Australian Government
Department of Defence

SOVEREIGN INDUSTRIAL CAPABILITY PRIORITY INDUSTRY PLAN

Aerospace platform deeper maintenance and structural integrity

November 2020

SECRETARY OF DEFENCE AND CHIEF OF THE DEFENCE FORCE FOREWORD

We are pleased to release the *Aerospace platform deeper maintenance and structural integrity* Industry Plan, which is a key deliverable of the *2018 Defence Industrial Capability Plan*.

This Industry Plan was developed in partnership between experts from industry and Defence. The Plan identifies critical industrial capabilities that must be delivered or supported by Australian industry. The Plan creates a framework for investment in these capabilities and provides guidance for Defence personnel on how to maximise Australian industry involvement in capability projects.

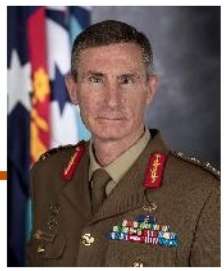
Defence and industry must sustain this partnership to make informed and timely decisions on Australia's defence capability. Those decisions will determine investments in: workforce, supply chains, infrastructure, and intellectual property.

This Plan addresses workforce and skilling requirements and forecasts technology developments that may impact on future defence capabilities. The Plan outlines broader defence industry and innovation initiatives available to support capability requirements. It lists actions that Defence must take to assist industry to deliver aerospace platform deeper maintenance and structural integrity outcomes.

Defence is ensuring that our people receive the support they need to succeed in their mission to defend Australia and its national interests. Australia's defence industry is critical to both enabling Defence preparedness for warfighting and sustaining the Australian economy.

We wish to thank the many Defence personnel and defence industry representatives who supported the development of this Plan. We look forward to building and strengthening this partnership to deliver the products and services needed to support our Defence Force.

Greg Moriarty
Secretary
November 2020



Angus J Campbell, AO, DSC
General
Chief of the Defence Force
November 2020

The Government's *2018 Defence Industrial Capability Plan* identified the first ten Sovereign Industrial Capability Priorities (Priorities). These Priorities are those that are critical to Defence and which must be developed or supported by Australian industry.

These Industry Plans, as well as the overarching Implementation Plans, build on the *Defence Industrial Capability Plan* to identify the critical industrial capabilities that underpin each Priority. They enable informed and timely defence capability decisions. To protect its sovereign interests Australia requires a level of access to, or control over: essential skills, technology, intellectual property, financial resources and infrastructure within the Australian defence industrial base. This level of access or control will enable Australian industry to realise the benefits associated with these interests. This Industry Plan enables both Defence and industry to understand better those opportunities and trade-offs associated with sovereign capability. This Plan should be read in conjunction with the corresponding Implementation Plan.

Guidance to Government Readers:

This Industry Plan supports Government, Defence project managers and others involved in capability acquisition and sustainment. This Plan provides information and guidance to enable Defence to align capability decisions with the strategic intent of the department and broader whole-of-government policies, including:

- The critical industrial capabilities to be developed in Australia to support this Priority (pages 6, 16-19).
- The capability enablers required to protect Australian sovereign interests (pages 35-39). This information will support industry's business planning and investment decisions, as well as enable the development of Australian Industry Capability Plans that align with Defence priorities.
- A description of the industrial base and its dynamic to support the planning and consultation, including preparing for and undertaking market solicitation, such as requests for information (pages 22-33).
- The actions to be taken by government to support development of this Priority (Annex A).

Guidance to Industry Readers:

This Industry Plan details specific areas of focus for Defence, enabling industry to support growth of sovereign capability by investing in those capabilities identified as critical (for example, in workforce, technology or infrastructure). The Plan includes:

- An explanation of the policy environment, the definition of defence sovereignty and what it means to be a Priority (pages 11-12).
- Identification of the critical industrial capabilities and capability enablers related to this Priority and Defence's intent to access or control particular aspects (pages 6, 16-19). This will support industry's business planning and investment decisions, as well as enable the development of Australian Industry Capability Plans that align with Defence priorities.
- A description of the industrial base and its dynamics, highlighting barriers and opportunities in the supply chain for this Priority. Learnings based on the National Defence Industry Survey report 2018-2019 and broader economic trends are shared (pages 22-33).
- Existing support levers available to industry seeking to develop Defence industrial capability (Annex B) and the specific actions to be taken by government to support this Priority (Annex A).

EXECUTIVE SUMMARY

The Australian aerospace platform deeper maintenance industry operates within a mature, highly-complex and evolving global sector. Sustainment of Australian Defence Force (ADF) aerospace platforms will continue to be outsourced to industry, predominantly through commercial arrangements with prime contractors. Engaging with prime contractors on deeper maintenance presents significant opportunities for Australian companies, training institutes and academia.

The vision for the sustainment of Defence's aerospace platforms is a close partnership between Defence and industry across all aspects of service delivery for this capability. Within this system, Defence expects that prime contractors will work to maximise opportunities for Australian industry for both global and local supply chains.

To achieve this vision, industry must have a deep understanding of total logistics support concepts (including supply chains) and an ability to effectively and efficiently achieve maintenance, repair, overhaul, and upgrade outcomes for aerospace platforms. The development of this understanding requires the pursuit of continuous improvement through the use of emerging technologies such as artificial intelligence, machine learning and additive manufacturing.

A sovereign industry aerospace platform deeper maintenance and structural integrity capability is characterised by:

- A capability focus that considers short and long-term requirements across all supporting activities that contribute to achieve Defence's mission and the preservation of capability across the platform life cycle.
- The use of available data to enable enterprise-level decisions and delivery against long-term sustainment and capability development objectives of the platform. This process requires an enterprise approach across all elements of the sustainment services supply chain.
- The development of a workforce that can deliver deeper maintenance, structural integrity and enabling capabilities across the entire spectrum of the platform life cycle and supply chain.
- The appropriate level of investment based on robust business cases that enable capability outcomes across the service life of individual or classes of assets.

The *2018 Defence Industrial Capability Plan* states that Australian industry must possess the industrial skills and technology for the conduct of deeper maintenance of Defence's rotary and fixed wing aircraft and remotely-crewed air vehicles to enable Defence to reduce strategic and operational risk. The ability to conduct appropriate and timely deeper maintenance in Australia as part of a cost-effective framework is a key requirement for Defence when working with industry. Appropriate management is required in order to allocate risk sensibly across all enterprise stakeholders.

Defence's aerospace capability is crucial to achieving the intent of the *2020 Defence Strategic Update* and delivering the strategic objectives of the *2020 Force Structure Plan*, primarily in the air domain. This Plan seeks to maximise sovereign aerospace platform deeper maintenance and structural integrity capability in the context of operating national fleets within a much broader global ecosystem. There are significant opportunities for Australian industry to contribute to the deeper maintenance of Defence's aerospace platforms. Defence will assist by evolving its acquisition and sustainment approach to ensure appropriate access to deeper maintenance enablers, including workforce, infrastructure, spare parts, technical data, and specialised test equipment.

Three industrial capabilities are critical within this environment and Defence seeks to have access to, or control over, certain elements of each. Defence also seeks to support or influence related Australian defence industry investment in these capabilities. Development of these critical industrial capabilities will ensure the availability and operational effectiveness of aerospace platforms. The development of specific capabilities will be based on consideration of the underlying sovereign requirements; the return on investment; and the capability benefits to be realised.

EXECUTION OF MAINTENANCE, REPAIR, OVERHAUL, AND UPGRADE ACTIVITIES

The application of fleet management techniques and supply chain optimisation to maximise operational aircraft availability and the ability to perform entire platform deeper maintenance cycles. This includes platform maintenance, repair, overhaul and upgrade in a timely and cost-effective manner. It also includes deeper maintenance of elements below the platform level, such as engine and propulsion systems, major mechanical and hydraulic components, avionics, and mission system components. Advanced surface coating and finishes at the platform and component level are also included.

AEROSPACE PLATFORM STRUCTURAL INTEGRITY

The ability to perform engineering analysis and testing of structures to inform the effective management of aerospace platforms ensuring they are operational, safe and fit for purpose throughout their service life. Specific areas of focus include: airframe and propulsion system life certification; fatigue testing and analysis; non-destructive testing for composite and advanced material repairs; the development of non-standard repairs for metallic and advanced composite structures; and the design, development and repair of parts through additive manufacturing processes.

