

Defence Strategic Review
Engineering the future of defence
October 2022



ENGINEERS
AUSTRALIA

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Defence Strategic Review Submission: Engineering the Future of Defence

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Executive Summary

The Australian Defence Force (ADF) is increasingly being deployed in non-traditional situations requiring additional capabilities not normally associated with Defence. Whilst these threats are varied, the growing regional instability, tensions around freedom of navigation manoeuvres, extreme climatic events alongside COVID-19 all point to increasing demand on the ADF. The range and complexity of these threats rightly calls for a fundamental review of our defence force to ensure it is both fit for purpose and able to fulfill its growing mandate. As the world embraces technology and systems become more sophisticated and interdependent, Australia will become more reliant on the skills of engineers. Many of the challenges the ADF will confront will increasingly require engineers at the centre, to solve complex problems and translate new ideas into useful products, systems and services.

To ensure the ADF is future ready, it first must overcome the engineering skills supply and demand challenge facing the country, which even before COVID-19, was impacting Defence and the private sector. The global pandemic, adaption to climate change and the clean energy transition and governmental stimulus spending measures have increased the need for trained and experienced engineers globally. Even before this increase in demand, a shortage of engineering skills was a structural feature of the Australian economy and, without decisive reforms being developed and implemented, will hold back the ADF along with the rest of government and industry.

The disparity in the supply and demand of engineering skills being experienced in Australia is fuelled by two factors. Most sectors are currently experiencing a shortage of experienced engineers; however, it is in the face of an economy-wide oversupply of qualified—but underutilised—migrant engineers and exacerbated by chronic challenges in the sources of domestic supply. At both these levels, the ADF can contribute positively to finding solutions to overcome the challenges. The long-term solution involves investment in young people and schools, development of early career graduates, attracting and retaining veterans and other experienced engineers to remain in the profession and the Defence sector, and an increase in community-wide understanding of the value of migrants.

The ADF needs to also consider how, through utilising the skills of engineers, they can enhance Australia's sovereign capability through a thriving Defence industry. Developing Australian innovation and increasing Australia's manufacturing capabilities through supporting small-medium enterprises to develop the tools and processes needed to partake in defence work is crucial to support the ADF to be prepared to tackle the unknown challenges of tomorrow. Reforms to procurement practices and Government funded programs will provide these opportunities.

As the peak body for the engineering profession Engineers Australia welcomes this review and encourages the implementation of reforms to strengthen and prepare the ADF for the challenges ahead.

About Engineers Australia

Engineers Australia is the peak body for the engineering profession in Australia. We are a professional association with over 115,000 individual members, constituted by Royal Charter, to advance the science and practice of engineering for the benefit of the community. As Australia's signatory to the International Engineering Alliance (IEA), Engineers Australia maintains national professional standards that are benchmarked against international norms. We continue to lead the profession and are proud to have many current and former ADF personnel as members.

Contact

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1. Engineering skills shortages and future challenges

The ADF is increasingly called on by the government in response to non-traditional threats and catastrophes. Many of these threats increase the value and importance of engineers and require engineering solutions. As indicated in the terms of reference, ‘technological disruption ... [is] complicating Australia’s strategic circumstances.’¹ A focus on the engineering preparedness of the ADF and deep technical capabilities both within the ADF and in Government is central to Australia’s capacity to respond.

The war in the Ukraine and other potential geopolitical events reminds us that we must be prepared for conventional threats, however, the remit of the ADF has been expanding. The use of ADF personnel during the COVID-19 pandemic is a case in point, much like the bushfire evacuations in 2020. It was telling both the 2016 and 2020 Defence Strategic Updates outlined climate change was an ongoing risk of significance.² As per the inquiry’s terms of reference, the ADF’s structure, posture and preparedness must ensure climate change readiness is one of the core priority areas. Additional capabilities will be required to support the ADF to respond to natural disasters, climate change increases Australia’s reliance on the ADF in response to natural disasters and will require the ADF to operate in non-traditional functions. Adapting to these threats, as well as the complicated geopolitical climate in Southeast Asia, will put additional strain on the ADF. In addition, growing cyber threats also point to emerging areas of conflict with risks that require new capabilities in response.

