



[Strengthening diversity in STEM]

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Strengthening diversity in STEM

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Introduction

Engineering is the largest employer of all STEM occupations. Engineers Australia acknowledges the independent panel's view that STEM reaches beyond distinct disciplines to how they apply in a broad range of problem-solving contexts.

However, engineering has:

- the lowest female representation, with only around 16 per cent of Australian engineering graduates and approximately 14 per cent of the Australian engineering workforce being female
- a retention issue, with only around 38 per cent of qualified female engineers working in an engineering occupation, and
- a high reliance on migrant engineers, which make up around 60 per cent of Australia's engineering workforce. Yet, migrant engineers are much more likely than their Australian born counterparts to be under or unemployed.

Overcoming the diversity challenge facing the engineering profession is critical to lessening current and future skills shortages in the independent panel's broader view of STEM, as well as enabling more people to see themselves in STEM. Engineers, including those representing diverse perspectives, enhance productivity and innovation by bringing in fresh perspectives and experiences to solving the complex problems facing our future.

About this submission

Engineers Australia understand the draft recommendations are broad areas for change, which are designed to prompt discussion and further refinement.

Engineers Australia's continued work to understand the dynamics of the engineering workforce, support migrant engineers find employment and encourage women to choose a career in STEM, has provided us solutions-oriented insights to many initiatives which support the draft recommendations.

This submission provides case studies to show how initiatives can be implemented at a practical level to support the final recommendations. Responses are not provided to all the recommendations.

About Engineers Australia

Engineers Australia is the peak body for the engineering profession, with over 115,000 members across Australia. Constituted by Royal Charter, our mission is to advance the science and practice of engineering for the benefit of the community.

Contact

Engineers Australia looks forward to continuing our engagement with the review panel and the Department of Industry, Science and Resources. If you wish to discuss any of the initiatives raised in this submission further, please contact Jenny Mitchell, General Manager, Policy and Advocacy at jmitchell@engineersaustralia.org.au.

Further information to support recommendations

Recommendation 1a

The Australian Government should set up an ongoing central office and independent council to maintain accountability, oversight and momentum of diversity in STEM initiatives.

Engineers Australia supports an ongoing central office and independent council to maintain accountability, oversight and momentum of diversity in STEM initiatives. This council can also lead a national strategic approach to diversity (see recommendation 2a).

Suggestion for further refinement of this recommendation:

The governance structure of the independent council should require representation from all the STEM professions (science, technology, engineering and mathematics).

Recommendation 2a

Building on recommendations of this review, the Australian Government should create a national strategic approach to diversity in STEM initiatives.

Engineering is the largest employer of STEM professions in Australia; however, it has the lowest female representation. Of the engineering qualified labour force, females make up 14 per cent of those in engineering occupations. This contrasts with other fields such as biological sciences, where gender is far more balanced.

Engineers Australia supports a national strategic approach to diversity in STEM initiatives. Any national strategic approach to diversity needs to differentiate the various components of STEM (science, technology, engineering and maths). The steps needed to achieve greater diversity and inclusion in each of these are likely to be supported by broader themes, but the initiatives needed can differ depending on the area. Engineers Australia's *National STEM Strategy* highlights the importance of engineering in STEM and details key actions to support engineering.

Suggestion for further refinement of this recommendation:

The Australian Government should commission peak bodies to provide strategies and initiatives to increase diversity in a specific component of STEM (science, technology, engineering and maths). These can then feed into a broader national strategy

Recommendation 4a

The Australian Government should develop and run a formal, long-term and measurable national communication and advertising campaign relating to STEM.

Case study demonstrating how this recommendation could be implemented:

Engineering. Making life happen.

In 2022 Engineers Australia launched a campaign to showcase engineering and all that it is.

Target audience:

Building awareness of engineering in the broader community.