THE EXPLOITATION OF DATA AND EMERGING TECHNOLOGIES TO OPTIMISE AEROSPACE PLATFORM DEEPER MAINTENANCE

The ability to deliver enhanced maintenance, repair, overhaul, and supply chain outcomes through the use of big data analytics, artificial intelligence, machine learning, and other evolving technologies.

To ensure that Australia retains the identified critical industrial capabilities, Defence seeks to build the following enabling capabilities over the next decade, starting with the actions listed in this Plan.

- Access to design, engineering, and maintenance-related intellectual property technical data and operational performance condition data supporting aerospace platform and component deeper maintenance.
- National multi-purpose and cross-platform infrastructure development for the conduct of aerospace platform deeper maintenance and structural integrity management.
- Innovative, flexible contracting that promotes and enables contracts across multiple platforms and encourages the realisation of economies of scale for management facilities established within Australia.
- Sustainment focus through the Smart Buyer approach in the early stages of the capability life cycle to ensure critical elements are established under commercial, cooperative and Foreign Military Sales programs.
- Working cooperatively with partner nations to establish shared management capability to leverage and enhance Australian skills, experience and capability.
- Enhanced collaboration between educational institutions and industry to enhance skills transfer that develops areas of critical need.
- Enhanced collaboration between Defence Science and Technology Group and academia to support relevant research and development.

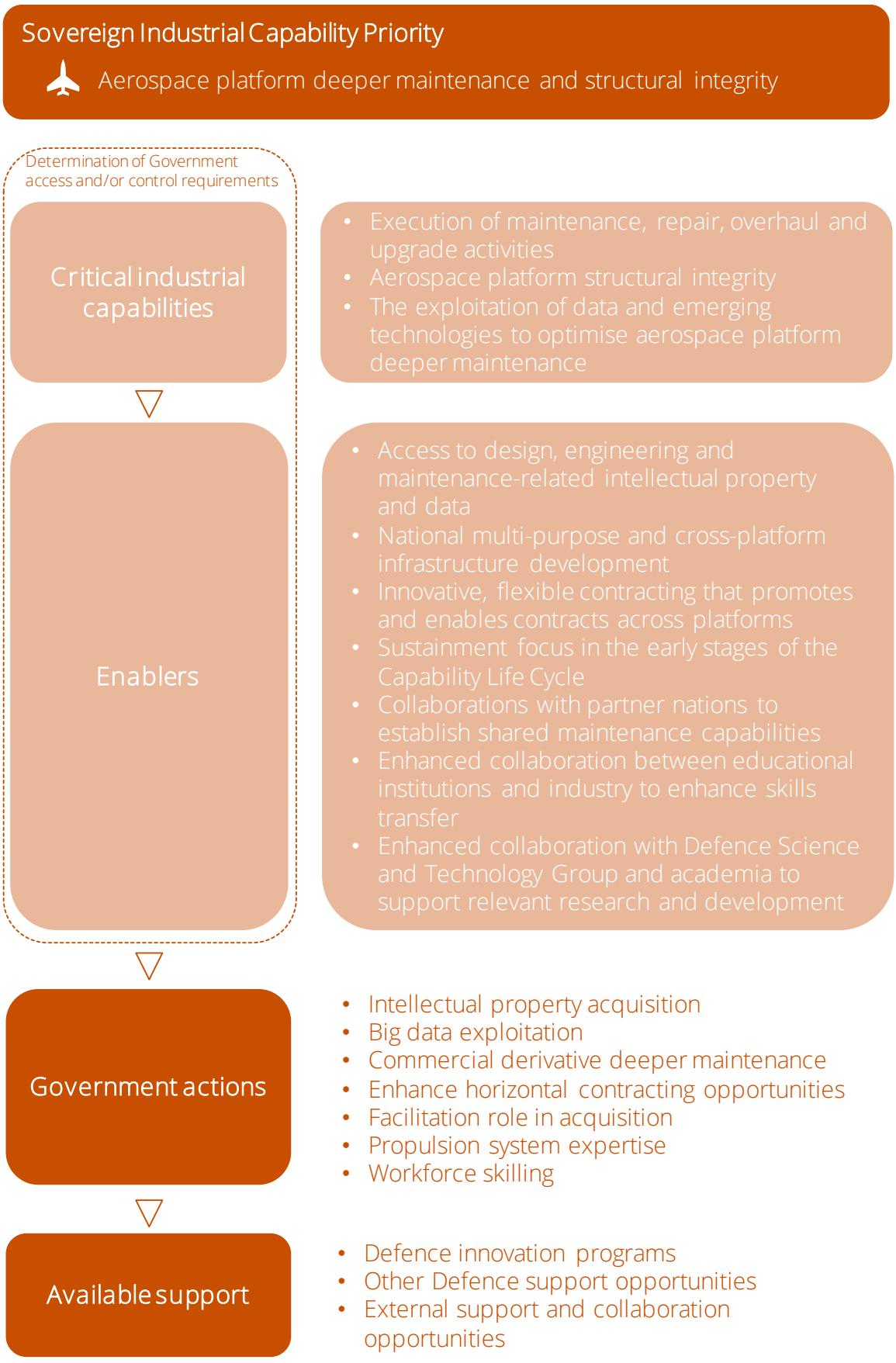
The recognition of aerospace platform deeper maintenance and structural integrity as a Sovereign Industrial Capability Priority provides industry with the certainty to invest in research, intellectual property, and its skilled workforce. This Industry Plan also includes details on support mechanisms available to businesses in Annex B.

Successful implementation of this Sovereign Industrial Capability Priority

- This Industry Plan describes Defence's priorities for the next three to five years in terms of investment in the industrial capability that delivers aerospace platform deeper maintenance and structural integrity management for each aerospace platform. Success in implementing this Plan will enable the following industrial landscape in 2023-2025:
    - Continued development of aerospace platform deeper maintenance and structural integrity enabling capabilities, including: infrastructure, skill development in engineering, maintenance requirements determination, fleet management, fault diagnostics, supply chain analysis and optimisation.
    - Continued development of data-driven platform and component-level aerospace platform deeper maintenance.
    - Analysis of supply chain data in partnership with suppliers to enhance deeper maintenance outcomes.
    - Collaboration between Defence and industry to enable access to the global supply chain.
    - Improved advocacy from Defence for enhanced Australian industry capability in all forms of platform and component deeper maintenance arrangements.
    - Enhanced industry resilience through the growth of Australian companies providing regional or global aerospace platform deeper maintenance services.
    - Increased awareness within Defence leading to promotion of horizontal contracting opportunities across multiple platforms in aerospace platform deeper maintenance and structural integrity to enable economies of scale for identified critical capabilities.

Features of this Industry Plan

This Industry Plan describes the *Aerospace platform deeper maintenance and structural integrity* Sovereign Industrial Capability Priority and specific sovereign capability requirements across four key areas. These key areas are standardised across all Industry Plans and are presented in the diagram below and discussed throughout the Industry Plan.



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STRATEGIC CONTENT

The case for a sovereign industrial base

Sovereign industrial capabilities are considered operationally critical because of the essential strategic advantage they provide to the ADF. They must be developed and supported by Australian industry because overseas sources do not provide the required security or assurances of access and supply. Australia must consider how we develop, maintain or enhance these capabilities and the degree of access to, or control over, them that we need now and in the future.

Sovereign Industrial Capability Priorities are those industrial capabilities assessed as:

- operationally critical to the Defence mission;
- priorities within the Integrated Investment Program over the next three to five years; or
- in need of dedicated monitoring, management, and support due to their industrial complexity, government priority, or requirements across multiple capability programs.[1]

The initial Sovereign Industrial Capability Priorities[2] are:

The Australian Government will make judgements about the optimal level of access to or control over each Priority on a case-by-case basis. A defence capability does not necessarily need to be designed, developed, manufactured or maintained in Australia. The level of sovereign access or control may vary for each Priority. Defence industrial sovereignty is made up of many elements and may include:

- access to resident technical design capabilities (for example, to modify or upgrade systems);
- the ability to test and ensure that equipment is operationally ready for service or to be returned to service;
- access to, or control over, the facilities, technologies and intellectual property underpinning our defence capability within Defence and Australian industry;
- access to allied capability that supports our warfighting advantage; and/or
- the ability to protect foreign-sourced or controlled technologies employed by the ADF.

