGREEMENT WITH STATEMENTS ABOUT STUDY EXPERIENCE (%), FOR ENGINEERING VS. OTHER DEGREE
Among double degree students and graduates

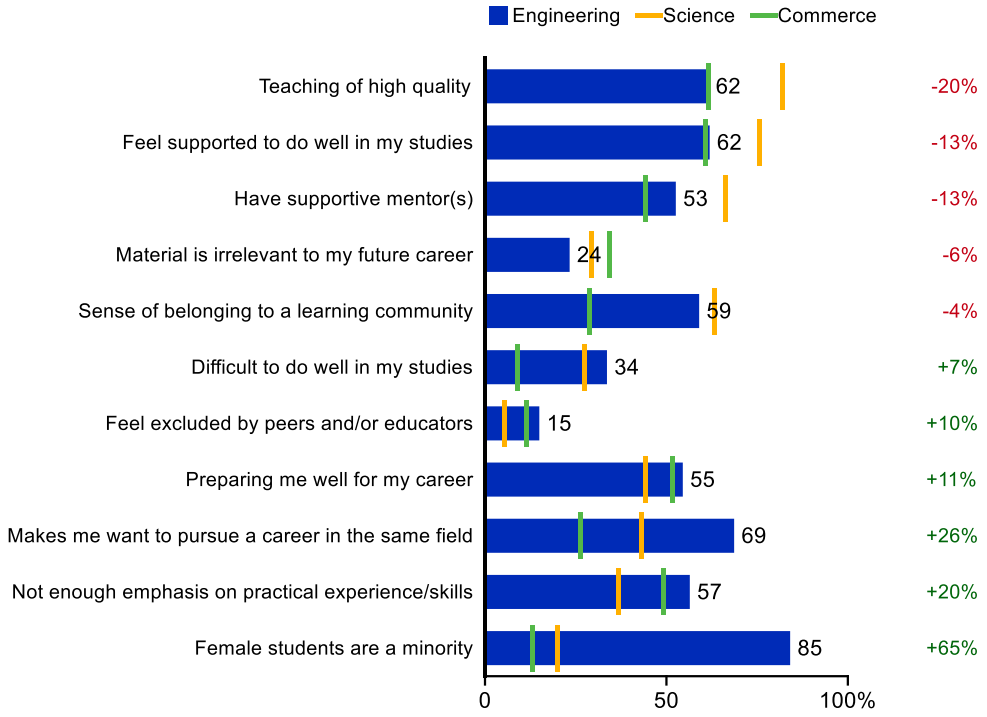


Figure 6.5. Agreement with statements about study experience (%), for engineering vs. other degree, among double degree students and graduates. | QC2 How strongly do you agree or disagree that each of the following [is/was] reflective of your experience studying [field] at university? [5-point scale from "Strongly disagree" to "Strongly agree"] | Data shown is % that selected "Agree" or "Strongly agree" | Base: Engineering double degree students and graduates, all genders. Science N=95, Commerce N=122

Issues for female engineering students specifically

Figure 6.4 shows that there is a considerably higher rate of feeling excluded by peers and/or educators among female engineering students (12%) compared to their male peers (5%). This statistic is probably related to the significant gender imbalance in the cohort. Given the importance of peer groups at university, this also likely contributes to the higher reported incidence among women of having difficulties in their studies (41%, compared to 30% of men).

It is also worth noting that feeling excluded by peers and/or educators is the area where non-participants (engineering graduates who ultimately do not work in engineering occupations) most over-index. This is true of both female and male non-participants, of whom about 30% agree that they felt excluded while studying engineering. Thus, social isolation at university appears to be a major risk factor for subsequent non-participation in the workforce.

Overall, however, female engineering students are as likely as their male peers to feel a sense of belonging to a learning community – despite the gender imbalance.

Drivers of satisfaction with the study experience

A regression analysis was run to understand the relative importance of specific experiences at university for how students perceive their university experience overall. This analysis reveals interesting differences by gender (shown in Figure 6.7). Most significantly, a sense of belonging to a learning community and (not) feeling excluded by peers and educators are far more important in driving overall course satisfaction for women than men.

