Engineers Australia provides its consent to the publication of this submission, as per Department of Defence guidelines.
EXECUTIVE SUMMARY

Engineers Australia is the peak body for engineering practitioners in Australia, representing all disciplines and branches of engineering. With membership of over 100,000 Australia wide, Engineers Australia is the largest and most diverse professional engineering association in Australia.

Engineering is a diverse profession, and engineers are involved in various aspects of defence-related organisations, infrastructure and processes. This includes everything from design and maintenance of information technology and communications networks to the design of critical infrastructure and physical and virtual assets. Engineering expertise plays a central role in government's ability to design, develop and to provide quality technical assessments and processes in the critical national security and defence environment.

According to 2011 Census data, defence, as an industry sector, employed 5,397 qualified engineers (placing defence as the 9th-largest employer of engineers), a figure that has shown growth of approximately 2.1 percent per annum.

Over the last decade, Australia has been feeling the effects of a chronics skills shortage across the engineering profession. While the last few years have seen a reversal of this position, the profession has been historically characterised by boom/bust employment cycles, arguably the product of politically-driven infrastructure spending across the country and compounded by the largely static nature of engineering graduations from our tertiary institutions. As a result of this boom/bust cycle, the broader Australian economy has had to rely strongly on skilled migration, meaning that over 53 percent of Australia’s engineering workforce is now overseas-born.

This reliance on overseas skills can have significant implications for recruitment in engineering roles subject to security assessment, such as those in Defence projects where an individual’s country-of-origin has potential to influence their security clearance. Engineers Australia expects that this will be even more of a problem facing the ADF in future due to an increasing reliance on high-tech materiel and processes that inevitably require a proportionate increase in the number of engineers and other technical specialists employed to design, deliver and sustain this technological capability. In response, Government policies, including Defence policy, must place greater emphasis on training Australian engineers and other technology professionals.

Engineers Australia believes that in developing the Defence White Paper, consideration should be given to adopting a policy that places greater emphasis than in the past on the importance of humanitarian assistance, disaster relief and related roles of the ADF. The force structure of the ADF should reflect this policy. The long-term benefits in strengthening international relationships could more than justify the cost.

The prime responsibility for any government is the defence of the nation. In discharging this responsibility, the government must have an effective Defence capability, not just one that is cost-effective. To achieve an acceptable level of defence self-reliance Australia must develop and sustain strategically important capabilities in-country to support our Defence operational capability, even if this costs more than acquiring support from overseas.

Engineers Australia believes it is critical that government strives to become an informed buyer of engineering, information technology and other technical goods and services. However, it is insufficient to rely on the significant contract management expertise that has been built up in defence procurement. These skills are vital, but are no substitute for technical engineering expertise.
Engineers Australia believes that further development of technical and engineering elements of defence procurement is necessary to overcome perceptions created by historical dismantling of engineering support structures and arrangements. Developing an effective engineering skills strategy requires attention to career structures for young engineers, and assurances of continuity of work and prospects of career progression over the medium to longer term are vital.

Engineers Australia believes that the Defence planning framework should be widened to include analyses of workforce requirements for all major acquisitions and associated sustainment. Not only will this lead to the development of a skills strategy that is relevant to defence planning, it will assist in alleviating the historical uncertainty and lack of continuity impeding Defence and defence industries in competing for engineering resources.

Capitalising on the skills and knowledge of engineering professionals to make more informed procurement decisions requires agencies to be able to access the appropriate volume and type of engineering expertise when needed, economically and efficiently. Accessing best value for money engineering expertise may mean using a combination of internally and externally sourced expertise. There are advantages and disadvantages for both approaches and these should be clearly understood by senior management and integrated into the purchasing decision framework.
INTRODUCTION

About Engineers Australia

Engineers Australia is the peak body for the engineering profession in Australia, representing all disciplines and branches of engineering. With membership of over 100,000 Australia wide, Engineers Australia is represented in every state and territory of Australia and overseas through chapters in the UK, Singapore, Malaysia and Hong Kong. All Engineers Australia members are bound by a common commitment to promote engineering and to facilitate its practice for the common good. Engineers Australia members are represented throughout the Australian Defence Organisation.

