

Pathway to Diversity in STEM Review Dialogue Starter

Engineers Australia Submission

11 May 2023



Pathway to Diversity in STEM – Dialogue Starter

Engineers Australia’s submission

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Introduction

Engineers Australia welcomes the initiative of the Department of Industry, Science and Resources to open a dialogue on how together we can collaborate to set a clear pathway for diversity in Science, Technology, Engineering and Mathematics (STEM) and build a more inclusive, accepting and supportive society for all.

Overcoming the diversity challenges facing the engineering profession in Australia is critical to alleviating current and future skills shortages and enhancing productivity and innovation by bringing in fresh perspectives and experiences and solving the complex problems facing our future. Through Engineers Australia's continued work to understand the dynamics of the engineering workforce and encouraging women to choose a career in STEM, we can provide valuable, solution-oriented insights to the current diversity in STEM challenges.

The STEM workforce is essential for the nation to create a sustainable future. Yet, it requires the breadth and experience of a diverse workforce to remain competitive. In this submission, Engineers Australia provides the view of the engineering profession, examines the current state of play and presents possible avenues for growth.

About Engineers Australia

Engineers Australia is the peak body for the engineering profession. We are the collective voice of over 115,000 individual members and exist to advance society through great engineering. We support engineers in the pivotal role they play in shaping the future of Australia: creating safe, successful, and sustainable communities.

Engineers Australia takes an evidence-based approach that harnesses the collective technical and professional skills of engineering leaders in contributing to important decisions and debates.

As Australia's signatory to the International Engineering Alliance, Engineers Australia maintains national professional standards, benchmarked against international norms. Under the Migration Regulations 1994, we are the designated assessing authority to perform the assessment of potential migrant engineering professionals' skills, qualifications, and/or work experience to ensure they meet the occupational standards needed for employment in Australia.

Contact Us

Engineers Australia welcomes the opportunity to engage further with the Department of Industry, Science and Resources to support the Diversity in STEM review and provide our expertise to assist in the review. To discuss the content of this submission further, please email policy@engineersaustralia.org.au.

Executive Summary

A country's ability to build a sustainable future and to secure economic growth in the face of increasing globalisation and automation, is deeply rooted to its STEM capability. The world is currently facing many challenges which require a workforce with strong knowledge in how to apply science and mathematical principles. This is the role of engineers.

As the peak body for the engineering profession, Engineers Australia has been a strong advocate of STEM since its inception, advocating for STEM subjects to be set as a priority and promoted in an inclusive way to inspire all young Australians. Diversity in STEM is a long-known challenge, not only for Australia but every nation. Diversity is a necessity, it provides a difference in perspectives and experiences, enhances thinking process and brings innovation.

Australia continues to face an engineering skills supply and demand challenge. The decline in uptake of maths and science subjects in school, and declining commencements in engineering studies in the past decade, show concerning signs for Australia's engineering workforce pipeline. The lack of representation of engineering occupations in the media, poor engagement at schools and lack of understanding of the breadth of engineering career and what engineers do has created perceptions of inaccessibility for young generations.

Engineers Australia believes that engineering is an industry open to all, where everyone belongs. More needs to be done to attract and retain greater diversity in the engineering profession. These can be along the dimensions of gender, race, ethnicity, sexual orientation, socio-economic status, age, physical abilities, religious beliefs, or other ideologies. They are the same attributes that represent our diverse community. Diversity in the workforce brings a range of views and experiences, allowing innovations and solutions to be formulated in a more inclusive way to respond to our society's challenges. Intersectional thinking is needed to reduce or remove barriers to inclusion, combats unacknowledged assumptions, biases and imposter syndromes.

More needs to be done to promote engineering and solve the shortage of skills currently impacting our workforce. Early interventions are essential to inspire younger generations while more support and role-models are important to support engineering students and those currently employed in engineering roles. This requires collaboration between government, industry and peak bodies to implement solutions that will bring more Australian people into engineering as well as retain and re-engage engineering professionals and workers who left to take up other careers or pursuits.