A large part of an engineer’s value lies in their ability to provide predictable results that match expectations and reduce risks. As systems become more sophisticated and interdependent, the ADF will become more reliant on the engineering profession. Engineers have the skills to solve complex problems and translate new ideas into products, systems and services that are fit-for-purpose and useful.

In addition to meeting the current projected demand, one of the ways Australia needs to respond to the challenges it is facing is through strengthening our supply chains, particularly in Defence, by ensuring a healthy pool of experienced and qualified engineers are available to develop our sovereign manufacturing capabilities. To ensure the skills needed are available, Australia needs to re-think our workforce to support engineers delivering on the big ideas and creating a more secure and resilient nation. Ensuring the ADF can access engineers at the cutting edge of the profession is fundamental for the ADF to have the ability to respond to future needs and threats.

1.1. Skills shortages

The skills shortage continues to disrupt nearly all sectors with engineers being in high demand and many critical positions across the industry remaining vacant. The capability gap this creates requires robust workforce planning in the engineering space. Given current skills shortages are not unique to Australia, we risk falling behind the rest of the OECD if we fail to invest in a sufficient pipeline of engineers.

The development of an engineer is a decade long process, requiring up to four years tertiary education and then around five years’ experience to be considered competent for independent practice.³ The length of time from university to proficiency require long-term skills planning. Failure to develop a sufficient pipeline of engineers will see a deterioration in our capabilities, particularly in emerging engineering

¹ ‘Defence Strategic Review: Terms of Reference for the Independent Leads of the Review *Australian Page 1 Government Defence* (August 2022) <https://www.defence.gov.au/about/reviews-inquiries/defence-strategic-review>

² ‘Defence ‘acutely aware’ of risks posed by climate change: ADF chief’ *Australian Strategic Policy Institute* (February 2022) <https://www.aspistrategist.org.au/defence-acutely-aware-of-risks-posed-by-climate-change-adf-chief/#:~:text=Defence%20has%20a%20key%20role,Defence%20Force%20chief%20Angus%20Campbell>.

³ Bell, M., Briggs P., et al, ‘Strengthening the engineering workforce in Australia’ *Engineers Australia* (August 2022) <https://engineersaustralia.org.au/sites/default/files/2022-08/strengthening-engineering-workforce-australia.pdf>

fields. The nature of the Defence industry provides a benefit in its ability to forecast future demand due to the budget cycle. Resources such as the Kinexus Defence Industry Insights report provides analysis of in-demand skills which can help to forecast which skills should be targeted in the short, medium and long term.⁴ This information can then help to inform initiatives targeted to developing these skills locally. Investing in the domestic supply of engineers is critical to the long-term sustainability of engineering skills.

1.2. Domestic pipeline

The domestic supply of engineers remains significantly below forecasted growth.⁵ Even in the next five years, demand is expected to increase by over 12 per cent.⁶ Figure 1 below shows an overall decline of commencements and graduations of engineers since 2018. Given that training in many engineering fields is a decades-long process, if nothing is done to address this rate, the current domestic supply chain issues may impact ADF capabilities for decades to come.



Engineers Australia’s *Strengthening the engineering workforce report* identifies several factors influencing the supply of domestically trained engineers in Australia.⁷ These factors include a lack of awareness of the engineering profession by teachers, students, parents and careers advisors at school, a reduction in Year 12 science and mathematics participation and an inability to retain many engineer graduates in the profession due to ‘pull’ factors such as better wages in other sectors (such as finance). Collaborating, developing and implementing initiatives to overcome these factors will assist to boost the domestic supply of engineers in the medium to long-term. Defence can play a significant role in this by showcasing the exciting nature of an engineering career filled with opportunity and stability.