Engineers Australia accredits university courses in engineering using internationally audited competencies; facilitates the transition of its graduate members to fully competent practicing engineers capable of independent engineering decision making; facilitates an environment of continuous professional development for its members, and provides the frameworks and facilities required for the development and exchange of engineering knowledge in learned society environments.

Engineers Australia is organised geographically and into Colleges, National Committees and Technical Societies that facilitate the conduct of its learned society functions. For this submission Engineers Australia has drawn on the assistance and expertise of the Australian Society for Defence Engineering (ASDE). ASDE is the Technical Society that embraces all aspects of engineering theory, practice, training and development relevant to the defence of Australia and its defence industries.

ASDE has a long history of public and professional engagement on a wide range of defence engineering issues. One of the central roles of ASDE is to advocate on behalf of defence engineering, and this involves ongoing projects ranging from government liaison, provision of technical and continuing education, to workforce development advice and eminent speaker events.

The Engineering Profession

The collective membership of Engineers Australia is referred to in terms of the ‘engineering team’. The engineering team in Australia is comprised of three groups:

- Professional engineers.
- Engineering technologists.
- Engineering associates.

To qualify for the engineering team, individuals must have formal educational qualifications in engineering. The educational qualifications required are:

- Professional engineers, at least the equivalent of a four year full time bachelor degree in engineering.
- Engineering technologist, at least the equivalent of a three year full time bachelor degree engineering.
- Engineering associate, at least the equivalent of a two year full time associate degree or diploma or advanced diploma in engineering.

Engineers Australia believes that academic qualifications alone are not sufficient to enable an individual to provide engineering services. As is the case for many other professions, practical and experience are also essential, including continuing professional development (CPD). Engineers Australia provides services and arrangements to its members to achieve these standards.
**Why a Submission from Engineers Australia?**

Members of the Engineering profession apply science-based theory and practice to analyse, design and manage the development and deployment of technology-based physical and virtual systems and assets and to provide the supporting infrastructure. Engineering is a diverse profession, and engineers are involved in various aspects of defence-related organisations, infrastructure and processes. This includes everything from design and maintenance of information technology and communications networks to the design of critical infrastructure and physical and virtual assets.

Engineering expertise plays a central role in government’s ability to design, develop and to provide quality technical assessments and processes in the critical national security and defence environment.

The capability and responsiveness of engineering-related aspects of defence is highly dependent on its technological edge. Technology permeates all elements of the Defence environment, including its platforms, effectors and the supporting infrastructure, doctrine and tactics. However, technology itself cannot achieve this capability and responsiveness; it is the people, knowledge, processes and systems that have shaped the development, selection, integration and operation of our national defence capability.

Over the last decade, the engineering profession in Australia experienced the effects of a skills shortage. While not all engineering disciplines, industry sectors or regions experienced shortages to the same degree, the problem was nonetheless severe from a macroeconomic perspective.

The seriousness of this problem is reflected by the 2012 inquiry into ‘the shortage of engineering and related employment skills’ by the Senate Education, Employment and Workplace Relations References Committee. While the Senate Inquiry focussed on infrastructure delivery, its recommendations are broadly applicable to many areas of engineering, and particularly relevant to public sector agencies, including those responsible for defence.

This submission is intended to broadly inform discussions and expose issues relevant to the engineering profession employed, both at present and in the future, within Australia’s defence structure.

**THE ENGINEERING LABOUR MARKET**

**Overview**

Skills and skills development have been important topics in Australian policy forums for several decades, yet statistics for specific occupations and skills remain fragmented and patchy. The statistics discussed in this section are extracts from Engineers Australia’s Annual Statistical Overview and are derived from official sources.¹

The Australian engineering labour market has been very tight over the past decade. The demand for engineers, as measured by employment, grew by an average 5.5 percent per annum between Census years of 2006 and 2011 (to 254,515). The supply of engineers, as measured by the engineering labour force, grew at a compound rate of 5.6 percent per annum between the Census years of 2006 and 2011 (to 263,890).