REVEALED IMPORTANCE FOR OVERALL RATING OF STUDY EXPERIENCE (% SHARE OUT OF 100)

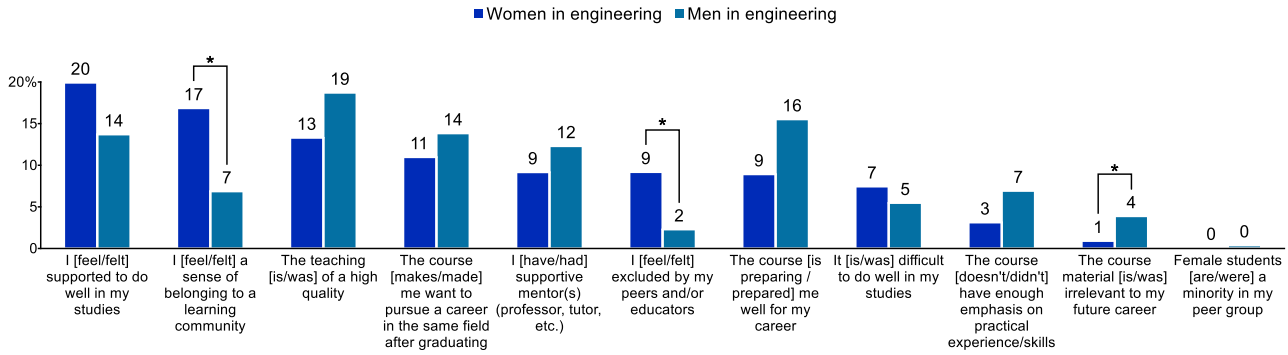


Figure 6.7. Revealed importance for overall rating of studying experience (% share out of 100), from regression analysis. | QC1 Overall, how would you rate your experience of studying engineering at university? QC2 How strongly do you agree or disagree that each of the following [is/was] reflective of your experience studying [field] at university? [5-point scale from "Strongly disagree" to "Strongly agree"] | Analysis: Shapley regression of QC1 on QC2. R-squared = 51.4% at total sample level | Base: Students and graduates. F eng N=678, M eng N=490

Interestingly, female students being a minority in the cohort has no revealed importance for overall course satisfaction. This suggests that the gender imbalance in engineering degrees does not, in and of itself, adversely affect women's overall experience.

Recommendations for improving the study experience

Key issues to address

Although there are a few areas of the engineering study experience where women under-index compared to men, there does not appear to be a significant problem at the university level – despite the gender imbalance in engineering courses.

Rather, there is room for improvement for engineering education in general:

A priority is for engineering faculties to provide more support to students – and not just in the first year of the degree

- Engineering students are less likely to feel supported to do well than science and health students.
    - 63% of current female engineering students agree that they feel supported to do well in their studies, compared to 70% of female students in science and health degrees.
- The problem does not appear to lie with female students in particular; there is no significant difference between male and female students' perceived support levels.
- Feeling supported is the top revealed driver of an overall positive studying experience for women.
    - Female engineering students are more likely to agree that it's difficult to do well in their studies (41%) than male students (30%), and female students in other degrees (29%). In fact, out of all students surveyed, female engineering students rate their degree as being the most difficult. Improving student support will help mitigate this.
    - There are indications that perceived difficulty of doing well is greater in the middle years of the degree (i.e. not the first or final year).
    - Student support may become even more important in the future if more women chose engineering for their future education.

Improving the practical experience and overall teaching quality is also important in universities

- Engineering courses lag behind other STEM in practical experience/skills, career preparation, and teaching quality.
- Over 50% of engineering students agree that their course doesn't have enough emphasis on practical experience/skills. This compares to just 37% of female science students (38% health). This pattern is also observed in engineering double degree students.
- These issues with course quality and delivery exist across all disciplines, though directionally, mechanical, electrical, and civil engineering appear to under-perform.

Potential initiatives

Some potential areas where Engineers Australia can support universities (and employers of engineering graduates) in developing and implementing initiatives include:

- Peer mentoring programs that provide support across the degree (beyond first year)
- Visibility of diverse (including female) role models
- Exposure to the diverse career opportunities within engineering – inspiring students and graduates to find a role that suits their own skills, interests, and values
- Ongoing communication of the impactful and fulfilling opportunities within the engineering profession (these messages are key to encouraging entry into engineering study – but it is important that they continue to be reinforced)
- Increased assistance with internships – boost awareness of Engineers Australia's Internships program which links industry internship opportunities with engineering students.
- Encourage inclusion and enhancement of practical and work-based learning activities

> "More practical application of theory topics or industry relevant activities. E.g. project management and planning is not fully fleshed out or useful in my experience for uni projects in contrast to what is observed in industry"

> "Mentoring for every female engineering student – having an older female engineer to talk to, even if only a few times a year, could possibly help when it gets hard at university. We have mentoring programs at my uni but they stop after first year, and if you didn't sign up at the start, you can't get access to a mentor later on"

> "[We need] women in STEM programs during early years of university – workshops, mentoring, industry nights with speed networking opportunities to help build confidence, resume writing and interview prep"

> "At a university level, representation matters - have a mix of female and male lecturers that include examples of work by females. It's hard to picture yourself in a profession where there is no one else like you"

8 / The work experience

Overview

Female and male engineers have similarly high levels of career satisfaction and optimism about their future prospects. The majority of women feel valued and respected by their colleagues and are passionate about their work – they find it dynamic, challenging, and impactful.