Recommendations

- Increase Australia’s teaching capability in STEM subjects by:

⁴ ‘Defence industry insights’ Kinexus (website) (accessed 20 October 2022) <https://gr.kinexus.com.au/landing/dii9>

⁵ Bell, M., Briggs P., et al, ‘Strengthening the engineering workforce in Australia’ *Engineers Australia* (August 2022) <https://engineersaustralia.org.au/sites/default/files/2022-08/strengthening-engineering-workforce-australia.pdf>

⁶ *ibid*

⁷ *ibid*

- Increasing the number of maths and science teachers with relevant qualifications and providing effective resources to out-of-field maths and science teachers, helping to boost student taking the maths and science prerequisite studies needed to undertake an engineering qualification.
- In addition, Government should look to offer programs which make it easier for mid-career STEM professionals to become maths, science or engineering studies teachers.
- Partner with local schools to provide support to school STEM programs and provide opportunities for early career engineers to engage with and inspire the next generation.
- Defence should work with the tertiary sector to explore other innovative pathways for individuals to undertake tertiary engineering study.

1.3. Opportunities to retain engineers in the profession

To ensure adequacy of engineering skills supply over the long term, efforts should be made to increase utilisation of recent graduates and retain engineers at all stages in their career in the profession.

Engineers Australia’s analysis shows there are many more engineering bachelor qualified engineers in Australia than there are people reporting working in an engineering role.⁸ The exact reasons why so many engineers don’t remain in the profession are unknown. However, the nature of engineering requires a strong cognitive ability which is sought by many employers. In addition, salaries and the prestige associated with working in certain industries and occupations may be greater outside the profession. Investing in engineering graduate employment outcomes, supporting engineers return from career breaks and increasing career opportunities for mid-senior level engineers will lessen future skills shortages.

Recommendations

- Defence should increase its engineering capability and explore ways to support engineers returning to the profession within Defence through training and support initiatives.
- Incentivise ADF contractors to provide graduate programs and internships through its procurement processes.
- Offer mid-career engineers a senior ‘sponsor’ within the organisation to help develop their career pathway, offering opportunities for development and advancement.
- Provide support for existing programs that assist engineers returning to the workforce after a career break (e.g., STEM Returners) and fund new programs to help and incentivise engineers working out of field to return engineering within the ADF.

1.4. Skilled migration

Due to structural challenges in the domestic supply of engineering skills, supplementing the domestic supply of engineers through Australia’s skilled migration program, will be an important part of workforce planning to alleviate any short to mid-term shortages. Currently, over 58 per cent of engineers in the Australian labour force were born overseas, however, migrant engineers are much more likely than their Australian born counterparts to work in non-engineering roles.⁹ Improving the employment outcomes of migrant engineers is crucial in developing Australia’s engineering capability.