The changes underlying this were a falling unemployment rate and a rising labour force participation rate. Labour force participation in the engineering labour market is exceptionally high, averaging more than 90 percent over the past decade, which is several percentage points higher than for comparable non-engineering groups.

Just prior to the ‘global financial crisis’ (GFC) engineering unemployment was 2.4 percent, a figure consistent with frictional unemployment, that is, the short periods of technical unemployment individuals experience when moving from one job to another. The GFC resulted in an increase in engineering unemployment to 4.1 percent in 2009 before recovering to 3.6 percent in 2011.

The number of permanent residents completing courses in engineering in Australia has averaged approximately 9,500 since about 2006, comprised of about 6,000 new degree qualified engineers from the universities and about 3,500 associate degrees and diploma qualified engineers.

Firm statistics on retirements from the engineering labour force are not available but there are indications that about 5,000 to 6,000 engineers (annually) reach 65 years of age and most likely retire from the labour force. In other words, since about 2006, net domestic growth in the engineering labour force is about 10,000 per year. In comparison, the demand for engineers has been about 13,000 per year and as high as 22,000. The balancing factor has been skilled immigration.

As we have seen in the context of infrastructure investment and construction, many projects have been affected by historical shortages of engineering skills. Hiring engineers without the full complement of skills required led to inadequate planning and trial-and-error problem solving. The mid-project amendments resulting from this often put undue pressure on timing and budgets, and some projects simply did not proceed, which had wider-reaching implications such as the loss of the jobs such projects would create, as well as the loss or delay of vital projects, programs and their supporting infrastructure.

Unfortunately, following Australia’s decade-long engineering skills shortage, the tide has since turned and Australia has now seen 30-straight months of declining job vacancies for engineers. However, an examination of the engineering workforce over recent decades would suggest that this downturn in engineering employment opportunities will soon be countered by an upswing in opportunities, and, inevitably in light of the static nature of engineering graduations, another skills shortage.

**Migration and the Engineering Labour Force**

Average annual growth in employment for the overseas born engineering labour force has been 7.9 percent over recent years, three times average annual growth in employment for the Australian born engineering labour force (2.5 percent). The result has been a large increase in the dependence of the engineering labour force as a whole on persons born overseas.

This reliance on overseas skills can have significant implications for recruitment in engineering roles subject to security assessment, such as those in defence projects where an individual’s country-of-origin has potential to influence their qualification for certain positions. In 2001, there were 41.8 percent overseas born individuals in the engineering labour force, and by 2011 this had increased to 53.9 percent. The overseas components of comparable non-engineering skills and the general labour force also increased over the decade but in 2010 were only 36.6 percent and 26.8 percent respectively.

The level of employer-sponsored (457) visas issued for engineering occupations are a useful indicator of the growth in demand for engineers. The number of employer-sponsored visas rose from 2,260 in 2003-04 to 5,501 in 2013-14.\(^2\) Clearly, looking to temporary skilled migration to fill gaps in a security-critical defence environment is not a universally viable option.

The cost and time taken to obtain security clearances for non-Australian citizens is a major obstacle for recruiting overseas engineers into Australian defence industries and Australian defence organisations. Engineers Australia expects that this will be even more of a problem facing the Australian Defence Force in future due to an increasing reliance on high-tech materiel and supporting technical capability.

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\(^2\) Data provided by the Department of Immigration and Citizenship.
Engineers in Defence

According to 2011 Census data, defence, as an industry sector, employed 5,397 qualified engineers (placing defence as the 9th-largest employer of engineers), a figure that has shown growth of approximately 2.1 percent per annum. Within this, approximately 76 percent of engineers employed in the defence sector are actually employed in engineering roles (i.e. roles that specifically apply engineering expertise or undertake actual engineering practice).