However, in contrast to the university experience, women do face substantial disadvantages in the workplace due to their gender. A third of female engineers feel like they need to act like "one of the boys" to fit in, and only 55% agree that women and men have equal opportunities in their workplace. Furthermore, about 1 in 5 female engineers report that there is bullying, harassment and/or exclusion of women in their workplace.

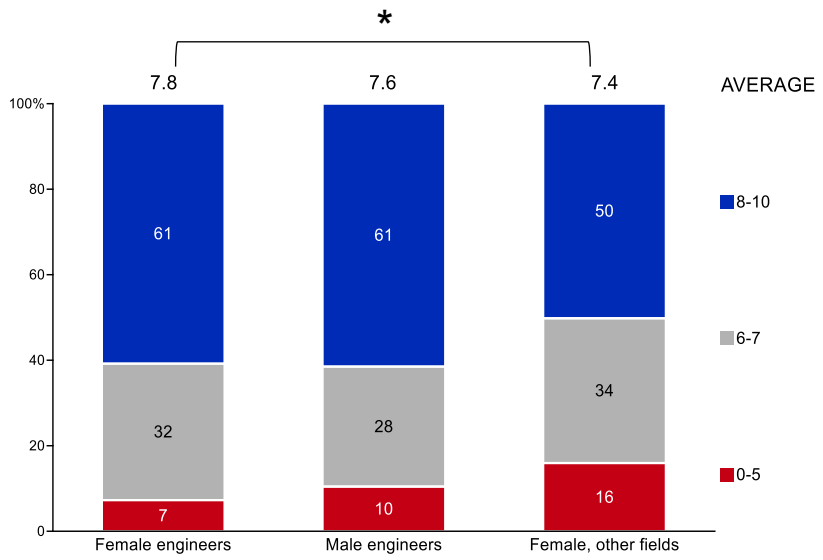
These issues with workplace culture appear more prevalent in larger firms and are among the most common reasons for women to leave the engineering profession. This points to a clear need for effective initiatives in this space.

Key metrics

Career satisfaction and future intentions

Female and male engineers have similar levels of career satisfaction (average ratings of 7.8 and 7.6 out of 10 respectively). This is strong compared to other degrees: on average, female engineers are more satisfied with their career than women in science and commerce fields, and on par with those in health fields. Career satisfaction also appears to be consistent across different engineering sectors.

SATISFACTION WITH CAREER TO DATE (RATING / 10)



"Of all female survey respondents, engineers have the highest career satisfaction"

Figure 7.1. Satisfaction with career to date (rating / 10). | QD1 Overall, how satisfied are you with your career to date? Please use a scale of 0 to 10, where 0 is very dissatisfied and 10 is very satisfied. | Base: Those working full-time in field of their degree. F eng N=398, M eng N=335, F non-eng N=257

Stated likelihood to remain in the profession is also high: 82% of female engineers say that they are likely or very likely to continue working in their current field in the next 5-10 years (43% say very likely). This is comparable to men, though a directionally higher proportion of men say that they are very likely to remain (50%).

Consistent with this, optimism about future prospects in one's current field tends to be high among female engineers (7.6 out of 10) – on par with male engineers (7.8 out of 10) and women employed in the health field.

LIKELIHOOD TO CONTINUE WORKING IN CURRENT FIELD [NEXT 5-10 YEARS] (%)