[1] http://www.defence.gov.au/SPI/Industry/CapabilityPlan/Docs/SICP-Factsheet1.pdf
[2] Full Defence Industrial Capability Plan descriptions can be found at https://www.defence.gov.au/SPI/Industry/CapabilityPlan/Docs/DefenceIndustrialCapabilityPlan-web.pdf

'Access' refers to the availability of key assets within Australia, able to be used by Defence, if required.

'Control' is more likely to be obtained by Defence through Government ownership or exclusive rights to a critical asset such as specialist machinery or infrastructure.

The Priorities represent only a subset of Australian defence industry capability. The Priorities identify a number of elements of the Australian defence industrial base at a capability rather than a company or technology level. This focus on capability delivery is to encourage innovation and development in the technologies and capabilities most essential for Defence.

Sovereign Industrial Capability Priority development

These Priorities were developed through a rigorous assessment framework which considered the strategic, capability, and resource dimensions of industrial sovereignty against the needs of Defence. Consideration of industrial capabilities was balanced against Defence's priority to provide the ADF with cost-effective, cutting-edge capability that maximises Australian industry involvement.

Management and support for the Priorities starts at the very beginning of Defence planning and continues throughout the Force Design Cycle and Capability Life Cycle, including the Australian Industry Capability Program, into government grants and initiatives to support industry directly. The Australian Industry Capability Program remains the critical lever for Australian industry involvement in supporting the Priorities and Defence's broader capability needs.

Policy framework

The *2020 Defence Strategic Update* sets out the Government's response to our changing environment. Australian industry will continue to play a major role in delivering the long terms plans for the defence of Australia and its national interests, set out in the *2016 Defence White Paper*. Industry's role as a Fundamental Input to Capability was reaffirmed in the *2020 Defence Strategic Update*. Through this reaffirmation, Defence formalised the pivotal role defence industry plays in generating military capability and supporting the ADF.

The *2020 Defence Strategic Update* and *2016 Defence White Paper* is complemented by:

- the *2020 Force Structure Plan* and the Integrated Investment Program, which outlines $270 billion of Defence capability investment and provides industry with the certainty to invest in people and infrastructure; and
- the *2016 Defence Industry Policy Statement*, which provides the foundation to take the partnerships between Defence and industry to new levels of cooperation, with a focus on stronger, more strategic partnerships and closer alignment between industry investment and Defence capability needs. The Defence Industry Policy Statement also provided the criteria to identify Sovereign Industrial Capability Priorities.

AEROSPACE PLATFORM DEEPER MAINTENANCE AND STRUCTURAL INTEGRITY

Aerospace platforms are essential to the ADF. These platforms enable situational awareness and rapid response in times of disaster or conflict, as well as across a broad spectrum of other operational scenarios. Defence aerospace platforms must be available to enable the ADF to meet its responsibilities to shape, deter and respond within its strategic context. Deeper maintenance is a critical component of ensuring the continued operational availability of ADF aerospace platforms and delivering capability when required.

The *2018 Defence Industrial Capability Plan* stated Australian industry must possess the industrial skills and technology for the conduct of deeper maintenance of Australia's rotary and fixed-wing aircraft, as well as large remotely-crewed air vehicles. This imperative includes the requirement to effectively identify and manage strategic and operational risk and opportunity across the enterprise. Defence and Australian industry provide different levels of repair and maintenance at different points in the operating cycle of an aerospace platform. For the purposes of this Industry Plan, aerospace platform deeper maintenance and structural integrity includes:

- maintenance, repair and overhaul not carried out by ADF units;
- heavy maintenance carried out on airframes and primary mechanical components requiring the removal of aircraft from service;
- engine overhauls and major checks, including maintenance or replacement of the engine, requiring it to be removed from the aircraft and dismantled;
- component maintenance including fault diagnosis and repair of aircraft components, including both avionics and mechanical systems;
- installation of modifications to improve reliability or maintainability, or to increase capability through new or upgraded systems or components;
- effective and cost-efficient management of platform structural integrity and life of type analysis and decision making;
- use of evolving technologies, such as additive manufacturing and digital twins;

- airworthiness certification following modification or customised component inclusion; and
- use of data, artificial intelligence and machine learning across supply chain analysis, reliability and maintainability, and maintenance cycle/fleet planning to inform Defence decisions.

The scope of this Priority does not include the procurement of aircraft but does consider the deeper maintenance of remotely-crewed aerial systems (with the exception of soldier-portable air vehicles), training devices and simulators.

Given the breadth and depth of capabilities within the scope of this Priority, this Plan prioritises:

- operationally critical platforms with deeper maintenance requirements; and
- systems and sub-systems with higher strategic and operational risk.

The vision for aerospace platform deeper maintenance and structural integrity

Defence's vision for aerospace platform deeper maintenance and structural integrity is for Australian industry to provide sufficient sovereign and cost-effective deeper maintenance services to support the operational availability of aerospace platforms to meet Defence's needs. Engagement with industry and academia is essential to harness emerging technologies and achieve supply chain optimisation, deeper maintenance and fleet planning, and engineering design. To realise this vision will require cost transparency and sharing of data across all elements of the supply chain.

The Aerospace platform deeper maintenance and structural integrity capability requires a focus on continuous workforce development to ensure that appropriate resources are available to support the capability. Long-term investment in infrastructure and specialist equipment is also required, and may need to be supported by cross-platform or longer-term contracts.

Aerospace capabilities

The ADF operates a diverse fleet of aerospace platforms to achieve air combat; mobility and intelligence; surveillance and reconnaissance effects. Despite the diversity of platform types, there are common technologies at the major sub-systems level (such as structures, propulsion and avionics) as well as technology trends (for example, the increased use of composites). Mission systems (sensors, computers and communication equipment) within aerospace platforms are increasingly required to deliver the advantage to warfighting capability,[3] particularly across the joint environment.

Table 1: A summary of the Australian Defence Force's current and future aerospace platforms and roles as at October 2020

Role	Platforms	Overview
 Air mobility	Fixed wing: C-17A Globemaster III, C-130J Hercules, C-27J Spartan, KC-30A Multi-Role Tanker Transport, KA350 King Air Rotary wing: S-70A-9 Black Hawk, MRH-90 Taipan, CH-47F Chinook	Air mobility assets are responsible for preparing and conducting air-lift and air-to-air refuelling operations for Defence force projection. These assets are often 'the first on the scene' when deploying in times of crisis.
 Air combat	Fixed wing: F-35A Lightning II (Joint Strike Fighter), F/A-18F Super Hornet, F/A-18A/B Hornet, EA-18G Growler Rotary wing: MH-60R Seahawk, ARH Tiger	Air combat assets deliver Australia's capability to control the air and conduct precision strike and airborne electronic attacks.

[3] As compared to previous periods when warfighting advantage was primarily derived by physical performance attributes, such as speed or manoeuvrability.

Role	Platforms	Overview
Air intelligence, surveillance, reconnaissance and electronic warfare	Fixed wing: P-8A Poseidon, E-7A Wedgetail, AP-3C Orion, MC-55A Peregrine (project not yet in service) Remotely-crewed: MQ-4C Triton, MQ-9B Sky Guardians (projects not yet in service) Rotary wing: MH-60R Seahawk, ARH Tiger	Intelligence, surveillance, reconnaissance and electronic warfare assets enable Defence to sustain and enhance multi-domain intelligence, surveillance, reconnaissance, strike, control of the air, maritime patrol and response, and aerospace management and control capabilities across the full spectrum of operations.
Air training	Fixed wing: PC-21, KA350 King Air, Hawk 127 (and simulators) Rotary wing: EC-135T2	Air training assets deliver essential, effective and efficient education and training as a key enabler to Defence's aerospace capability.

Defence relies on each of these aerospace roles and capability effects to achieve its mission. The Government will make judgements on a case-by-case basis on the optimal level of access to, or control over, capabilities for this Priority.

The current aerospace platform deeper maintenance environment

Industry partners presently perform almost all deeper maintenance functions for Defence aerospace platforms. Deeper maintenance relies on global supply chains to provide the repairable items, consumables, support equipment and tools needed to conduct maintenance. Original equipment manufacturers and their in-country representatives (subsidiaries) are integral to the delivery of effective aerospace platform deeper maintenance, due to their detailed design and manufacturing knowledge, and are needed for access to certain technical data. Accordingly, deeper maintenance is fundamentally reliant on a strong partnership between Defence and original equipment manufacturers and their in-country representatives.