Through ground-breaking research like our *Strengthening our Engineering Workforce report*, *Women in Engineering research* and *Barriers to Employment Migrant Engineers Report*, we have identified the areas that need to be addressed and solution which should be implemented, based on decades worth of learning through our involvement in various STEM initiatives and programs. The recommendations identified in this submission and the reports above, need to be implemented to overcome the current skills shortages and meet the needs of future demand.

1. What does STEM mean to you?

STEM underpins everything we do as a society. It provides a way to understand the world around us and helps to solve complex problems. Prosperity and advancement are deeply rooted in a civilisation's ability to embrace STEM. STEM qualifications and skills are essential to Australia's productivity, innovation and success. As the Department of Education WA reports, 75 per cent of all new jobs will require skills in STEM in the future, and the former National Skills Commission predicts STEM occupations will increase by 12.9 per cent over the next five years.^{1,2}

Australia's engineering workforce is facing significant challenges, with a reduction in the uptake of science and mathematics subjects at school a major contributor. Australian students' performance in mathematics has been in declining since 2003 compared to OECD countries.³ This is exacerbated by reports that 38 per cent of secondary education teachers had taught outside their field of expertise, including mathematics, science, and technology.⁴ This is contributing to continued engineering skills shortages through a reduction of locally educated students having the prerequisites to undertake higher or vocational engineering education.

While Science, Technology and Mathematics are the theories and tools needed, engineering allows for the practical application of the theory. Engineering plays a vital role in shaping and transforming the world around us. Engineers are at the forefront of emerging fields, problem-solvers who use their scientific and mathematical knowledge to develop practical solutions to real-world problems. Without engineering, the theoretical knowledge gained from science, technology, and mathematics would not be used to its maximum potential.

Strengthening the pipeline of engineers is of upmost importance to ensure Australia's productivity and societal prosperity. Diversity plays a critical role in helping to solve this issue. Overseas-born engineers make up over 60 per cent of the engineering workforce in Australia. They bring their experience and breadth of knowledge to contribute to the nation. Yet unconscious and conscious biases can often lead to difficulty in securing a job or finding employment that matches their level of experience.⁵

Diversity in STEM is essential to bring different experiences and perspective, to enhance research and innovation. While 27 per cent of the STEM workforce are female, engineering, though the largest female employer, has the lowest female participation of the STEM professions, with just 16 per cent of Australian engineering graduates and 13 per cent of Australian engineering workforce female.⁶

Australia has a proud history in engineering. Engineers Australia was proud to see the Budj Bim eel traps, an engineering feat carbon dated to 6,600 years old, recognised as one of the country's top engineering achievements and first Australian UNESCO World Heritage site listed.⁷ Australian engineers have since brought important innovations like the black box flight recorder, Wi-Fi and the cochlear implant, which all have contributed to changing the world.

¹ Department of Education WA, <https://www.education.wa.edu.au/what-is-stem>

² Australian Government National Skills Commission, *Australia's shift to a higher skilled, services-based economy* <https://www.nationalskillscommission.gov.au/sites/default/files/2021-12/Australia%E2%80%99s%20shift%20to%20a%20higher%20skilled%2C%20service-based%20economy.pdf>

³ Engineers Australia, *Strengthening the Engineering Workforce in Australia: Solutions to address the skills shortage in the short, medium, and long term*, August 2022, pp14-18

⁴ O'Flaherty, Antonia. (2021) "Worrying' STEM teacher shortage with pressure felt in rural and remote schools' ABC News (accessed 9 February 2022) <https://www.abc.net.au/news/2021-06-15/school-principals-dont-have-enoughmaths-science-teachers/100214738>

⁵ Engineers Australia, *Barriers to Employment for Migrant Engineers*, October 2021, p7

⁶ Engineers Australia, *Women in Engineering – Identifying avenues for increasing female participation in engineering, by understanding the motivators and barriers around entry and progression*, June 2022, p5

⁷ Create Digital, *6,000-year-old Aboriginal Engineering Feat Named to World Heritage List*, July 9, 2019, <https://createdigital.org.au/6000-year-old-aboriginal-engineering-feat-named-world-heritage-list/>

Reigniting the passion for STEM in Australia should be the Government's focus to provide a sustainable future to all Australians. This can only happen should we inspire the next generations and bring more inclusion, acceptance and support to the whole workforce.