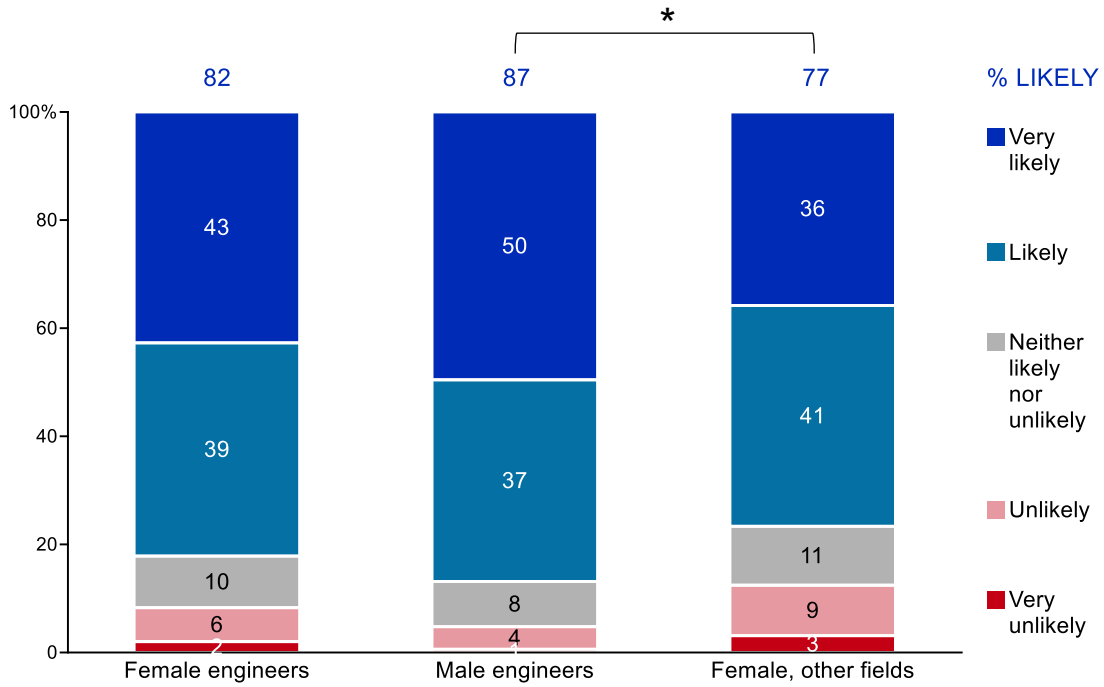


Figure 7.2. Likelihood to continue working in current field [next 5-10 years] (%). | QD5 Thinking about the next 5 to 10 years of your career, how likely are you to continue working in your current field? [5-point scale from "Very unlikely to "Very likely"] | Data shown is % that selected "Likely" or "Very likely" | Base: Those working full-time in field of their degree. F eng N=398, M eng N=335, F non-eng N=257

Specific perceptions of current job and workplace

Figure 7.3 shows agreement with various statements around respondents' view of their current job and workplace. The results are broadly positive: about 80% of female engineers agree that they bring a unique perspective to their team; that their daily work is dynamic, challenging, and has a positive impact on broader society; and that they are passionate about their work.

Meanwhile, about 2 in 3 agree that they are paid well – on par with male engineers. Women working in the mining sector are more likely to believe they are paid well (86%); the opposite is true of those in consulting and professional services (50%).

AGREEMENT WITH STATEMENTS ABOUT WORKING EXPERIENCE (%)

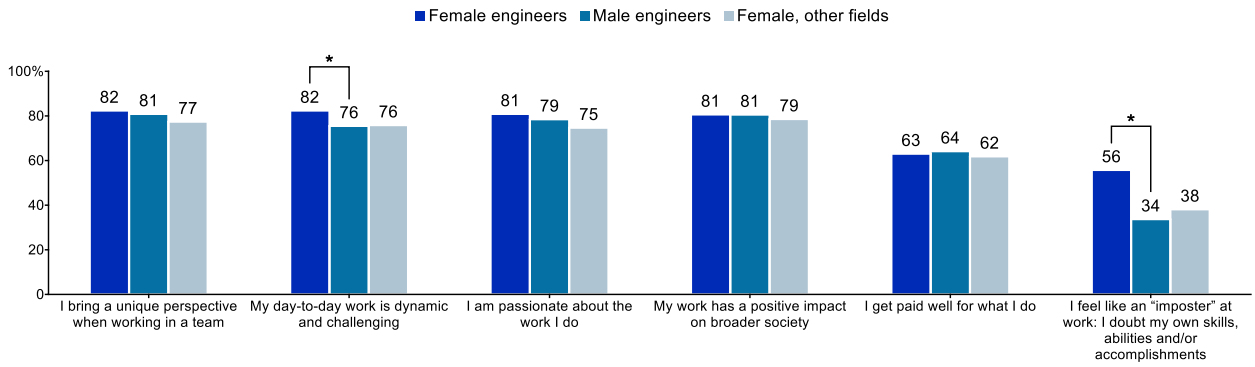


Figure 7.3. Agreement with statements about working experience (%). | QD2 Thinking about your current job and workplace… How strongly do you agree or disagree with each of the following? [5-point scale from "Strongly disagree" to "Strongly agree"] | Data shown is % that selected "Agree" or "Strongly agree" | Base: Those working full-time in field of their degree. F eng N=398, M eng N=335, F non-eng N=257

Figure 7.4 shows agreement with statements about the workplace environment. Again, there are some clear positives: most women agree that they feel respected and valued by their colleagues, and that they can be themselves at work. However, several concerning issues are apparent: these are explored further in the next section.