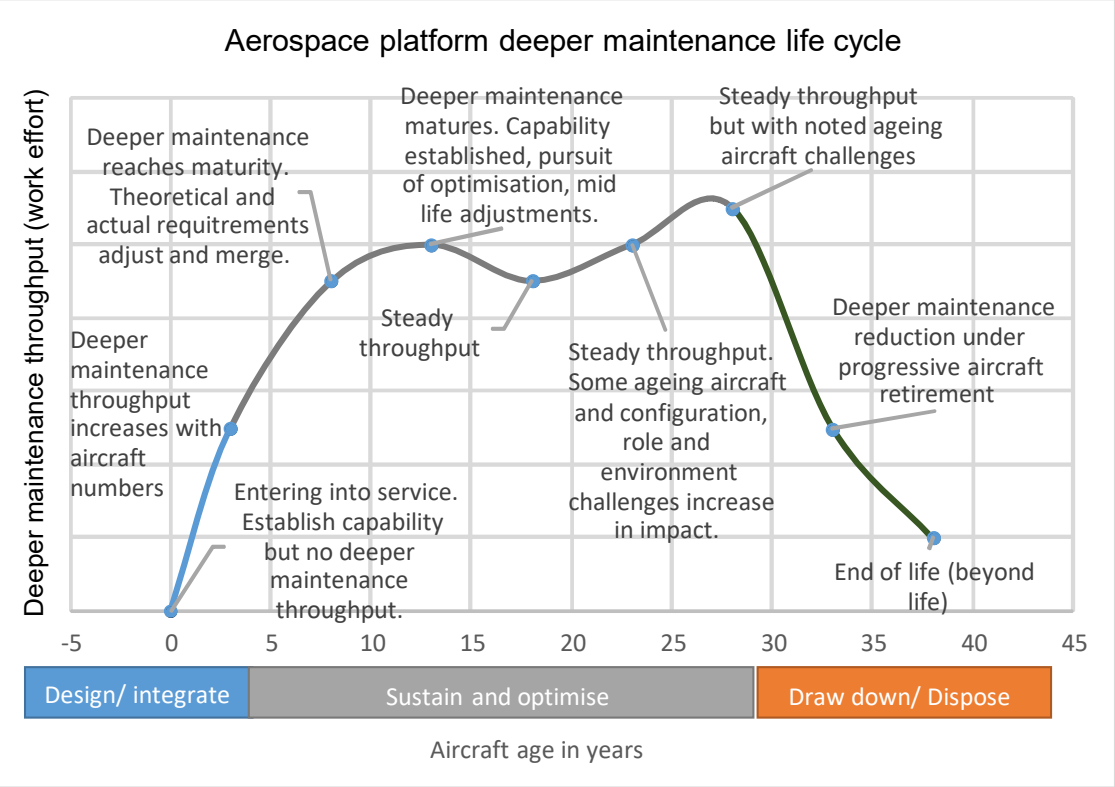


Figure 1: Aerospace platform deeper maintenance life cycle

Modern aerospace platforms comprise interconnected networks of sub-systems drawn from multiple original equipment manufacturers. They may also include bespoke systems specified by Australia to ensure interoperability within the ADF and with partner nations. The supply chain for each platform is accordingly unique, multi-tiered and complex. Additionally, the advanced materials and technologies used in defence aerospace platforms can often result in single sources of supply with long-lead times – sometimes more than 12 months for repairing and/or procuring components.

Aerospace platform deeper maintenance and structural integrity management requires ongoing access to in-depth and, at times, sensitive intellectual property. With increasing supply chain diversity at a platform level, organisations are often required to work through multiple channels and licences to obtain the necessary intellectual property. Intellectual property is also frequently layered as aerospace platform deeper maintenance requirements move from the core activity of undertaking maintenance in accordance with provided technical manuals, to in-depth fault diagnostics, modifications and resolution of issues beyond the immediate maintenance limits of the aircraft. Assuring access to essential information may require specific technical data beyond the maintenance manuals that may, in turn, require engagement with, and authorisation from, the original equipment manufacturer.

Critical industrial capabilities

Defence requires a level of access to, or control over, the following critical industrial capabilities in support of this Priority:

EXECUTION OF MAINTENANCE, REPAIR, OVERHAUL, AND UPGRADE ACTIVITIES

The application of fleet management techniques and supply chain optimisation to maximise operational aircraft availability and the ability to perform entire platform deeper maintenance cycles. This includes platform maintenance, repair, overhaul and upgrade in a timely and cost-effective manner. It also includes deeper maintenance of elements below the platform level, such as engine and propulsion systems, major mechanical and hydraulic components, avionics, and mission system components. Advanced surface coating and finishes at the platform and component level are also included.

Defence needs industry to develop a broad and sustainable base of maintenance, repair and overhaul skills. These skills are critical to ensure the availability of aerospace platforms and the delivery of outcomes for the ADF.

The application of fleet management and project management skills is essential to optimise deeper maintenance activities and maximise capability availability within relevant resource constraints. The management of entire platform deeper maintenance cycles encompasses the full span of services across planning, engineering, maintenance, quality assurance, and supply chains.

Defence requires industry to establish and leverage in-country engine and propulsion system[4] repair and testing capabilities for military engines and propulsion systems. This requirement is needed to reduce turn-around times and improve platform availability. Enhanced capability will reduce the need to purchase and hold additional engines and related components, as well as reduce freight costs.

Specific skills and authorisations are required for each engine and propulsion system. Ongoing access to respective maintenance publications is required, together with development of the original equipment manufacturer-endorsed specialist skills and base trade skills. Industry will also need to deliver or maintain enabling facilities for select platforms. This includes type-specific rigs and attachment frames particular to each engine type or propulsion system. Engine facilities also need to include engine test cells certified for each engine type. Propulsion system aerospace platform deeper maintenance facilities can be less asset-unique; however, all require extensive environmental controls to prevent contamination into critical sub-systems.

The ability to undertake modification, repair and overhaul of aerospace platform mechanical and avionics components is also required. This includes the engineering and technical skills to analyse and undertake system and component fault diagnosis, repair and modification to reduce maintenance timeframes and ensure the availability of ADF assets. Industry should seek to establish an economic level of repair, and leverage cross-platform capability and infrastructure. Additionally, industry may seek to leverage partner-nation repair effort to improve business cases, use standard test equipment for cross-platform activities, and identify sub-component repair venues in Australia.

[4] This includes the rotor group and associated drive systems for rotary wing platforms.

The use of additive manufacturing in maintenance, repair and overhaul of ADF aerospace platforms is required. Defence needs industry to develop and apply additive manufacturing repair techniques for applicable components in conjunction with original equipment manufacturers. These activities will require the appropriate investment in developing an enduring engineering and technical skills base to undertake this work.

The ability to apply specialised (or advanced) coatings and surface finishing at the platform and component level is an integral aerospace platform deeper maintenance function. This ability includes the development of cross-platform and system capability to develop advanced coatings and eliminate corrosion to ensure the operational availability and performance of aerospace platforms and components.

AEROSPACE PLATFORM STRUCTURAL INTEGRITY

The ability to perform engineering analysis and testing of structures to inform the effective management of aerospace platforms ensuring they are operational, safe and fit for purpose throughout their service life. Specific areas of focus include: airframe and propulsion system life certification; fatigue testing and analysis; non-destructive testing for composite and advanced material repairs; the development of non-standard repairs for metallic and advanced composite structures; and the design, development and repair of parts through additive manufacturing processes.

The economic life of type of aerospace platforms is typically governed by the airframe and propulsion system, necessitating a robust approach to the management of structural integrity. An effective structural integrity capability requires access to a broad range of technical competencies and associated infrastructure. For ADF platforms, structural integrity is managed by Defence (including the Defence Science and Technology Group) in partnership with defence industry.

In this context, Defence requires industry to continue development of structural integrity engineering skills and to integrate this knowledge into optimising structural integrity management programs and maintenance requirements, as aircraft age and other issues arise. Continued fostering and development of this capability are necessary to ensure skills are current and in line with the latest composite techniques adopted in defence aerospace platforms.

Structural analysis is important in assessing the impacts of damage and degradation on structural integrity, and understanding the implications of changes to the configuration and/or role of the platform. It enables timely development of repairs, informs maintenance processes, and supports effective platform management decision making. These specialist skills are more relevant as platforms age and Defence is inevitably required to make more significant and numerous engineering assessments and decisions. The skills underpinning this capability require ongoing investment to ensure long-term viability of the industrial base.