2. What are your stories or perspective of accessing and belonging (or not) in STEM?

Through our ground-breaking research⁸, Engineers Australia has heard many stories about the struggles women are facing to first access then belong in engineering occupations. The lack of visibility and poor STEM engagement create the illusion of engineering occupations being unattainable. It's further re-enforced by the lack of familiarity, resources, support and role-models. Women are far more likely to experience 'imposter syndrome' than their male counterparts, feeling they don't belong and should not be here.

Below are some of our members' stories⁹ and stories compiled through our research¹⁰.

"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."

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

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

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

"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'"

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

"I can see it in my colleagues' faces when females in engineering are brought up, can 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."

"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."

⁸ Engineers Australia, *Women in Engineering - Identifying avenues for increasing female participation in engineering, by understanding the motivators and barriers around entry and progression*, June 2022

⁹ Margaret Gayen & Carina Nixon, *Creating Cultural Change to Support Gender Equality in Engineering (in the Oil, Gas and Pipeline Industry)*, 2022, p11

¹⁰ Engineers Australia, *Women in Engineering - Identifying avenues for increasing female participation in engineering, by understanding the motivators and barriers around entry and progression*, June 2022, pp19, 28, 53

“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.”

“On my first day working for an engineering firm, I was chatting in reception with the other 5 new grads starting in my team that day (all male). The HR person opened the door and said welcome, come on in. We started to file through the door, and she stopped me and said "Sorry, who are you here to see?" I said I was one of the new engineering grads. She said, "No you're not". None of the male grads had to even say their name, she just assumed they were all meant to be there.”

“I answered a phone call from a colleague with whom I had been corresponding by email. When I answered the phone, my colleague asked to speak to me. I said, "yes, I'm speaking, that is me", and he replied, "no I want to speak to the mechanical engineer", and I replied again, "yes, that is me". There was an awkward pause and then an "oh, ok".”

This is just a selection of the stories we have heard. We keep hearing from other minorities the struggles they face daily, engineers with disability, nonbinary, neurodivergent and veterans. Looking at elements of diversity as separate issues will not address all the issues and ignores the compounding impacts of marginalisation. The experience of a woman with a disability may be completely different to those of other women. Using intersectionality as a framework to consider these issues will provide a better understanding of people’s lived experiences by thinking about the cultural, structural and organisational barriers to participation in the engineering workforce. Intersectional thinking also allows us to consider that we are all intersectional in our advantages and disadvantages and that it can change depending on context.

Giving equal access and a sense of belonging to all will not only help build our engineering pipeline but also provide a greater level of retention in a workforce afflicted with attrition.

3. How can we fix the unacknowledged assumptions, including unconscious biases, of our STEM system?

Promotion of STEM in education

While lawyers and medical professionals are heavily represented in the media, engineering occupations are hardly seen. This lack of representation feeds the assumption that engineering occupations require you to do well in science and maths, that they are hard to study, and employment can be difficult to find. This is far from reality.

Many of our members report how engineering can often be presented the wrong way, especially to women, emphasising on the challenging aspect rather than the exciting opportunities. Our members believe this emphasis acts as a major deterrent, creating unconscious biases towards the requirements needed for a career in engineering when modern engineering is more intersectional.

Engineering specially is suffering from a lack of understanding of the public on what an engineer does and what skills are required to study and work in engineering. Engineers Australia recommends the

following actions be implemented at school and university to promote a career in engineering and fix the current biases:¹¹

- 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 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 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 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

- Study
 - Investigate critical assessment of the curriculum 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

A focus also needs to be given to raising awareness of the various pathways available for a career in engineering. The engineering team is composed of three occupational categories: Engineering Associates, Engineering Technologists and Professional Engineers. These occupational categories are generally based on level of qualification, an advanced diploma (2 years degree) being required to be an Engineering Associate, a bachelor in science engineering (3 years degree) for Engineering Technologist and a bachelor in engineering (4 years degree) for Professional Engineer. The whole engineering team has a part to play in advancing our society and the various occupations offers a greater level of flexibility for all in terms of study requirements.