Outcome:

The campaign produced:

- A [TV advert](#) and other content for various advertising channels (including outdoor media)
- A website with engineering stories, showcasing some inspirational engineering endeavours
- Links to our STEM resources to encourage future engineers
- Social media toolkit and 'IAmAnEngineer' hashtag campaign to raise individual engineers' profiles.

It reached a large audience and the results exceeded expectations, including 17 per cent whole population recall of exposure, and increases in awareness and positive attitudes towards engineers.¹

Engineers Australia would be happy to provide further information about the campaign's results and success factors.

Recommendation 4b

The Australian media and entertainment industry should work with relevant academies, STEM peak bodies and not-for-profit organisations to celebrate diversity in STEM. This would involve more accurately representing the diverse people and roles in STEM.

Unlike lawyers and medical professionals, the engineering profession is not often seen in the media. Engineers Australia supports recommendation 4b and would welcome the opportunity to work with the Australian media and entertainment industry to improve this.

The case studies below illustrates how engineering is being promoted to children in engaging ways.

Case studies demonstrating how this recommendation could be implemented:**Engimites and EA Junior Club²**

Engineers Australia's Junior Club helps spark curiosity in the minds of young students by helping to bring engineering principles and knowledge into the home and classroom. The Engimites support this initiative by helping to engage students.

Target audience:

Primary school students.

Outcome:

EA Junior Club provides activities and resources to parents and primary school teachers who want to bring engineering into the classroom. Engimites were developed to help grasp kids imaginations and get them thinking about engineering.

The Engimites include Ziggy (aerospace engineer), Lexi (water engineer), Jax (biomedical engineer), Raf (electrical engineer), Boots (software engineer), and Digby (civil engineer).

¹ Ergo Research 'Brand Campaign Report' October 2022

² Engineers Australia 'EA Junior Club' (accessed 6 September 2023) <https://eajuniorclub.com.au/about>



To support recommendation 4b, Australian media and entertainment industry could work with Engineers Australia to adapt Engimites into short cartoons showcasing the ‘e’ in STEM and further propelling engineering into the home.

Engibears – picture books for children

The Engibears books (*Engibear’s Dream*, *Engibear’s Bridge*, and *Engilina’s Trains*) written by Andrew King and illustrated by Benjamin Johnston are designed to personalise engineering and make it accessible for young children through the combination of story, pictures and friendly characters.

The engineering projects that Engibear, Engilina and the Bearbot work on in the fictitious city of Munnagong have parallels to both the work that engineers do in our own communities and to the activities that children undertake when they are playing and creating. A common feature of the Engibears books is the Engineering Design Process - essentially the way engineers work – aspects of the process are illustrated in each of the books.

Target audience:

Engibear was created to help raise awareness of engineering with young children (three years and up) and spark their creativity.

Outcome:

These books help to introduce engineering in an engaging way that invites children to dream, draw, design and create. It introduces various engineering disciplines and activities. The books were also written to link into the Early Years Learning Framework and the Australian Curriculum.