The certification of airframe and propulsion system life is a key aspect of ensuring platform integrity across the capability life cycle. The ability to undertake fatigue analysis and dynamic fatigue testing is important at both the whole-of-airframe and component level, and requires access to both relevant skill sets and supporting infrastructure. Industry is required to analyse data recorded on an aerospace platform's health and usage monitoring system, research and develop fatigue management and treatment processes, and support life of type extension decisions. These processes are also important for ensuring the integrity of propulsion systems, as is expertise in relevant exotic metallurgy to support the propulsion system integrity program.

Industry needs to develop a broad and sustainable base of skills in composite and advanced material test, repair and installation. Industry will also be required to increase the number and depth of non-destructive testing practitioners.

These skills are integrated into the operational and deeper maintenance of aerospace platforms. They underpin the structural integrity of the aircraft and are central to the ongoing airworthiness of the platform. These skills are particularly critical in military platforms given the extensive use of composite structure to enhance strength and provide lower observability characteristics. In addition, military platforms operate under a more diverse operating environment, which necessitates advanced monitoring regimes and unique, targeted and deeper inspections.

Significant spikes in demand for these skills are frequent, driven by extensions to the operational life of platforms, unexpected failures or where damage or degradation beyond limits are encountered. Industry and Defence need to work together to identify specialist skills, noting the difficulty in accurately forecasting demand, and build capacity to meet capability needs and regulatory requirements, on demand.

The ability to develop non-standard repairs for metallic and advanced composite structures is also required. This ability includes developing a responsive capability able to certify non-standard repairs to airframes through access to the required technical data inclusive of design organisation approval.

Defence also requires industry to develop the use of additive manufacturing processes for the design, development and repair of components, including those with advanced composite materials and bespoke parts. Additive manufacturing is closely aligned with structural integrity capabilities and requires engineering and design certification support.

THE EXPLOITATION OF DATA AND EMERGING TECHNOLOGIES TO OPTIMISE AEROSPACE PLATFORM DEEPER MAINTENANCE

The ability to deliver enhanced maintenance, repair, overhaul, and supply chain outcomes through the use of big data analytics, artificial intelligence, machine learning, and other evolving technologies.

Defence requires industry to develop and maintain a detailed knowledge and understanding of aerospace supply chains in order to make informed supply chain decisions and execute supply functions.

Efficient and effective supply chain operation is key to the reduction of operational and strategic risk as it directly supports the performance of deeper maintenance activities. Where supply chain management was once wholly a Defence responsibility, Defence is increasingly contracting industry to provide holistic support under a more integrated suite of responsibilities that includes maintenance, engineering and supply support.

Defence also requires industry to establish a sustainable pool of maintenance analysis practitioners in order to optimise the maintenance program and achieve capability objectives. Optimising the maintenance program also improves safety and reduces overall life cycle cost for the platform. An optimal maintenance program is particularly important in ageing platforms.

The ability to develop and operate effective fleet planning tools and capabilities is essential to optimising maintenance, repair and overhaul outcomes. Defence requires industry to access and analyse health and usage monitoring system data to understand and predict reliability issues. Defence also needs industry to develop planning tools to optimise fleet availability and incorporate data-based repairs based on predictive models rather than on a calendar or hours-based approach.

Contemporary supply support for aerospace platform deeper maintenance is characterised by highly technical and often bespoke components, limited sources of supply, long-lead times and an increasing reliance on multi-tiered supply chains. Aerospace platform deeper maintenance supply chains also operate under complex contracting models and across multiple system and sub-system providers. As a result, these supply chains are often constrained and, at times, opaque. Defence is reliant on industry partners to navigate these challenges, understand and articulate risk, and manage the supply chain to enable capability outcomes. Delivering the supply solution includes the understanding, analysis and navigation of the multi-tier supply chains to identify where criticality and single points of failure may exist.

As Defence and industry develop an enhanced understanding of maintenance drivers (systems degraders), Defence requires industry to identify and implement adjustments to maintenance programs to align with Australia's unique operation of the capability. This maintenance program also requires ongoing monitoring, analysis and adjustment as the platform moves through the life cycle.

Australian industry must be able to conduct engineering analysis to inform and enable aerospace platform deeper maintenance and structural integrity management decision making. This includes decision making associated with variations to platform life and operational tempo, which enables informed trade-off decisions. Technology advancements have provided software-enabled digital twins that can inform aerospace platform deeper maintenance and structural integrity management decision making. Defence will look to industry to develop the necessary tools, systems and scenario analysis techniques to support such decision making. This will require relationships with original equipment manufacturers and international partners to understand global trends in addition to Australian-specific circumstances.

What is a Digital Twin?

A digital twin is a virtual representation of a physical asset along with its operating environment. Sensors on the asset gather and send data to the digital twin, which is then analysed against other business or contextual data inputs to provide a model of possible outcomes. This pairing allows real-time monitoring to prevent problems and alert the operator to changes or degradation in asset condition and system performance. Generated in real time, this data can provide insights into degradation and support the development of optimal interval and frequency for a particular maintenance task.

A digital twin also enables examination of analysis and 'what-if' scenarios without risk to physical assets, people or system performance. This aids in capturing performance improvement and cost savings as well as identifying and contextualising training and risk. A digital twin requires the use of aerospace maintenance engineering knowledge and expertise to understand and govern for the identified outputs of this analysis.

Future trends and technological evolutions

The most significant technology change for Defence aerospace is the introduction of fifth-generation air combat and network-centric warfare capabilities into service, including platforms such as the F-35A Lightning II - Joint Strike Fighter. In essence, Defence is moving from being weapons system-centric to focussing on systems connected by networks.

Over the next three to five years, a number of ADF aerospace platforms will start to enter the middle of their service lives. As deeper maintenance and structural integrity management requirements vary based on a platform's time in service, industry will be required to develop and maintain broad skill sets, facilities and services.

Software systems and integration of military mission systems

Technology advances are expected to focus on military mission system equipment with an increasing reliance on software development and integration. Technology continues to evolve through the development of integrated systems including fly-by-wire, radar, sensor and weapon systems. These systems now form the foundation of platform interoperability, surveillance and warfighting capability. Computer and technology advancements will continue to deliver command, control, communications, computers and intelligence into the operational battle space. Future capability solutions will see continued integration of multiple systems across domains, creating a system–of-systems environment. Air platforms will integrate and communicate with ground-based communications, as well as sensor and targeting systems of other air, land and maritime systems. Interoperability, achieved through increased and enhanced systems integration, is crucial for enabling Australia and our strategic and coalition partners to operate in a coordinated manner in the battle space. Fault diagnostics of these complex integrated avionics and mission systems, together with the cybersecurity of operational and support systems, will become increasingly important over the next decade.

Structures

Technology advancements in aircraft structures will continue as new materials and coatings are developed for future platforms. Technology continues to evolve from traditional aluminium-based airframes towards greater use of composite and carbon fibre-based airframes to form the structure. Advanced coatings and paints will ensure Australia's air combat and strike platforms maintain their full-spectrum, low-observable stealth capabilities. The deeper maintenance environment expects to continue to feature structural and mechanical-based maintenance with a focus on assessing structural integrity, major component removal, and the installation and maintenance of systems such as hydraulics.

Nature of sustainment

The boundaries and delineations between operational maintenance, deeper maintenance and upgrades will continue to blur beyond the three to five year horizon of this Plan. This blurring refers to the shifting of maintenance activities between operational units and deeper maintenance facilities and vice versa, which affects the underlying facilities and equipment necessary to conduct that maintenance. Maintenance skill development continues to rely on deeper maintenance capabilities to provide on-the-job exposure to more in-depth maintenance activities, and to develop skills which are harnessed and used across all levels of the capability.

Additive manufacturing techniques and 3D printing will be more relevant to future aerospace platform deeper maintenance and structural integrity functions, as the processes, technologies and associated certification and authorisation mechanisms mature. Defence will look to Australian industry to lead innovation in this area.