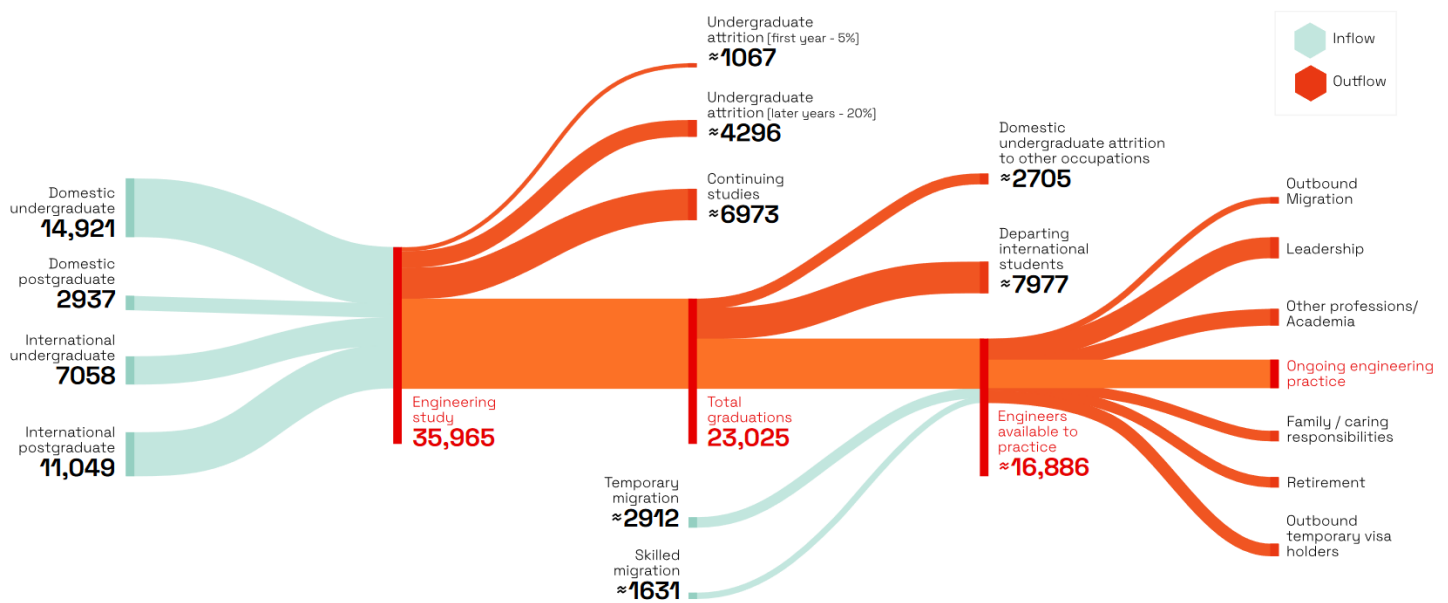
⁸ Bell, M., Briggs P., et al, ‘Strengthening the engineering workforce in Australia’ *Engineers Australia* (August 2022) <https://engineersaustralia.org.au/sites/default/files/2022-08/strengthening-engineering-workforce-australia.pdf>

⁹ Romanis, J. ‘Barriers to Employment for Migrant Engineers’ *Engineers Australia* (October 2021) <https://www.engineersaustralia.org.au/sites/default/files/resource-files/2021-10/barriers-employment-migrant-engineers.pdf>

Engineers Australia understands the challenges facing Defence in their use of migrant engineers due to security clearance requirements which are often unobtainable for skilled migrants. However, increasing our skilled migration intake will help to alleviate workforce pressure in other sectors, freeing up more domestic engineers for the ADF. Additionally, the ADF should explore flexible options targeting skilled migrants for in-demand areas now to ensure that any unforeseen capability gaps resulting from engineering skills shortages can be quickly ameliorated. This is particularly important for new technologies such as nuclear submarines, where Australia doesn't have, and is unlikely to have, domestic capability in the short to medium-term.

Figure 2 below highlights the importance of both temporary and skilled migration which acts to partially alleviate the outflows of domestic engineers from the profession.

Figure 2: Inflows and outflows of Professional Engineers 2019¹⁰



1.5. The role of veterans

As the ADF confronts workforce shortages, identifying ways for veteran engineers to remain engaged in Defence specific projects will help to ensure the skills needed are available, with the added benefit of the engineers already holding security clearances and knowledge of the ADF. Veterans are a source of incredible talent and capability within the engineering and STEM professions more broadly. Given the range of unorthodox challenges they train for and confront when deployed, they can bring a unique set of skills and experience which complements those who have worked exclusively in the private sector. Their training is exceptional and provides an ability to lead challenging projects in the face of adversity. Engineers Australia is proud to have many veteran members and we continue to explore how we can engage ADF engineers after being discharged.