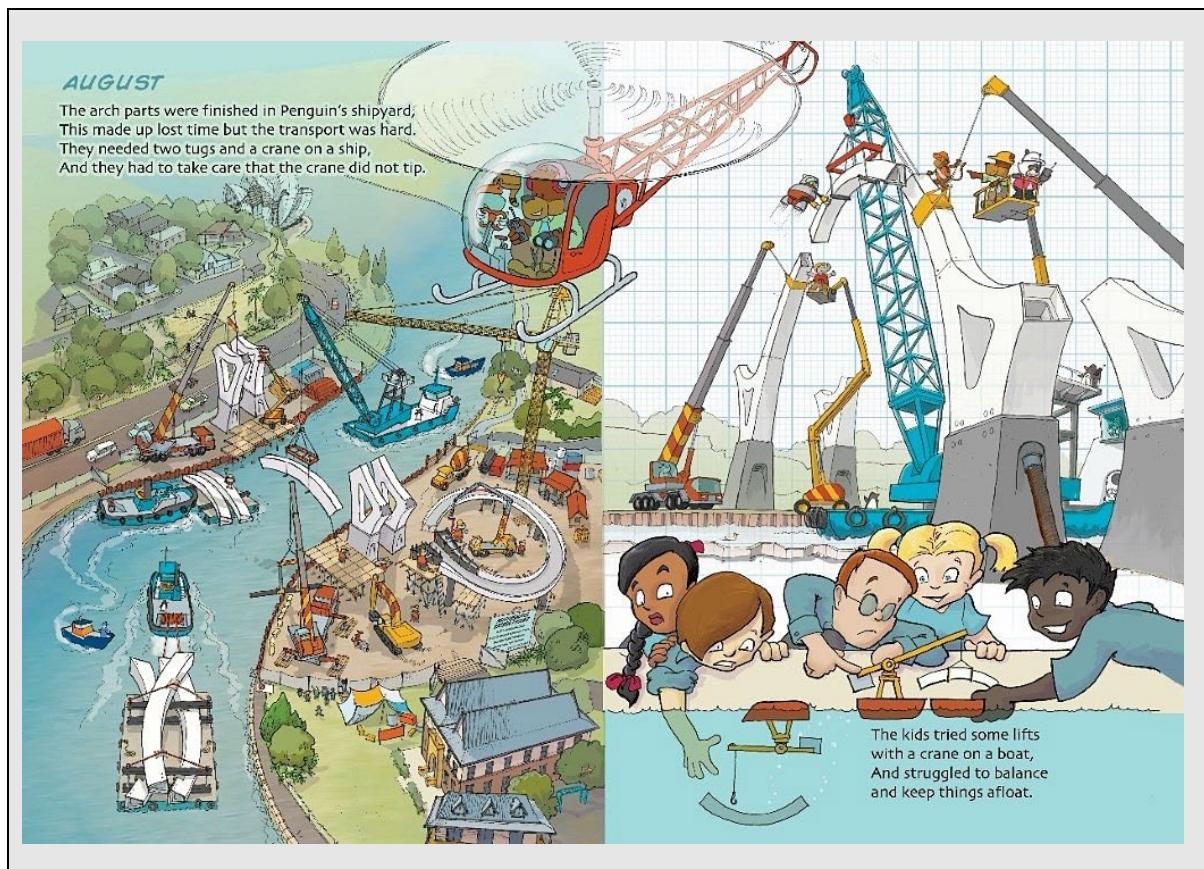
Engibears encourage adults and young children to share stories about engineering and engage in play-based engineering experiences together. The books also portray gender diversity in the industry.

These books are published by Little Steps Publishing. The following reviews are provided on the Little Steps website:

Engibear’s Dream: “I don’t think I have ever read a picture book that demonstrates the engineering and working technologically process so well.” (Learning Hub, Vol 2, 2015).

Engibear’s Bridge: “Engibear’s Bridge is an excellent representation of the whole civil engineering process for young readers”. (The Literature Base, 2016).

Engilina’s Trains: “The growing popularity of STEM subjects in schools indicates the importance attached to areas of study such as Engineering. The bright and busy text contributes to this reputation by engaging young readers, enhancing their knowledge and challenging their imagination to solve practical engineering problems.” (CBCA Reading Time, 2017).



Recommendation 4c

All STEM-related sectors should actively include diverse knowledges and representations of diversity in research, publications, education materials and scientific approaches.

Greater diversity is well established as being beneficial for workplaces. The reasons for this include enhanced productivity and innovation, and fresh perspectives which leads to greater inclusion for society broadly.

Research conducted by Engineers Australia saw that for women, familiarity was the biggest barrier to choosing engineering as a career. Testimonials from the research highlight how it is difficult to consider a profession you don't really know exists. This is exacerbated for a profession that is typically male dominated.

Engineers Australia has several member groups focused on supporting greater diversity in the profession. These groups include our Indigenous Engineers Group and Women in Engineering. We also have an InterEngineer community of LGBTQIA+ engineering professionals and allies. These groups are called upon in our work to provide their perspectives and bring diversity in thought.