> "My male colleagues appreciate my point of view – I see things they don't… I would ask what would happen if there was a woman [entering a building] who has a pram, you need something other than stairs"

Regarding working arrangements, 75% of female engineers agree that their workplace offers flexible arrangements to support working parents. The construction sector under-indexes here (56%). A considerable proportion of women (29%; 59% among women in construction) say that their work hours are long and/or inflexible. These issues do not appear unique to women or to the engineering field; however, a lack of flexibility is likely to disproportionately affect women given that women with children are likely to take greater responsibility for childcare.

AGREEMENT WITH STATEMENTS ABOUT WORKPLACE ENVIRONMENT (%)

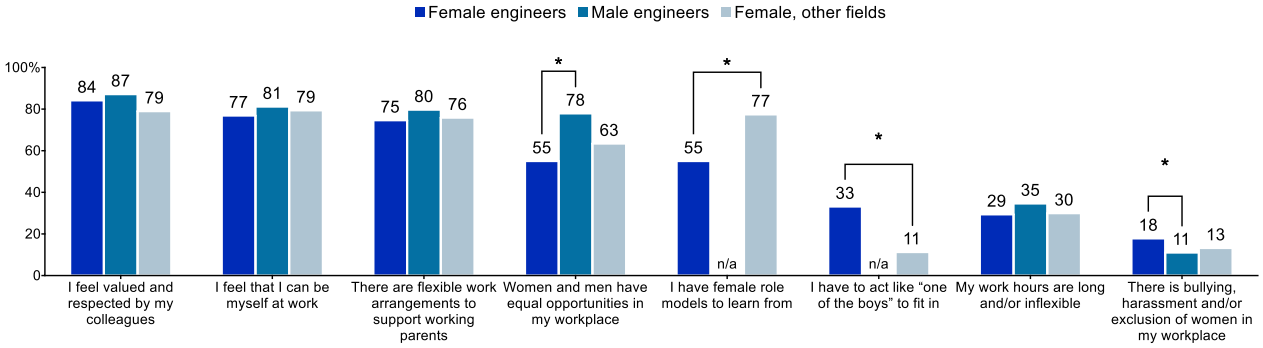


Figure 7.4. Agreement with statements about workplace environment (%). | QD2 Thinking about your current job and workplace… How strongly do you agree or disagree with each of the following? [5-point scale from "Strongly disagree" to "Strongly agree"] | Data shown is % that selected "Agree" or "Strongly agree" | Base: Those working full-time in field of their degree. F eng N=398, M eng N=335, F non-eng N=257

The power of passion

Regression analyses were conducted to determine the specific factors that most influenced overall career satisfaction, likelihood to remain in the profession, and likelihood to recommend others to study the same degree.

Interestingly, these analyses revealed that "I am passionate about the work I do" is by far the most important driver of all of these outcomes – and has greater importance for women than men (although it is still the top driver for men). This suggests that feeling passionate about and intrinsically motivated by one's work may go some way in offsetting the negative experiences that are detailed in the next section of this report.

Gender inequity and discrimination

Despite 77% of female engineers agreeing that they can be themselves at work, 1 in 3 agree that they have to act like "one of the boys" to fit in (see Figure 7.4). The incidence of this is triple for women in engineering compared to women in other fields. (The fact that some women agree with both of these two statements points to the complexity of their experience – there may be particular contexts in which women feel pressured to modify their behaviour, and others where they feel less inhibited.)

Meanwhile, about 1 in 5 female engineers say that there is bullying, harassment and/or exclusion of women in their workplace.

Furthermore, only 55% of female engineers agree that they have equal opportunities at work compared to men, for promotions, pay rises and the like; 1 in 4 actively disagree with this statement. In contrast, 78% of men say women and men have equal opportunities, highlighting the unsurprising fact that women maybe more acutely aware of gender inequality than their male colleagues.

Unsurprisingly given the low rate of female participation in engineering, female engineers are less likely than women working in other fields to have female role models to learn from. The lesser representation of women in the workplace contributes to these issues.