One of the standout findings from the Inquiry into the Transition from the Australian Defence Force¹¹ was that 62 per cent of those moving from Defence to civilian employment had 'difficulty in finding

¹⁰ Bell, M., Briggs P., et al, 'Strengthening the engineering workforce in Australia' *Engineers Australia* (August 2022)

<https://engineersaustralia.org.au/sites/default/files/2022-08/strengthening-engineering-workforce-australia.pdf>

¹¹ 'Inquiry into transition from the Australian Defence Force (ADF)' *Australian Parliament* House (accessed 20 October 2022)

https://www.aph.gov.au/Parliamentary_Business/Committees/Joint/Foreign_Affairs_Defence_and_Trade/TransitionfromtheADF/Report

meaningful employment'.¹² Despite a range of government and ADF transition programs the Inquiry stated 81 per cent of those who participated in those programs 'did not find the programs useful'.¹³ Given the exceptional training and public investment in personnel serving in the ADF, there is a clear and ongoing need to improve employment and transition outcomes. The ADF needs to explore ways to increase participation of veterans and civilians in non-sensitive projects. Failure to engage the wider engineering and STEM profession or failure to identify projects which can be executed by the private sector will only deepen the skills crisis in Defence.

Recommendations

- The ADF should explore ways to provide a more flexible workforce:
 - Identify non-sensitive areas where transitioning ADF personnel and veterans can fill workforce shortages.
 - Reduce barriers to entry, such as security clearance timelines, helping to create opportunities for veteran and civilian engineers, ensuring a more open ADF workforce.

¹² 'Inquiry into transition from the Australian Defence Force (ADF)' *Australian Parliament* House, p40 (accessed 20 October 2022) https://www.aph.gov.au/Parliamentary_Business/Committees/Joint/Foreign_Affairs_Defence_and_Trade/TransitionfromtheADF/Report

¹³ *ibid*

2. Defence Industry

A vibrant Defence industry is an effective way to both build sovereign capability and provide flexibility to the ADF in responding to new and emerging threats. Defence is listed as one of the six focus areas under the National Manufacturing Priorities Roadmap. For Australia's Defence industry to manufacture competitively they need to adopt a combination of advanced knowledge, advanced processes and advanced business models. Advanced manufacturing and Industry 4.0 are critical areas which need to be supported by the ADF to build Australia sovereign capability.

Engineering is often the foundational aspect of advanced manufacturing with the first stage of the advanced manufacturing process being Research and Development (R&D).¹⁴ This preproduction aspect of advanced manufacturing creates the greatest value. At this stage engineers use their ability to innovate, and problem solve to take ideas to concepts. To fully adopt this transformation a change of mindset is needed by Defence manufacturers, particularly investing in knowledge by attracting and retaining staff with skills in engineering and digital literacy. Developing a local Defence industry has many benefits including additional avenues to upskill the Australian workforce, however, support needs to be provided to local businesses to ensure they are capable of tendering for Defence work.

Government programs such as the *Entrepreneurs Program*¹⁵ and the *Office of Defence Industry Support*¹⁶ currently assist to develop Australia's Defence Industry, assisting SMEs to become 'Defence ready' by advising them on the various standards and practices needed to be eligible to tender for Defence work. These types of programs assist in building Australia's sovereign capability, foster innovation and create jobs and should continue to be supported.

2.1. Defence innovation

Engineers Australia welcomes the groundbreaking work done by the Defence Innovation Hub (DIH). The COVID-19 pandemic has illustrated how important STEM ecosystems are for crisis response, from creating vaccines to helping people and businesses transition to new modes of operating during lockdowns. It has been particularly evident during the COVID-19 pandemic that countries that have been able to innovate more effectively were often able to recover faster.

Engineers Australia recommends fostering greater collaboration with innovation and start-up hubs around Australia to deepen ties with the private sector. Cross pollination of ideas remains a critical way innovation takes place. Further integrating DIH and other Defence innovation clusters with those in the private sector will produce significant benefits for the Defence industry. Engineers Australia has released a report on [Commercialisation of engineering innovation](#) which provides further information on Australia's innovation landscape as it relates to engineers.

Recommendation

- Foster collaboration with innovation and start-up hubs around Australia, assisting to deepen ties with the private sector.