In publications, Engineers Australia is conscious to limit the use of stereotypical imagery such as people in hard-hats and high-vis clothing. Engineers work in an array of different settings, from offices, to laboratories, hospitals, mine sites and everything in between.

Suggestion for further refinement of this recommendation:

Including the objective for this recommendation may make it more impactful, i.e. 'in order to increase familiarity of STEM careers among diverse people, supporting more people to choose a career in STEM'.

Recommendation 5a

Empower schools and educators to teach STEM thinking and skills, and support pathways to STEM careers for diverse students

Any organisation that is future focused should be engaged in schools in an active and purposeful way. STEM education starts in early childhood and needs to be fostered and encouraged to help these students undertake tertiary education in STEM and build a long-term career in the field.

Case studies demonstrating how this recommendation could be implemented:

F1 in schools³

The Re-Engineering Australia Foundation (REA) is a leading force in promoting STEM education in Australia. A prominent initiative under REA is the F1 in Schools™ program, where students from years 5 to 12 design miniature F1® race cars, integrating STEM principles and collaborating with industry partners.

Target audience:

Year 12 Students

Outcomes:

This program emphasises durable industry-school partnerships, ensuring contemporary curriculum alignment and bridging urban-rural divides to spur innovation.

The program helps to develop interest in STEM subjects, validate academic progress and inspires students to embrace their STEM education. This supports building a robust pool of STEM skills for industry. Over one million Australian students have engaged with F1 in Schools, reflecting a surge in STEM interest.

Engineering is Elementary⁴

This program is supported by the Department of Defence and provides professional development to teachers upskilling them in teaching STEM. It was developed by the Museum of Science, Boston.

Target audience:

Kindy to year six teachers.

Outcomes:

The program helps teachers to develop STEM teaching strategies and build confidence to teach STEM subjects. The program provides the tools needed to engage students in critical thinking and problem solving. Skills critical to engineering.

Year 13⁵

Engineers Australia works with Year 13, a program designed to improve the well-being of young Australians by helping with the school to work transition. One of the academy programs offered by

³ REA, 'F1 in schools' (accessed 6 September 2023) <https://rea.org.au/f1-in-schools/>

⁴ Questacon 'Engineering is Elementary' (accessed 6 September 2023)
<https://www.questacon.edu.au/about/programs/engineering-elementary>

⁵ Year 13 (accessed 6 September 2023) <https://year13.com.au/about>

Year 13 is the *Engineering your future* module. Here, Engineers Australia and Year 13 showcase what engineering is all about and the cool and exciting projects engineers get to work on.

Target audience:

Mid-late high school students considering their career opportunities.

Outcomes:

This program showcases a broad range of careers outside of school and delivered a 29 per cent uplift in the likelihood of young people's intention to pursue a career in engineering. One of the limitations of students deciding what to study is knowing what opportunities exist, and how these opportunities match their personality and skills. By providing information on engineering (and other) careers, students are more equipped to choose these careers moving forward.

Further details regarding the success of this initiative can be provided upon request.

Recommendation 5b

Governments should partner with First Nations people and the education sector to reflect First Nations scientific knowledges in courses. This would include school curriculum support materials, teacher professional development, and vocational and higher education courses.

First nations have engineered the landscape using sophisticated technological and philosophical knowledge systems in a deliberate response to changing social and environmental circumstances.⁶ These knowledge systems integrate profound understanding of Country, bringing together an understanding of the topography and geology of the landscape, its natural cycles and ecological systems, its hydrological systems and its natural resources, including fauna and flora. This has enabled people to manage resources sustainably and reliably.

Work done by the Australian Academy of Technological Sciences & Engineering⁷ and the Australian Council of Engineering Deans⁸ provides recommendations on partnering with Indigenous groups and integrating their traditional scientific knowledge into the school curriculum, teacher professional development and tertiary education courses.