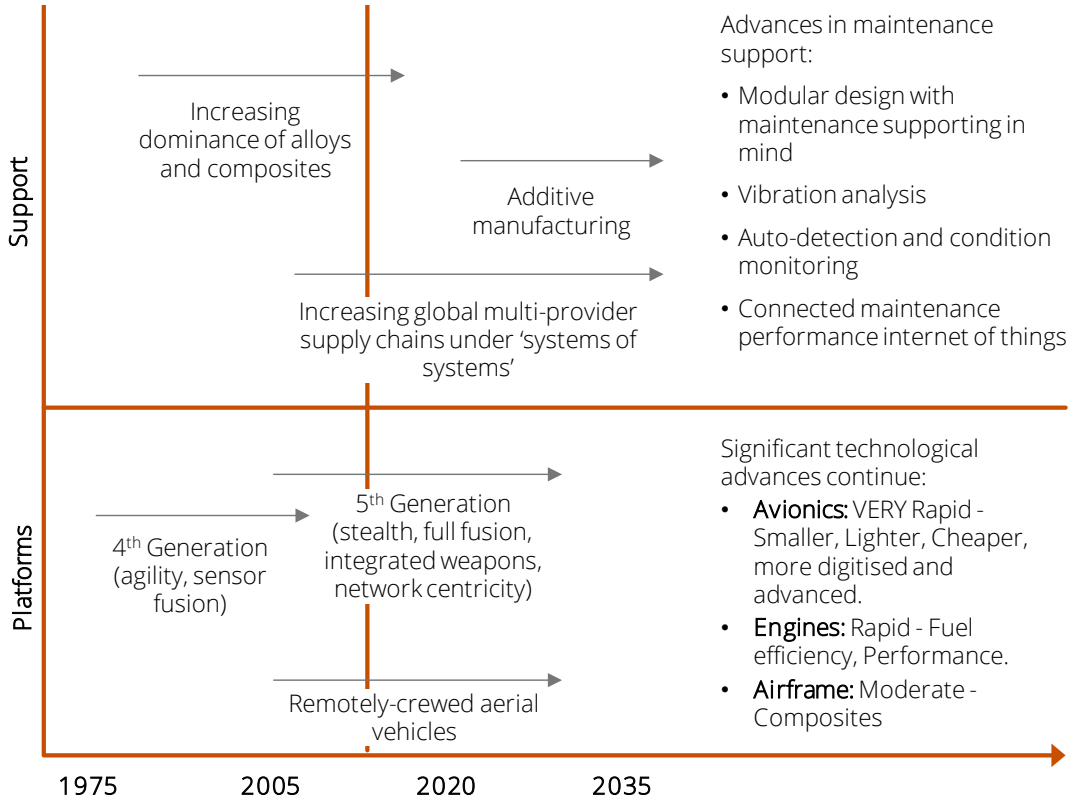


Figure 2: Evolution of technology and trends in aerospace impacting ADF capability

CASE STUDY

RMIT University – Academic education and industry support

RMIT University is a research university providing tertiary education opportunities and research capabilities to the defence aerospace sector. Industry partnership and engagement are core activities of the school, including work placements, internships, and industry-based student projects. The Department of Aerospace Engineering, via the Sir Lawrence Wackett Centre, supports industry with short-course training and postgraduate opportunities, such as the Master of Airworthiness and the Defence-only Master of Engineering and Reliability. This ongoing engagement ensures that the university's training and research remains relevant to employers and offers its graduates opportunities in their chosen fields.

RMIT University is heavily involved in defence industry projects, working with organisations including Boeing, General Electric, Lockheed Martin, Northrop Grumman, Pratt & Whitney, Thales, QinetiQ, RUAG and the Defence Science and Technology Group. Current areas of research include ultrasonic sensors for aircraft structural health monitoring, cost-benefit assessment of future aerospace concepts for Defence, and improved autonomous surveillance for remotely-crewed aerial vehicle flight in complex urban terrains.

The university currently has approximately 800 students enrolled. 80-100 students will graduate each year, with most entering careers in the aerospace industry or businesses that support the aerospace industry.

CURRENT AUSTRALIAN INDUSTRIAL CAPABILITY

The aerospace deeper maintenance and structural integrity management industrial capability is stable and mature, but relies on international relationships and continued access to original equipment manufacturers.

The industrial base supporting aerospace platform deeper maintenance and structural integrity management in Australia is dominated by in-country representatives (subsidiaries) of overseas manufacturers at the prime contract level, with a small number of second and third-tier suppliers. Pockets of wholly Australian-owned organisations undertake aerospace platform deeper maintenance support for a small number of major components. Australian small-to-medium enterprises typically support aerospace platform deeper maintenance at the platform and component-level areas. While challenging for Australian business, these dynamics are consistent across the defence sector. Similar challenges also exist in the commercial aerospace sector, albeit amplified by the presence of regional and global maintenance hubs that are able to manage more homogeneous fleets operated by commercial airlines.

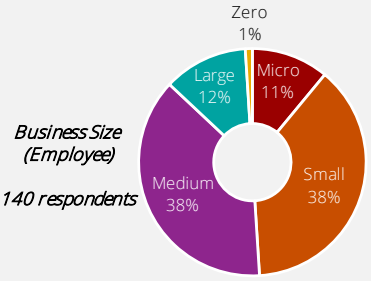
Australian industry attributes

Findings from consultation during the development of this Industry Plan, through the National Defence Industry Survey Report 2018-19,[5] and research and analysis into the industrial base, provide insight into the attributes of the current Australian industry capability. Data in this section reflects those organisations that completed the survey.

Size and composition

140 of the organisations surveyed identified supporting aerospace platform deeper maintenance and structural integrity management capability in Australia.

While the market composition appears mixed with a prevalence of small-to-medium enterprises, large companies dominate the market[6]. This reflects the in-country prime organisations undertaking aerospace platform deeper maintenance on respective platforms, and a number of small-to-medium enterprises providing support to the primes or undertaking support within the broader aerospace environment in Defence.



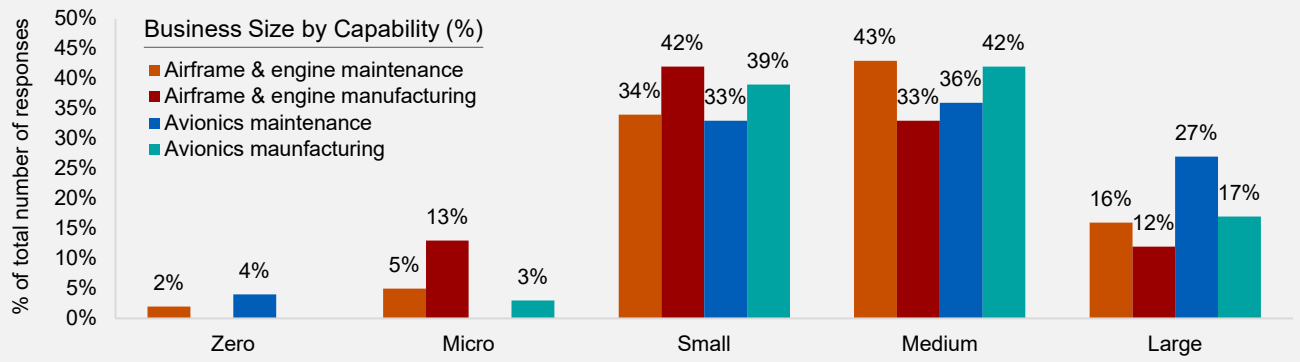
NOTE: Percentage of respondents of a specified business size, based on the number of employees in Australia

There are significant differences between the services performed by different organisations due to the substantial investment costs needed to establish aerospace platform deeper maintenance capability; less complex components carry lower facility costs. For example, a one-to-three ratio exists between large-to-medium organisations engaged in airframe and engine maintenance and manufacture, while a one-to-two ratio exists for avionics.

Industry noted that component manufacturing does not necessarily translate to component maintenance, especially as Australian manufacturing roles are often at the sub-component level within original equipment manufacturer supply chains. As a result, the profile and presence of component manufacturing organisations and capabilities as they relate to aerospace platform deeper maintenance needs to be viewed with caution, while skill development (of varying relevance to maintenance) and the development of trusted relationships with original equipment manufacturers, is a significant enabler towards securing sustainment opportunities.

Survey responses suggested respondents are diversified and are not specialists in any one particular capability.