HUMANITARIAN ENGINEERING AND DISASTER RELIEF

The Defence Issues Paper 2014 acknowledges that our military forces could be used for operations such as humanitarian assistance and disaster relief operations, evacuation of Australian nationals, peacekeeping and stabilisation roles in our nearer region, and the protection of our borders (p 11 and p 26). Engineers and other technology professionals are able to play an important role in the provision of this type of assistance. As we have seen in numerous operations of this type, for example, the disaster relief provided to Indonesia following the 2004 tsunami in Aceh, Indonesia, and more recently the support to the search for Malaysian Airlines 370, this type of assistance has been extremely valuable, making significant contributions to building and sustaining close and strong relationships with neighbouring countries. Engineers Australia believes that in developing the Defence White Paper, consideration should be given to adopting a policy that places greater emphasis than in the past on the importance of humanitarian assistance and related roles of the ADF. The force structure of the ADF should reflect this policy. The long-term benefits in strengthening international relationships could more than justify the cost.

IN-COUNTRY SUPPORT OF DEFENCE SYSTEMS AND EQUIPMENT

A major concern is that procurement and through-life support decisions are made primarily on the basis of the cost-effectiveness of a proposed solution. P 24 of the Issues Paper states: ‘In its announcements about the Navy’s resupply vessels, the Pacific Patrol Boats and the Future Frigate program, the Government flagged that it will need to see productivity in the sector improved to internationally competitive levels before it will commit to further major construction projects in Australia. This position is likely to remain the benchmark for other defence industry policy decisions.’ There is no doubt that cost-effectiveness and value for money must always be important factors in any Defence procurement decision. But the prime responsibility for any government is the defence of the nation. And what is most important is to have an effective Defence capability, not just one that is most cost-effective or internationally competitive. If Australia needs to have strategically important capabilities in-country to support our Defence operational capability, this is what must be provided, even if it costs more than an overseas solution. In-country support capability is fundamental to defence self-reliance. We must guard against the risk that, in times of war or international tension, overseas sources of supply and support might be denied to Australia.

Although in many cases, construction of naval ships for the RAN could be done overseas at lower cost, it is essential to consider the benefits of developing through-life support capabilities through construction in Australia. In many cases, for complex systems such as the Collins submarines, the expertise gained from construction, especially through systems integration, is critical to developing a capability for through-life support. These in-country capabilities may take many years to develop.

The Issues Paper asks ‘Is the Priority Industry Capabilities (PIC) framework still the appropriate mechanism and how does this policy also deliver value for money?’ While the concept of specifying strategically important capabilities that should be nurtured and sustained in Australian industry has some appeal, Engineers Australia believes that it is time to review the PIC concept to see whether it is delivering the desired outcomes. There is a risk that industry capabilities identified as PICs will become out-dated in an environment of rapidly changing technology with a consequent misallocation of resources. It might be better to link the development and sustainment of Australian industry capabilities more directly to specific platform and system requirements.
RETAINING ENGINEERING EXPERTISE IN DEFENCE

Almost a decade ago Engineers Australia drew attention to the risks associated with inadequate assessments of engineering and technical aspects of defence procurements. These concerns were documented in a comprehensive report and Engineers Australia’s recommendations on the way forward were summarised in a companion policy statement. In 2009 Engineers Australia issued its policy statement on Engineering for Defence which proposed recommendations to government on these matters.

During the 1980s and 1990s engineering establishments in government agencies at all levels, including in Defence, were seriously reduced. Engineers Australia drew attention to the risks associated with the ensuing loss of engineering expertise in its 2000 report Government as an Informed Buyer, and again in its 2013 revised second edition of this publication. These risks open the possibility of large financial and human costs that have been detailed in coronial enquiries, in Australian National Audit Office (ANAO) reports and in numerous ministerial statements.