Case study demonstrating how this recommendation could be implemented:

Indigenous Knowledges & Perspectives Woven in Australian engineering education: a landscape study⁹

A research project collaboration between the Faculty of Engineering and Information technology of the University of Melbourne and the School of Engineering and Built Environment of Griffith University.

⁶ Create Magazine, *5 Indigenous Engineering Feats You Should Know*, <https://createdigital.org.au/5-indigenous-engineering-feats-you-should-know/>

⁷ Australian Academy of Technological Sciences & Engineering, *Our STEM Skilled Future – An Education Roadmap for an Innovative Workforce*, October 2022, p14

⁸ Australian Council of Engineering Deans, *Embedding Aboriginal and Torres Straight Islander Perspectives Into the Engineering Curriculum, Position Statement*, August 2017,

https://www.aced.edu.au/downloads/POSITION_STATEMENT_No_3_IndigenousPerspectives.pdf

⁹ 'Indigenous Knowledges and perspectives woven in Australian engineering education: A landscape study' The University of Melbourne and Griffith University Queensland (accessed 6 September 2023)
https://melbourneuni.au1.qualtrics.com/jfe/form/SV_d9YTYxKgDptpLZs

Target audience:

Engineering curriculum materials courses and teacher professional development in higher education

Outcome:

Led by three researchers and supported by an advisory group with Indigenous and non-Indigenous members, this study will map the landscape of current education practice and identify opportunities for strengthening this work. The research is guided by principles co-created by the project team and draws on decolonising research approaches. The aim of this study is to:

- Listen to, explore and map, how Aboriginal and Torres Strait Islander knowledges and perspectives are woven throughout engineering education experiences in Australia
- Listen to and describe the experiences of educators involved in this work
- Identify opportunities to strengthen this work

This work will enable universities to achieve reconciliation goals relating to weaving Indigenous knowledges in higher education curricula, as outlined in various policy commitments and strategies, leading to a more just and reconciled Australia.

Recommendation 6a

Vocational education and training (VET) providers, industry and other education providers (like schools and universities) should increase collaboration to promote VET-based STEM offerings. This includes promoting streamlined pathways to STEM careers or university STEM qualifications. These communications should reach parents to address parental perceptions of STEM VET education.

There are many different pathways into engineering, including through vocational education. In Australia, roles in engineering fall within three occupational categories. These categories are based on qualifications, experience and the type of work undertaken by the engineer.

Known collectively as “the engineering team”, the three occupational categories are:

1. Professional engineer (typically four-year bachelors qualification)
2. Engineering technologist (typically three-year engineering technology degree)
3. Engineering associate (typically a two-year advanced diploma or associate degree)

Engineering Associates typically hold a two-year advanced diploma or associate degree of engineering. Engineering Associates have a wide range of functions within engineering enterprises and engineering teams. Engineering Associates are often required to be closely familiar with standards and codes of practice, and to become expert in their interpretation and application to a wide variety of situations.

Engineering Associates often develop wide-ranging experience of practical installations, particularly on detailed aspects of plant and equipment that can contribute very greatly to safety, cost or effectiveness in operation.

Building greater awareness of these alternative pathways and opportunities in a STEM career can help to attract a broader and more diverse group of people. By undertaking these alternative qualifications, individuals can also look to articulate to a bachelors qualification. Some tertiary institutions offer programs tailored for articulation that bridge a gap between the knowledge a student already has and where they need to be. Some also offer credits for recognition of prior learning.

Suggestion for further refinement of this recommendation:

Coordinated through Jobs and Skills Australia, professional associations, industry, peak bodies and the tertiary education sector should be tasked to develop a clearer understanding of the various occupational categories and pathways to employment and articulation to other qualifications for the major STEM professions, including engineering.

This work will also support industry understand how best to utilise all parts of the engineering team when undertaking workforce planning.

Recommendation 8a

Governments and Australian universities should work together towards equity in access, participation and attainment of STEM higher education.