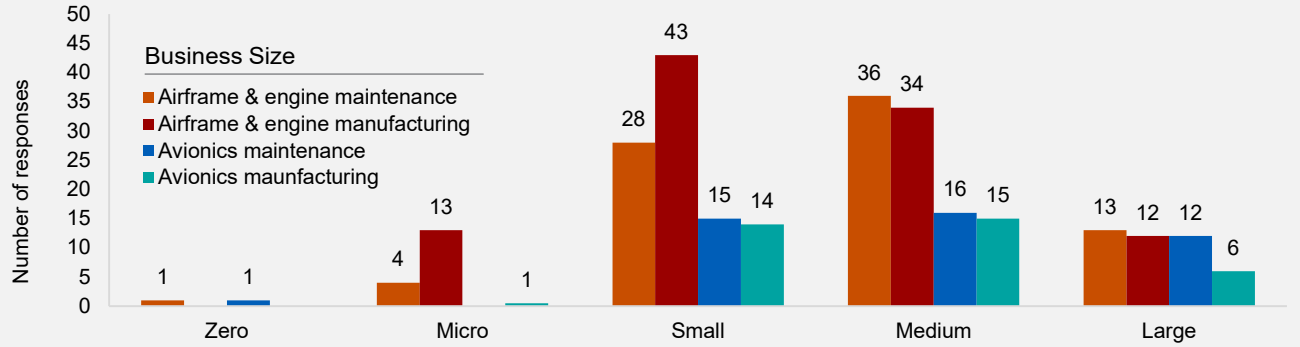
[5] The survey, administered by the Centre for Defence Industry Capability in 2018, required industry to complete a range of questions in relation to their business and the industrial capabilities able to be generated with a Defence application. Approximately 1,800 organisations responded to this survey the data collected was self-reported, not validated through other sources; accordingly, there are limitations in terms of data bias and representation of the sector.
[6] The survey categorises organisations as: micro (up to 4 employees), small (5 to 19 employees), medium (20 – 200 employees) and large (200+ employees).



NOTE: Percentage of respondents of a specified business size, based on the number of employees in Australia – split by capability

The prevalence of organisations performing airframe/engine functions is aligned with the ADF's requirements for platform and major component maintenance to be conducted close to operations. Alternatively, avionics support relies on components being sent back to the offshore original equipment manufacturer for repair. Typically this has been driven by high-cost test equipment, automated test procedures and low arising rates (improved reliability). The result has been a reduced ability to conduct maintenance at varying levels below full factory acceptance levels and when coupled with relatively small Australian fleet sizes, typically diminishes a viable business case to establish a repair venue in Australia. Opportunities need to be explored to support increased volume in Australia by attracting more work across the global supply chain as a second source of repair, and promote resilience and redundancy in the supply chain.

Overall numbers are relatively low in comparison to other industries, largely reflective of the bespoke nature of the aerospace sector.



NOTE: Number of respondents of a specified business size, based on the number of employees in Australia – split by capability

Small-to-medium enterprise base

Capability and company data indicate diversification among small-to-medium enterprises in this market. Considering workforce size, it is apparent that this is partially driven by the dominance of large primes within this sector, with small-to-medium enterprises engaged to produce a specific, specialised function or service. Industry consultations confirmed this dynamic, as many small-to-medium enterprises seek to expand their expertise from aerospace to land or sea domains to achieve growth.

There is a resurgence in manufacturing across the Australian aerospace industry, particularly as a result of winning global supply contracts, such as those within the Joint Strike Fighter program. These programs have provided growth and stability for many small-to-medium enterprises that are manufacturing components and sub-systems for the aerospace sector, in particular those at the second and third tiers in the supply chain. It should be noted that these functions are distant from the point of integration into the platform and do not directly translate to aerospace platform deeper maintenance industrial capability.

Small-to-medium enterprises noted the Government's emphasis on using large primes to engage local industry across the sector, making a positive impact in the sub-sector. While there is an active group of small-to-medium enterprises delivering services across the sector, many are significantly aligned to only one or two platforms (through respective primes for that particular platform) with limited ability to work with other primes on different platforms. Intellectual property constraints and navigating the flow down of Australian Standard for Defence Contracting clauses to subcontracts, remains a significant barrier to small-to-medium enterprise engaging with primes effectively. In addition, small-to-medium enterprises that create substantial innovation in the sector are often acquisition targets.

A recurring theme in industry consultation was the need for opportunities to generate value-for-money through collaboration across multiple platforms. For example, using common facilities and shared services within and across aerospace platform deeper maintenance functions, such as airframe maintenance, painting and non-destructive testing. Barriers to collaboration included intellectual property constraints and the absence of a framework that incentivises and encourages collaborative behaviour.

Innovation

"Emerging technologies and innovation is a strength of local industry and a focus area; however there is not as much focus on sustainment" - global prime in the aerospace sector.

Government and global supply chain opportunities have driven Australian industry investment in innovative processes and technologies, in particular those supporting manufacture.

Although industry participants continue to invest in research and development, there is a limited focus on sustainment elements including aerospace platform deeper maintenance and structural integrity management. Non-destructive testing, aircraft structural integrity and advanced supply chain analytics were noted as areas of vulnerability in the market, which lend to innovative approaches and advanced techniques. Defence will work to strengthen the sustainment focus for all its platforms.

Industry consultation revealed some degree of cross-pollination between the commercial and defence aerospace sectors in areas such as specialist fasteners, where advanced commercial practices are finding their way into Defence through small-to-medium enterprise engagement. However, this dynamic was rare and industry noted the need for innovators in Australia to be closely connected to the original equipment manufacturer, ensuring access to intellectual property (beyond what might be required for the performance of routine tasks) and to pursue innovation.

Global connectivity

The network of companies involved in developing and sustaining aerospace platforms has substantially increased as platforms have progressively moved towards a 'system of systems' model; the integration of avionics components and systems now dominates the capability definition of the overarching platform. Global connectivity is fundamental to ensuring ongoing aerospace platform sustainment, driven by significant technological advances and bespoke products subject to intellectual property constraints. The need to be globally connected has never been more important, whether with regard to spares, maintenance procedures or engineering assistance.

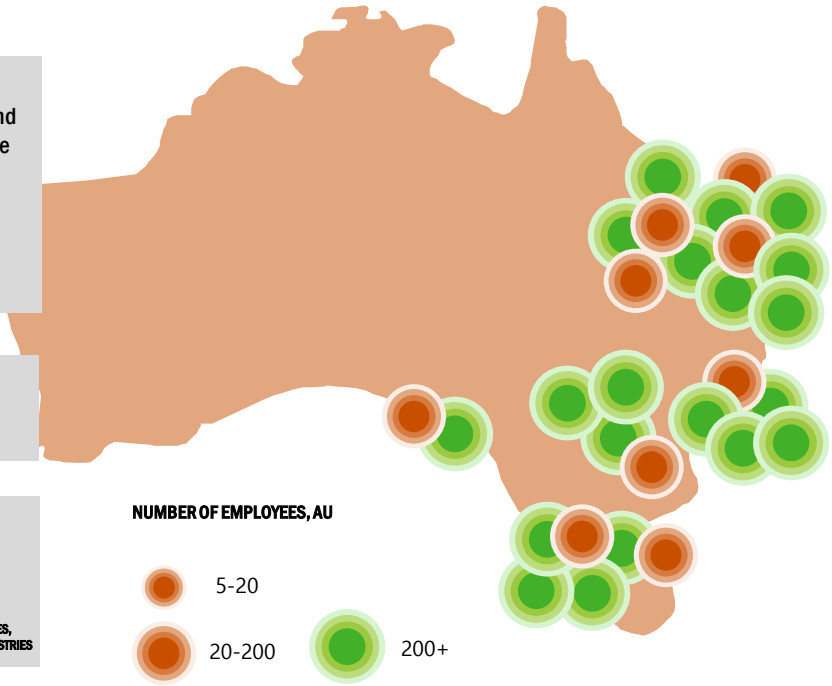
Global connectivity is critical to the viability and competitiveness of the Australian aerospace platform deeper maintenance sub-sector. The survey indicated that, on average, this sub-sector generates between nine and 11 per cent of their revenue from exports and that some small-to-medium enterprises rely on export markets for up to 50 per cent of their revenue.

Defence met with entities of all types in the development of this Plan, including academia and small-to-medium enterprises. The location on the map represents the head office of organisations consulted. Actual operations of these entities is conducted across Australia.