> "I can see it in my colleagues' faces when females in engineering are brought up, can hear the words said in conversations where it is thought I can't hear and can feel the surprise when I speak up and contribute. It is believed that females have an advantage because of scholarships or the desire to have more females in the engineering field. It is believed we have it easy"

Impact on workforce retention

About 2 in 3 of the surveyed women who left the engineering profession did so because of the issues outlined above: they felt that their opportunities for career progression were limited, and/or they experienced gender discrimination, bullying or sexual harassment.

In contrast, only a small proportion of women indicate that they left engineering because the work wasn't a good match for the skills and interests. This indicates that women do not typically leave because of the work itself; they leave because of the work*place* – the sexism and cultural issues that limit their opportunities and adversely impact their daily working experience.

> "Being in such a sexist and restrictive boys' club environment all day every day is exhausting"

A bigger issue in bigger companies

In general, it seems that workplace challenges are more prevalent in larger companies (defined here as organisations with 100 or more employees). While larger companies seem more likely to have infrastructure in place offering flexible work arrangements and tend to have greater female representation in their workforce, they are also more likely to suffer from issues around gender inequality and poor workplace culture.

As shown in Figure 7.5, 21% of female engineers working in larger companies report that there is bullying, harassment and/or exclusion of women in their workplace (triple the incidence of the same in smaller companies). Women working in larger companies are also significantly less likely to agree that they have equal opportunities to men (52%, compared to 73% of those working in smaller companies). They are also less likely to feel that they can be themselves at work.

AGREEMENT WITH STATEMENTS – WORKPLACE ENVIRONMENT (%), by ORGANISATION SIZE
Among female engineers

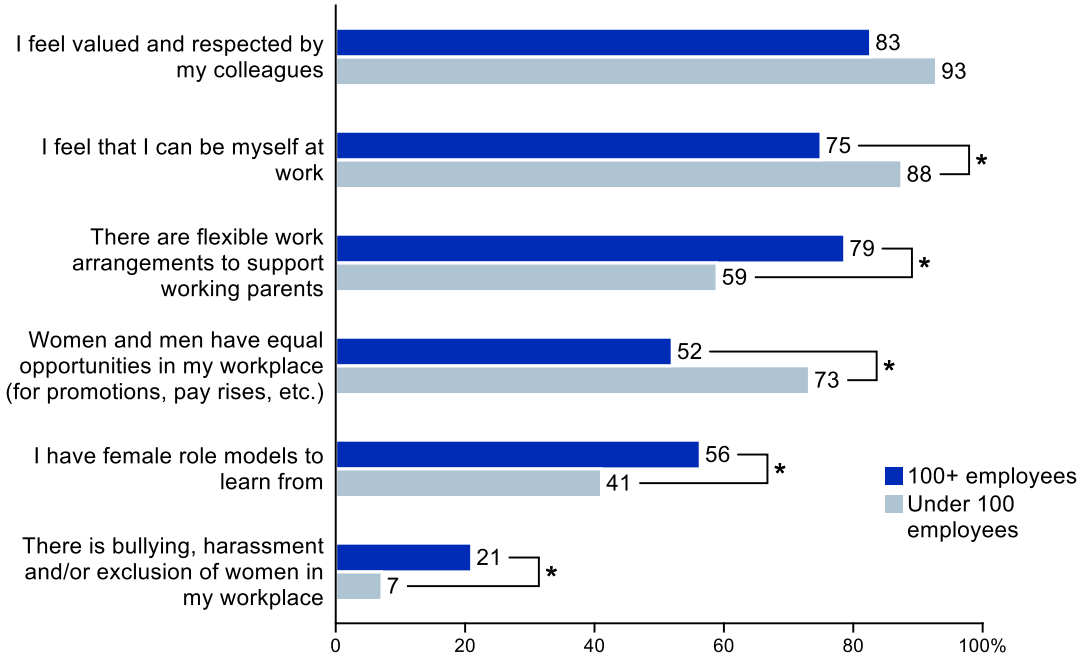


Figure 7.5. Agreement with statements – workplace environment (%), cut by organisation size and shown among female engineers. | QD2 Thinking about your current job and workplace… How strongly do you agree or disagree with each of the following? [5-point scale from "Strongly disagree" to "Strongly agree"] | Data shown is % that selected "Agree" or "Strongly agree" | Base: Female engineers working full-time. 100+ employees N=300, Under 100 employees N=56

Imposter syndrome

One concerning pattern shown in Figure 7.3 is that female engineers have a disproportionately high rate of "imposter syndrome". 56% agree that they feel like an imposter at work, doubting their own skills, abilities and/or accomplishments – compared to just 34% of men, and 38% of women in other fields. The incidence of imposter syndrome appears consistent across different engineering sectors.