Engineers Australia's [Response to the Australian Government's Universities Accord Interim Report](#) explores the issue of equity in STEM higher education in further detail. Engineering higher education can be less attainable for those from lower socio-economic backgrounds. This can be illustrated in several ways.

Programs, such as engineering, include practical/lab components which provides students the opportunity to apply academic theory with practice. This means many engineering units need to be done in person. This can be a barrier for students who need to work to support themselves through university. To combat this, many students need to reduce their study load to allow them to attend work and not fall behind study.

Work Integrated learning opportunities are also an important part of an engineer's development. For a higher education provider to have a professional engineering program accredited, they are required to provide opportunities for student engineers to engage with professional engineering practice. This can be through a range of work integrated learning opportunities (WIL), including placements.

Placement poverty is a real concern that can and does impact education outcomes. The need to undertake placements can negatively impact students who need to pause or give up paid work opportunities to complete the required placement hours.

To increase participation from more diverse groups, greater financial support needs to be provided to students. This should be a shared responsibility between government and industry. Industry needs to provide more paid WIL placements, and more incentives are needed to support them doing this. Government should also review the current fortnightly rates for Youth Allowance and Austudy which are not sufficient to support students to study full time.

In addition to this, a focus should be made on outreach to schools to help build awareness of STEM careers earlier enough that students can undertake the required pre-requisites to enter higher education study. Secure, sector wide funding should be provided to support outreach programs, specifically designed to build awareness of higher education opportunities in critical in-demand professions such as engineering. In addition, mathematics education in Australia is in a crisis (particularly for lower-SES and regional/remote students), and as a precursor to engineering study initiatives to support the learning of mathematics are urgently required.

Suggestion for further refinement of this recommendation:

The Australian Government should provide priority investment in increasing equity in STEM higher education through:

- Work integrated learning (WIL) that incentivises employer-paid WIL placements and increases financial support for students undertaking placements

- Secure funding to universities to allow for the development of outreach programs aimed at improving equity by building awareness of in demand professions early in a child's education
- Reviewing the current fortnightly rates for Youth Allowance and Austudy which are not sufficient to support students to study full time.

Recommendation 9a

STEM-employing organisations and governments should apply policies like anti-bullying and harassment, flexible work and pay transparency to create safe and inclusive environments. They should invest in programs to accelerate progress for underrepresented groups, like career development, fellowships, job customisation or mentoring.

Case study demonstrating how this recommendation could be implemented:

Engineers Australia

As the peak body for the engineering profession, Engineers Australia employs engineers in key areas where knowledge of engineering is critical to enable us to advance the practice and science of engineering for the benefit of the community.

As at July 2022 Engineers Australia had 354 employees with a gender split of 59 per cent female. Of the 36 executive team members/business unit leaders, 61 per cent were female.¹⁰

Engineers Australia aims at creating a safe, fair, and inclusive work environment for all its employees. The people and culture team has developed a whole set of policies and procedures to ensure the safety, respect and inclusion of all employees, regardless of their gender, backgrounds, and sexual orientation. Some policies below outline how Engineers Australia supports a more diverse and inclusive workplace.

- Flexibility.
 - A standard 35-hour work week.
 - Hybrid working, with work-from-home arrangements supported for most employees.
 - To support a diverse and inclusive workforce Engineers Australia recognises some employees require flexible work arrangement.
 - These arrangements can be applied for by all employees and offers:
 - Staggered work hours.
 - Compressed working week.
 - Alternative work locations in another office.
 - Individual arrangements can also be negotiated to support individual circumstances.
- Additional leave
 - Engineers Australia offers 15 paid personal leave days per year.
 - Purchase leave arrangements are also available.
- Recruitment policies which support our diversity agenda by requiring diverse applications to be considered and diversity to be a main consideration when appointing to a team.
- Dedicated roles supporting diversity and inclusions.
 - Internally this includes a Head of Organisation Development and externally for the profession a National Manager, Professional Diversity and STEM.