In its policy, Engineers Australia proposed a set of recommendations and methodological advice to ensure that government as a buyer of engineering, information technology and other technical goods and services adequately addressed technical and engineering risks. The recommendations recognised the changes occurring in the public sector, in particular, decentralisation of control and devolution of decision making, and the broader environment in which defence procurement takes place, notably increasing technological complexity and the frequency of very large purchases.

Engineers Australia believes that it is insufficient to rely on the significant contract management expertise that has been built up in defence procurement. These skills are vital, but are no substitute for technical engineering expertise. Experienced engineers with relevant expertise are able to make the complex engineering judgements often required in balancing technical factors, costs, schedule implications and risks associated with complex acquisitions. This is an argument about the strategic value of engineering input to complex technical decision making in defence procurement to avoid the costly problems identified by the ANAO Performance Audit into Navy Capability; it is not an argument about ‘protecting’ engineering jobs in Defence.

Engineers Australia believes that the necessary expertise can either be in-house or acquired externally. There are advantages and disadvantages for both approaches and these should be clearly understood by senior management and integrated into the purchasing decision framework. Ultimately, the benefits of technical and engineering expertise are best demonstrated when:

- Senior management are assured and convinced that necessary technical advice has been sought, understood and taken into account.
- The appropriate balance between technical and commercial considerations has been achieved and ‘gold plating’ has been avoided.
- All relevant issues have been resolved in reaching a final decision, including candid assessments of equipment performance, ex-post assessment of weaknesses in the statement of requirements and the reliability, maintainability and availability of materiel in the environment to which it will be deployed. The issues to be considered are not just matters of management opinion; they also include professional scientific, engineering and legal judgements based on sound principles accepted by practitioners of these professions.

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Engineers Australia is aware of steps being taken within defence agencies and defence contractors to improve the professionalism and skills base of engineering staff, and Engineers Australia commends these initiatives. Nonetheless, Engineers Australia believes that further development of technical and engineering elements of Defence procurement is necessary to overcome perceptions created by historical dismantling of engineering support structures and arrangements.

In addition, as Defence equipment and systems become increasingly complex and reliant on state-of-the-art technology, Defence and defence industry must have people with the skills to design, build, operate and maintain this equipment and these systems. Many of the personnel required are engineers and other technologists. Defence/defence industry need the specialist skill sets not readily found in general industry, e.g. weapons systems and electronic warfare. These skills can only be developed through experience, so Defence must have strategies and programs in place to develop and retain for the long-term the skills required to support its equipment and systems. Engineers Australia believes that more effort must be made to address the scarcity of skills shortages, especially in engineering and other technology areas.

Developing an engineering skills strategy will necessarily require attention to career structures for young engineers, and assurances of continuity of work and prospects of career progression over the medium to longer term are vital.

Engineers Australia believes that the defence planning framework should be widened to include analyses of workforce requirements for all major acquisitions and associated sustainment. Not only will this lead to the development of a skills strategy that is relevant to defence planning, it will assist in alleviating the historical uncertainty and lack of continuity impeding Defence and defence industries in competing for engineering resources.

As much of the technical and project support to Defence comes from defence industry, Defence should consult more with industry to determine the skills it will require in the future. This will assist industry to train its workforce to meet these requirements.

GOVERNMENT AS AN INFORMED BUYER

Contracting by Australian governments has grown enormously over the past two decades. Today, nearly one quarter of all government budgets are spent on procurement. While once most procurement was simply an administrative task in acquire products and services used internally by government agencies, it is now increasingly delivering infrastructure and frontline services. This transition has seen procurement transformed from a clerical function to one that is central to delivering an agency’s program goals and advancing the government’s core objectives.

Government procurement has become more effective and efficient over the last decade due to the increasing ‘professionalisation’ of the procurement workforce and new procurement approaches. However, there is still a significant need to improve, as illustrated by high profile contracting failures such as the cancellation of Defence’s Super Seasprite helicopter project after some $1.4 billion was spent but not one operational helicopter was delivered.