¹¹ Engineers Australia, *Women in Engineering – Identifying avenues for increasing female participation in engineering, by understanding the motivators and barriers around entry and progression*, June 2022, pp57-58

Building awareness of the importance of all engineering occupations is critical to inspire more students to study engineering, especially those having the perception previously stated around high mathematics level requirements. Some engineering occupational categories do not require students to study advanced mathematics but would allow them to have a fulfilling career in engineering.

Increasing the utilisation of engineers in the profession

Unacknowledged assumptions and unconscious biases aren't limited to the early days but run through an engineer's career. We hear from our members the struggles women and migrants can regularly face. Both groups often deal with negative assumptions undermining their experience and capabilities stemming from a lack of understanding and consideration.

Many female engineers have shared with us their difficult experiences, having to constantly reaffirm their place in a male-dominated environment. They can often be seen as less qualified than their male counterparts despite being the most qualified and experienced member of the team. These perceptions lead to a toxic culture deterring many from the engineering profession, feeling undervalued and exacerbating their "imposter syndrome". Our research¹² shows how this is particularly the case in larger companies, where female engineers are more likely to suffer from bullying, harassment and/or exclusion in the workplace. They are also less likely to experience the same level of equal opportunities than their male counterparts. A significant portion of female engineers end up giving up on their dreams of pursuing a career in engineering, leaving the profession for other careers offering them more flexibility and valuing their skills and experience.

Migrant engineers are also suffering from similar types of negative perceptions around the value of their qualifications and experience. Many migrant engineers have shared how little value was given to their overseas experience and doubts raised on the legitimacy of their overseas qualifications. The requirement around having "local experience" is reported as the biggest hurdle migrant engineers are facing, an unconscious bias employers tend to have, focusing on applicants with local experience to validate any other overseas experience.

These perceptions are having a significant impact on our engineering workforce. While inspiring the young generations to see the possibilities for a career in engineering is a clear need, retention of our engineering workforce is also an imperative. Creating an inclusive culture to allow female engineers to thrive and not feel like imposters at work should be a priority. We also need to find ways to break down the barriers afflicting migrant engineers so employers can take better advantage of this untapped pool of engineering skills available in Australia.

To fix the STEM system, our research on both Women in Engineering¹³ and Barriers to Employment for Migrants Engineers¹⁴ indicate that we need to embrace and implement more:

- "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
- Position migrant engineers as a collective talent pool and talk to the size of the opportunity for employers

¹² Engineers Australia, *Women in Engineering - Identifying avenues for increasing female participation in engineering, by understanding the motivators and barriers around entry and progression*, June 2022, p53

¹³ Engineers Australia, *Women in Engineering - Identifying avenues for increasing female participation in engineering, by understanding the motivators and barriers around entry and progression*, June 2022, p59

¹⁴ Engineers Australia, *Barriers to Employment for Migrant Engineers*, October 2021, p35

- Provide credible, trusted information on employment pathways for migrant engineers
- increase local networks by developing networking and sponsorship programs/opportunities for migrant engineers
- coordinate initiatives to build local knowledge and experience of migrant engineers
- assist humanitarian visa holders with credentials assessment
- “Make it easy” for employers to access talent pool

4. Have you had experience with existing measures or programs (government funded or not) aimed at improving the diversity of Australia’s STEM system?

Engineers Australia and its members actively support programs aimed at improving the diversity of Australia’s STEM system. Some of these programs include:

- STARportal
- Engineering is Elementary
- Year 13
- Power of Engineering
- Engineers Without Borders
- Robogals
- Re-Engineering Australia Foundation, F1 in schools STEM Challenge
- Global Engineering Talent Program
- STEM Returners
- Champion of Change Coalition

“The limitation for engineers to be able to support young people in STEM is having access to materials to showcase the professions at schools. I know that CSIRO and Questacon are doing amazing things, showcasing what engineers do, which could be customised for the differing age levels and engineering disciplines, Australia wide, to encourage, and gear up, engineers to walk into schools.”