The present research points to some factors that likely drive imposter syndrome in female engineers:

- Gender inequity and discrimination, as described above. Women who are excluded from teams, projects, and career progression opportunities due to gender discrimination may feel that it reflects on their own abilities. This exclusion may also hinder their professional development, hence exacerbating the problem.

- Internalised messaging and experiences from an early age that cast doubt on women and girls' abilities in STEM. This leads to ongoing doubt about whether they truly belong in the engineering profession.

Recommendations for improving the work experience

Key issues to address

Figure 7.6 summarises the key issues for women working in engineering identified in this research, and some ways in which they interact with each other.

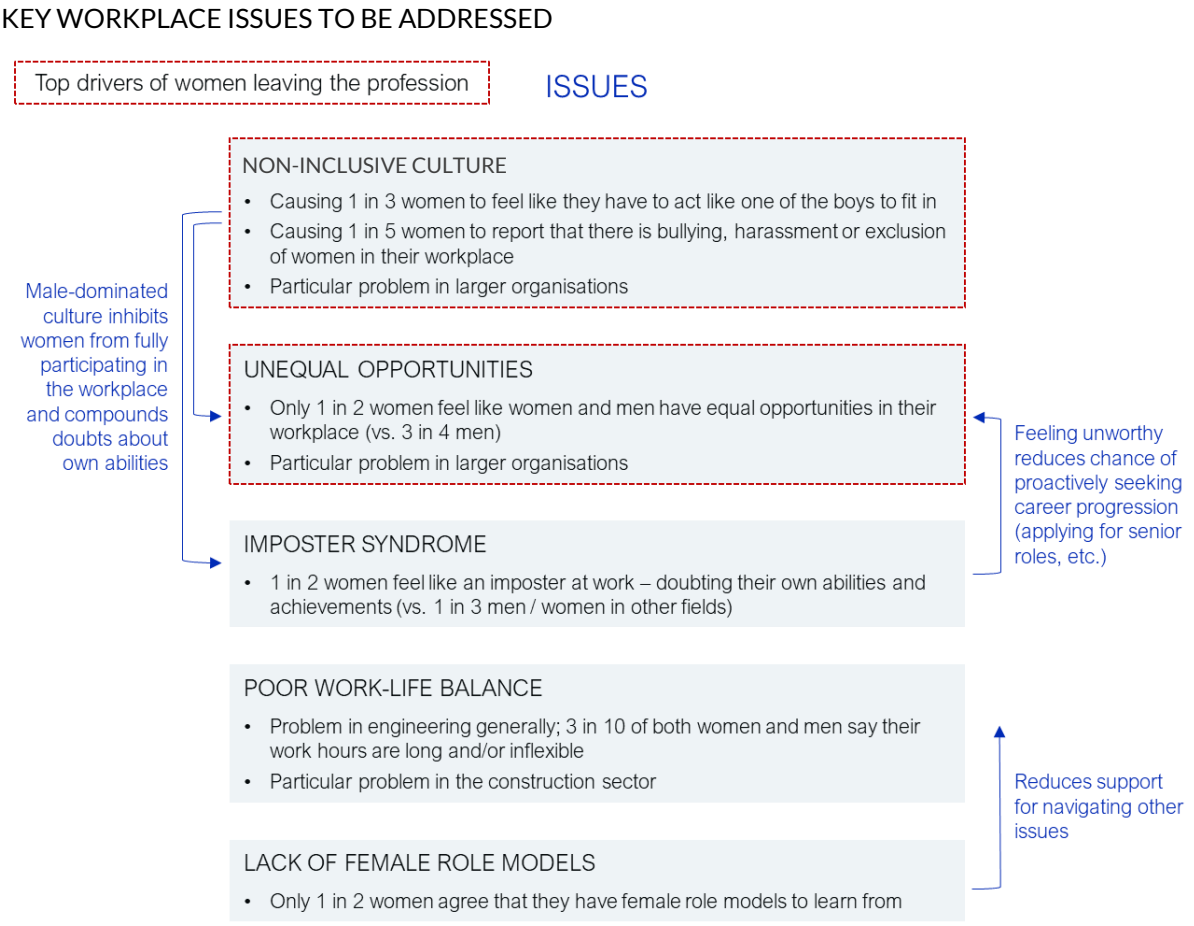


Figure 7.6. Schematic showing key workplace issues to be addressed, and their interactions.

Addressing these issues is a difficult task, as they tend to stem from ingrained attitudes and norms; formal processes and policies often fall short. Certain workplace initiatives can also exacerbate the very issues they are intended to address. Implementation of gender quotas, for instance, can lead to perceptions that certain women are given their positions only on the basis of their gender, and are in fact unqualified or undeserving.