Most pressing is the need to achieve better value from procurement. This does not mean simply getting something for the cheapest possible price; it means considering the whole-of-life, financial and non-financial costs and benefits that accrue to all relevant stakeholders including the agency, end users and government as a whole. It also means ensuring that what is being procured is actually needed, that it will actually meet the requirements, that it aligns with the agency’s program and corporate objectives, and that it contributes to advancing the government’s enduring and transient objectives. In too many instances, procurement has been focused on meeting the requirements of one area of an agency without considering how it could advance other government objectives.
Defence must clearly identify the whole of life costs of its acquisitions, particularly as Defence tends to operate platforms and systems for many years, sometimes after the country from which they were initially sourced has ceased using them. Thus Defence must ensure it acquires the IP to allow this long term support and must understand the whole of life costs at the time of acquisition.

Critical to achieving better value for money is being an informed buyer. This means having the knowledge – including costs, benefits and risks – to take a multi-stakeholder perspective in answering the following questions:

- Why buy?
- What to buy?
- When is it needed?
- How to buy?
- How much to pay?

For engineering-intensive products and services, engineering expertise is required to assist in answering these questions. It is critical in providing sound professional judgement during certain stages of the procurement cycle. Engineering professionals should not be seen just as providing technical skills and industry sector knowledge. To be an informed buyer the processes must include procedures by which engineering advice, including appropriate risk analysis is provided and considered by management at all levels of decision making.

Engineers also have an ability to apply engineering practices/approaches and organisational techniques in non-engineering contexts to enhance the procurement system more broadly. These can make a significant contribution to obtaining better value from procurement.

Capitalising on the skills and knowledge of engineering professionals to make more informed procurement decisions requires agencies to be able to access the appropriate volume and type of engineering expertise when needed, economically and efficiently. As mentioned above, accessing best value for money engineering expertise may mean using a combination of internally and externally sourced expertise.

Our updated Government as an Informed Buyer\(^6\) report makes recommendations to ensure that agencies have access to the appropriate level of engineering expertise to support the procurement of engineering-intensive products and services. The report includes the following recommendations (among other things):

1. Agencies should explicitly recognise that procurement is a strategic and core function, and focus their activities on developing procurement systems that ensure alignment between procurement and multi-level governmental objectives.
2. Agencies should use the procurement cycle methodology to identify the contribution that engineering expertise makes to their procurements, to identify the volume and type of engineering expertise required, and to determine how best to access it.
3. To ensure that governments make informed decisions at a public service-wide level on the most cost effective way to access engineering expertise to support agency procurement, agencies should collectively examine how improvements could be made by addressing constraints in the sourcing of engineering expertise.

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4. Agencies should identify uncommon and specialised engineering expertise that is critical to their outputs, and develop effective and efficient arrangements to ensure its continued provision.

5. Agencies undertaking capability and maturity assessments of procurement systems should incorporate engineering expertise considerations into their methodology and outcomes.

6. Agencies should identify issues specific to engineering professionals and factor these into their workforce ageing strategies.

7. Agencies should identify any remuneration gap between public and private sector engineering professionals, determine if this acts as a disincentive to recruitment and retention, and if it does, take steps to close the gap.

8. For areas where an agency is a significant market player in the use of engineering expertise and where there is a shortage, agencies should influence the supply of expertise through increased recruitment and training of graduate engineers.

9. Public service employment classification systems should accommodate engineering professionals by:
   - Allowing engineers to become specialists with status and remuneration that reflects their unique and valuable contribution.
   - Ensuring that the competencies specified in job statements align with modern national competency standards.

10. Public services should seek to better facilitate the movement of engineering professionals between agencies.

11. Public services should commission a study of the reasons why engineering professionals stay or leave, and use this information to improve retention strategies.

12. Each public service should establish a cross-agency engineering community of practice to improve engineering practice, encourage multi-agency engineering workforce planning, and facilitate the movement of engineers between agencies.