¹⁰ Engineers Australia '2021/2022 Annual Report' <https://www.engineersaustralia.org.au/publications/annual-report-2021-2022>

- Promoting gender diversity through participation in [the Champions of Change Coalition](#) (formerly Male Champions of Change) STEM Group and diverse representation on industry speaking panels.
- Groups and Committees
 - Creating an InterEngineer community to support our LGBTQI+ engineers.
 - An Indigenous Engineers Group which through the College of Leadership and Management which is committed to expressing Indigenous culture as a form of awareness within the industry and to engage with Indigenous engineers. This includes increasing the awareness of the presence and activity of Indigenous engineers in the workforce.
 - Women in Engineering committee
- Training
 - All staff attend bullying and harassment training in person to build a more inclusive workplace.

Engineers Australia has established a Diversity, Inclusion and Belonging Committee which is chaired by the Group Executive for People and Culture. The purpose of this group is to support and bring people into the organisation who have unique experiences, diverse backgrounds, and individual differences to create a dynamic and innovative workplace where people feel more connected and have a shared sense of purpose.

Recommendation 10b

The Australian Government should do a detailed analysis of how overseas STEM qualifications are recognised in Australia.

For those looking to migrate to Australia as an engineer via the skilled migrant stream, their skills need to be formally assessed. Engineers Australia is authorised by the Australian Government's Department of Home Affairs to assess migrants' qualifications, skills and experience.

Migrant engineers are assessed to ensure applicants' experience and qualifications align to international benchmarks, with an occupational category and engineering occupation being reflected in the outcome letter.

Often, despite migrants having gone through this process, when they migrate to Australia, they find it challenging to secure employment in engineering roles. Some experience when they do find work, it does not meet their skill and experience level and they remain underemployed. Humanitarian visa holders tend to struggle more than skilled migrant holders.

Research conducted by Engineers Australia highlights the biggest barriers these engineers face. They include:

1. No Australian work experience and international experience not being valued
2. A lack of local networks
3. No local referees
4. Jobs often advertised for citizens or permanent residents only

To support migrants overcome these barriers Engineers Australia has developed two pilot programs, described in the case studies below.

Case studies demonstrating how this recommendation could be implemented:

International University Student: Engineering your future

The aims of the program were twofold: to create opportunities for international students, and to promote the benefits and value international students can bring to a business. The program has three parts, an introductory session, work integrated learning opportunities and networking workshop and events.

Target Audience:

International students studying engineering.

Testimonial:

Sandesh Aryal worked in his home country of Nepal as a civil engineer after graduating with a Bachelor of Engineering in 2019. Wanting to pursue a master's in another country - his Darwin based cousin suggested Charles Darwin University.

Sandesh doggedly pursued engineering work opportunities while studying so he could hit the ground running for employment post-graduation but was unsuccessful. He then linked in with Engineers Australia, registered for free membership and took part in our Future Engineers Australia program.

Outcome:

The program opened doors to work experience in the civil engineering industry, networking opportunities, mentoring sessions, interview preparation and resume guidance. Last year, Sandesh applied for a placement opportunity at GHD's Darwin office and was successful - he says the Future Engineers Australia program was instrumental in getting him the role.

Global Engineering Talent (GET)

The Global Engineering Talent (GET) program is an outcome of Engineers Australia's *Barriers to employment for skilled migrant engineers* research. It is designed to overcome the barriers faced by migrant engineers in Australia to support the 47 per cent of migrant engineers actively seeking an engineering job.

Target Audience:

Migrant engineers who are currently in Australia on a skilled migration visa unable to find work or are working in an engineering position not commensurate with their skill and experience level.

Outcome:

The GET program will include a six-week preparatory course through Engineering Education Australia with engineering standards-specific training, and a 12-week paid internship at an engineering firm.

The Northern Territory Government has contributed \$198,000 to the program to help an initial 20 overseas-born engineers with a pathway to engineering employment in Australia.