¹⁴ 'About Advanced Manufacturing' *Advanced Manufacturing Growth Centre* (Web Page 26 February 2021) <https://www.amgc.org.au/our-purpose/about-advanced-manufacturing/>

¹⁵ 'Entrepreneurs Program' *Australian Government Business* (accessed 20 October 2022) <https://business.gov.au/Grants-and-Programs/Entrepreneurs-Programme>

¹⁶ 'Office of Defence Industry Support' *Australian Government Defence* (accessed 20 October 2022) <https://www.defence.gov.au/business-industry/finding-opportunities/office-defence-industry-support>

2.2. Procurement

Awarding defence contracts to local Australian small-medium enterprises (SMEs) is a critical tool government can use to incentivise the sustainable development of the domestic defence industry. Procurement is frequently about walking a fine line between the ease and security of awarding defence contracts to larger multinationals instead of taking the risk with local firms. Finding additional avenues for local enterprise to get involved in domestic contracts will help to strengthen Australia's sovereign capability.

Whilst there are a variety of different models that can be used, increasing the number of dual-awarding contracts will help support local firms that are incapable of fully delivering on a contract due to issues of scale. The vision of dual-awarding contracts is to promote the development of domestic capabilities and power Australian businesses to scale and compete with larger, foreign corporations. Facilitating this may mean implementing a secondary stream in tendering for government contracts specifically for SMEs and Australian start-ups with innovative ideas to test and iterate their products. This would also allow them to leverage the revenue and networking from these contracts to develop their organisations further. The risk appetite is clearly higher, and this approach should be used strategically where there is strong upside. The advantage of dual awarding contracts is that the larger corporate ensures the fundamentals of the contract are delivered with any benefits that smaller, innovative SMEs have is an added benefit.

Recommendations

- Increase dual-awarding of contracts to increase SMEs' participation in Defence work and increase innovation.

3. Concluding remarks

New and emerging threats require the ADF to pivot their existing capabilities to engage with the challenges facing Australia. Engineering shortages will increasingly impact on the ADF's ability to respond to these threats particularly as competition for engineering skills globally increases. Recognising that many other nations are also competing for skilled engineers, Australia must develop a competitive skilled migration program to alleviate this shortage and to strengthen the pipeline of domestically trained engineers. Engineers Australia also encourages the ADF to deepen their ties with the private sector to increase collaboration and drive innovation. More cross-over between private sector engineers and those in the ADF will build a more dynamic and agile workforce. Whilst this may require changes and flexibility around working arrangements, the growing demands on the ADF requires new solutions.

Summary of recommendations

- Increase Australia's teaching capability in STEM subjects by:
 - Increasing the number of maths and science teachers with relevant qualifications and providing effective resources to out-of-field maths and science teachers, helping to boost student taking the maths and science prerequisite studies needed to undertake an engineering qualification.
 - In addition, Government should look to offer programs which make it easier for mid-career STEM professionals to become maths, science or engineering studies teachers.
- Partner with local schools to provide support to school STEM programs and provide opportunities for early career engineers to engage with and inspire the next generation.
- Defence should work with the tertiary sector to explore other innovative pathways for individuals to undertake tertiary engineering study.
- Defence should increase its engineering capability and explore ways to support engineers returning to the profession within Defence through training and support initiatives.
- Incentivise ADF contractors to provide graduate programs and internships through its procurement processes.
- Offer mid-career engineers a senior 'sponsor' within the organisation to help develop their career pathway, offering opportunities for development and advancement.
- Provide support for existing programs that assist engineers returning to the workforce after a career break (e.g., STEM Returners) and fund new programs to help and incentivise engineers working out of field to return engineering within the ADF.
- The ADF should explore ways to provide a more flexible workforce:
 - Identify non-sensitive areas where transitioning ADF personnel and veterans can fill workforce shortages.
 - Reduce barriers to entry, such as security clearance timelines, helping to create opportunities for veteran and civilian engineers, ensuring a more open ADF workforce.
- Foster collaboration with innovation and start-up hubs around Australia, assisting to deepen ties with the private sector.

Increase dual awarding of contracts to increase SMEs' participation in Defence work and increase innovation.



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