> "KPIs set by businesses to employ more women can have negative impacts... I have heard people say "she only got the job to meet a KPI" in reference to other female engineers on more than one occasion"

Potential initiatives

Below are some potential areas where Engineers Australia and others, can work with and support industry in developing and implementing initiatives:

- Gender bias training
- "Reversed mentoring": young women mentoring senior leadership
- Supportive female mentorships and networks
- Workshops and resources for women to navigate gender-based issues in the workplace and progress their careers (e.g., salary negotiation skills)
- "Opt-out" policy for promotions
- Policy improvements: HR / escalation processes for bullying and harassment; leave and flexible working arrangements
- Investment in the industry / profession (e.g., creating more and higher-value jobs)

> "Have more women networking events or women's groups in the workplaces, often I'm always the only woman and don't get to connect with the other women in the organisation [due to] the work I do"

9 / Summary of Insights and Opportunities

There is an enormous opportunity for Engineers Australia to take a leadership position in addressing the key areas identified through this research to increase women's representation in the engineering profession. Engineers Australia will evaluate opportunities to establish solutions including working with our members, academia, industry, and government to deliver positive gender outcomes for the profession.

Driving greater female participation in engineering is a tremendously challenging and complex undertaking. The overall recommendation through this research is that while there is work to be done at all stages of the engineering journey – from the school years through to university and then the workforce – the first stage is where the greatest focus should be given because it offers the strongest opportunity to influence the number of women who consider engineering for further study and career.

Currently, most girls do not even consider engineering as an option, and those who do are held back by concerns about it being too difficult and male dominated. It is critical that we increase awareness of engineering as a viable and appealing career for women by increasing familiarity, tapping into their key motivators, whilst also working to nurture their interest in STEM subjects throughout the primary and high school years.

A concerted focus on the first stage of the journey will have long term effects, creating a positive feedback loop. If we effectively drive more girls to consider and choose engineering, that leads to more women entering engineering study and workplaces, this will translate to more female role models and mentors available for those earlier in their journey and lessen limiting perceptions of engineering as a fundamentally male profession.

The opportunities to be addressed can include, but are not limited to, the below:

Entry

> Familiarity drives consideration.

Primary to Junior High School

- Outreach prior to senior high school should focus on introducing engineering as an exciting and fulfilling career. Currently girls are unlikely to consider engineering so early on, so getting it into their consideration set is key.
- Sparking interest in STEM and encouraging continued effort in STEM subjects is important. This can be done through initiatives that depict engineering as a vibrant, fulfilling, and creative career path that can be matched with personal priorities such as environmental pursuits and contributing to society for young women.

Senior High School

- Outreach aimed at Year 11-12 students (including university open days) should target those who are studying STEM subjects and already have interest/aptitude in math's and/or science.
- It should address the barriers by emphasising that it is enough to be *good* at and interested in math's and science – you don't necessarily need to be getting top marks, and by presenting the good job prospects for engineering graduates – including salary and opportunities to work across many different roles, industries, locations, and the in-demand skills developed through an engineering degree.
- Outreach needs to communicate the variety of disciplines and areas of practice within engineering – appealing to different interests and values and highlight the fact that the majority of female engineering students and graduates are highly satisfied with their choice to study engineering and are passionate about their field of work.
- There is a critical need to address messaging around engineering; what it is, what it does and its impact on society that aligns with personal interests, there is an area of engineering that pretty much covers all interest areas and all facets of life.

> Key drivers for young women are making a difference to society and the environment

Study

- Investigate critical assessment of curricula to increase industry relevance and help students build more practical skills
- Peer mentoring programs that provide support across the degree (beyond first year)
- Visibility of diverse (including female) role models
- Exposure to the diverse career opportunities within engineering – inspiring students and graduates to find a role that suits their own skills, interests, and values
- Ongoing communication of the impactful and fulfilling opportunities within the engineering profession (these messages are key to encouraging entry into engineering study – but it is important that they continue to be reinforced)
- Increased assistance with finding internships
- Flexibility and support in changing between engineering disciplines

Work Experience

- Gender bias training
- “Reversed mentoring”: young women mentoring senior leadership
- Supportive female mentorships and networks
- Workshops and resources for women to navigate gender-based issues in the workplace and progress their careers (e.g., salary negotiation skills)
- “Opt-out” policy for promotions
- Policy improvements: HR / escalation processes for bullying and harassment; leave and flexible working arrangements
- Career progression plans for women in engineering

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