“I remember with great pride the Engineers Australia campaign many years ago as a young engineer walking through airport and seeing the large Engineers Australia sign promoting Chartered Engineers and with a little boy with a plane looking at the horizon. I could point that sign out to family and colleagues and friends and made me so proud of the contribution that engineers make to society and making it more visible as generally engineers work is hidden and not well understood by broader society.”¹⁵

Visibility is key to strengthen the STEM pipeline. However, finding the right material, adapted to the right audience can be challenging. The STARportal was designed as a one-stop shop to facilitate the connection between parents, students, teachers and their local and online STEM activities. This initiative created by the Office of the Chief Scientist, Engineers Australia, Telstra, AMSI, BHP Billiton

¹⁵ Quotes from members of Engineers Australia’s Women in Engineering Group

and the Commonwealth Bank, in consultation with the Department of Education, has brought an easy way for Australian families to access all STEM outreach activities in their area and online.

RECOMMENDATIONS:

- STARportal is a perfect example of how collaboration between government, peak bodies and industry can achieve efficient results.
- STARportal needs to remain a priority for the Government to support.

Engineers Australia is currently developing a Global Engineering Talent program aimed at increasing employment outcomes for migrant engineers, equipping them with an understanding of Australian cultural and technical differences but also helping employers understand the value of their overseas experience through rigorous assessment processes. Developing such a program is no easy task but can generate great returns for Australia, helping to alleviate some of the engineering skills shortages.

While building a strong pipeline of engineers is of primary importance, more needs to be done to retain engineering professionals in their professions. As our research¹⁶ shows, simply increasing intakes of undergraduate engineering students is unlikely to solve the problem. Women are more likely to leave an engineering career for a more flexible profession allowing to juggle a better work-life balance. We often hear from our members the challenges returning to work after parental leave or parental leave related sabbatical can have, predominantly on women once again. They often come back on a part-time basis, which adds to the complexity. Engineering being a team-lead type of work, many struggle with having to miss important meetings scheduled on their off-days. It impacts the team's productivity, despite everyone's best efforts to accommodate it and reinforces the 'imposter syndrome' too often felt by women and leads many to leave the profession for more accommodating professions like in the finance sector.

More employers have policies or initiatives in place to enable flexible access to parental leave for parents, like 97.2 per cent of the Champions of Change Coalition members¹⁷, most are still largely affected by it and too many women especially are forced to abandon their career.

Engineers Australia supports programs like STEM Returners which aims at offering sustainable ways to encourage STEM professionals to come back to work. Initiatives like Career Renewal Program, which is set up by Origin Energy and provides individuals with tailored training, coaching and support for professionals who have taken a career break but are eager to come back, with a way to settle into permanent part-time or full-time roles should be supported, celebrated and promoted.

As a nation, we need to ensure we are providing equal opportunity across the whole of society; to create economic prosperity, to compete globally in innovation and, because it is fair and just. Diversity and inclusion go hand in hand. To employ a diverse workforce is only half the effort, creating a culture of inclusivity where that diversity of thought is embraced and encouraged is the other half.

RECOMMENDATIONS

- Diversity and inclusion efforts are mostly successful when they are driven by a commitment from organisational leaders. For this commitment to be meaningful, it requires leaders to understand why diversity and inclusion matter.
- Engineers Australia encourages more Australian companies to join initiatives such as the Champions of Change Coalition, which aims at changing the status quo and disrupt the system on sexual harassment and overall promote a more diverse and equal workforce in Australia.
- Support from governments needs to be provided to raise awareness on these types of initiatives.

¹⁶ Engineers Australia, *Strengthening the Engineering Workforce in Australia: Solutions to address the skills shortage in the short, medium, and long term*, August 2022, p17

¹⁷ Champion of Change Coalition, *2021 Impact Report Summary, Men Stepping Up Beside Women On Gender Equality*, 2021, p9



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