29 ORGANISATIONS ENGAGED

ORGANISATION FOCUS

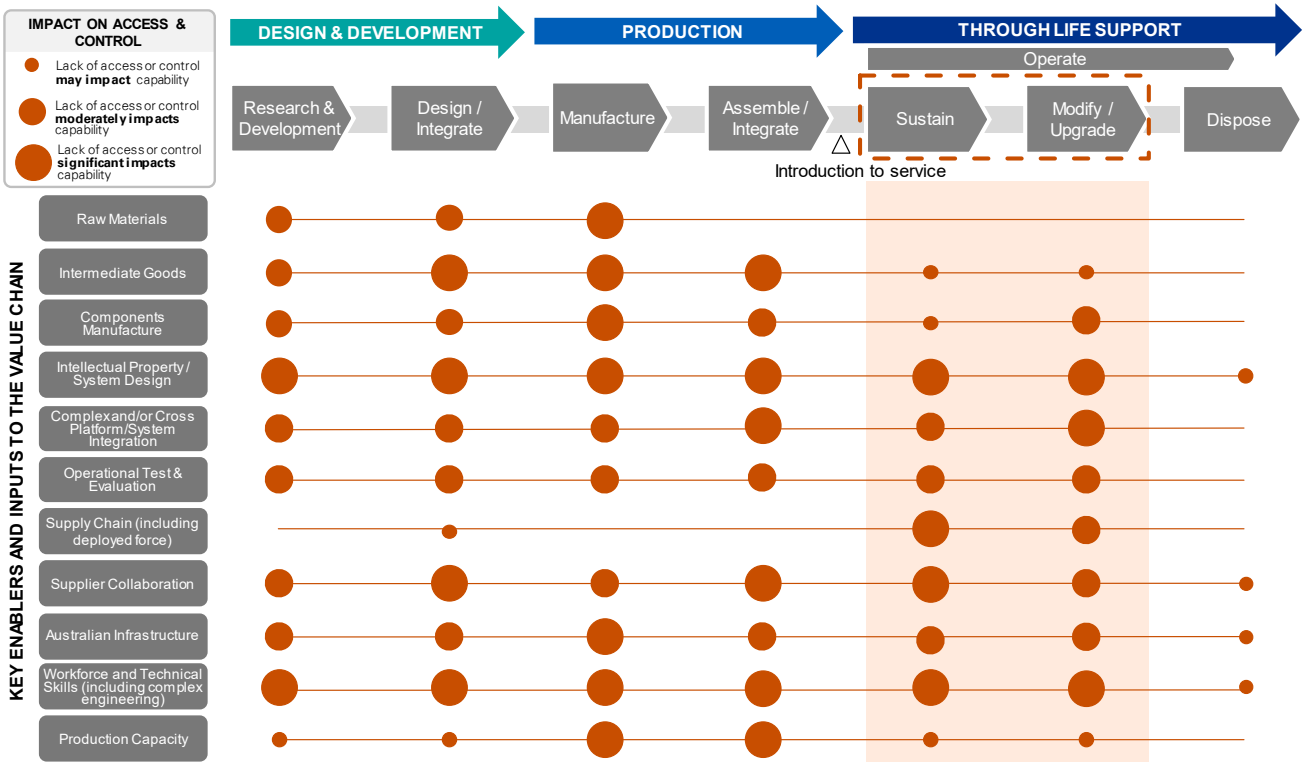
7	11	7	4
PLATFORM/ SYSTEM PRIMES	MAJOR SERVICE PROVIDERS	SMES	PROFESSIONAL SERVICES, ACADEMIA, ADJACENT INDUSTRIES



Industry value chain

Companies supporting aerospace platform deeper maintenance and structural integrity in the defence sector are a subset of the broader aviation sector operating in the through-life support portion of the end-to-end value chain. Upstream activities (research and development, design and integrate, and manufacture and assemble/integrate) all occur in the Australian market to varying degrees. With some notable exceptions, these upstream activities have declined over the past 50 years. More recently, this portion of the sector has been bolstered by concentrated efforts associated with the Joint Strike Fighter program, securing significant opportunities for Australian companies, and by a groundswell of innovation associated with remotely-crewed aerial systems (ranging from hand-held micro-systems to full-size aircraft, such as Loyal Wingman). This Plan acknowledges components of the industrial base involved in stages of the capability life cycle other than sustainment, as well as those providing through-life support other than deep maintenance.

The Defence value chain (below) presents the activities involved in the design, development, production, and through-life support for the capabilities defined within this Priority. Enablers and inputs to each activity are assessed for their relative impacts, with a view to understanding the strengths and weaknesses of the domestic industry as well as determining any action needed to ensure that Defence has the access, or control, it needs in relation to this Priority.



Defence and industry both contribute to infrastructure, technology, knowledge and intellectual property across the value chain, but there are areas of delineation between the contributions. Defence will provide specifications and requirements to industry, while industry will continue to perform the design, manufacture and integration of a platform. Platform and system original equipment manufacturers will use their own processes and technologies to design, manufacture and assemble. Defence's contribution peaks during operations, as Defence takes on the owner/operator role of the platform. Sustainment activities need to comply with original equipment manufacturer needs (including supplier certification and quality assurance expectations), as well as meet and integrate into Defence processes.

The scope of aerospace platform deeper maintenance and structural integrity management focusses on the sustainment, modifications and upgrade sections of the value chain. Movement through the aerospace value chain often takes place over a considerable period of time. The time from initial design to entry into service, could be as long as 10 to 20 years and the operate phases will last in excess of another 20 to 25 years. Historically, aerospace platforms had a high degree of customisation to suit each operator, which necessitated customised sustainment activities as well. More recently, Defence has sought increased commonality with global fleets and integration standards. This requirement provides further opportunity for industry.

Industrial processes supporting aerospace deeper maintenance

State distribution of employment in Australian Bureau of Statistics-identified businesses operating in related areas, 2018

Australian economics data does not directly identify or relate to the aerospace platform deeper maintenance and structural integrity industry, and there are no direct correlations with the industrial classifications that underpin this Priority. However, an understanding of the composition of the broader industrial group does provide insights, as the aerospace sub-sector is expected to share workforce, raw materials and specialist machinery with other sub-sectors. Accordingly, six industrial processes, leveraging Australia/New Zealand Standard Industrial Classifications, are reflected in the above graphic and discussed in detail below. Of these, the 'Other Transport Equipment Manufacturing (Aircraft Manufacturing and Repair Services)' is directly relevant to aerospace platform deeper maintenance and structural integrity, while the five others cover related industrial processes.

Other Transport Equipment Manufacturing (aircraft manufacturing and repair services)

The inputs into the aircraft manufacturing industry rely heavily on domestic professional, scientific and technical services, and the wholesale trade industry. Other major inputs include manufacturing imports from several industries, such as polymer product, non-ferrous metal, and specialised and other machinery. The vast majority of outputs are for the capital goods, and air and space transport industries.

Industry observations

- There are 3,300 Other Transport Equipment Manufacturing businesses identified nationally, with 30 per cent located in NSW, 30 per cent in Queensland and 76 per cent concentrated on the east coast. Approximately 14 per cent are located in Western Australia. In terms of business size, the vast majority of businesses employ less than 20 workers. Only four per cent of Other Transport Equipment Manufacturing businesses employ 20 or more workers.
- Over 80 per cent of the workers in this group have completed qualifications outside of high school education, with 56 per cent having qualifications in engineering and technology. The average salary of workers in this industry in 2017-18 was approximately $87,000 per annum. The industry is small, with a well-paid and highly educated workforce.

Table 2: Industrial processes supporting aerospace platform deeper maintenance

Area	Summary	Observations
Computer systems design and related services	More than a quarter of the inputs in computer systems design and related services come from professional, scientific and technical services, which is almost wholly domestically sourced. This industry group provides business support functions, in terms of database administrators, software programmers, security specialists and information communication technology professionals. Review of the industry demonstrates that it is a large, well-paid sector and does not appear to require significant actions to ensure long-term domestic sustainment.	• There are over 51,000 computer system design and related services businesses identified nationally, with almost 40 per cent located in NSW and 85 per cent on the east coast. Only two per cent of computer system design and related services businesses employ 20 or more workers. • Over 35 per cent of the workers in this industry group have qualifications in information technology or computer science, and 11 per cent of this group have business management qualifications. This is proportionately higher than any of the other related groups. The average salary of workers in this industry in 2017-18 was approximately $92,000 per annum. This is the most highly concentrated group, with the top 10 occupations making up 65 per cent of the group.
Computer, simulation and communication equipment and antenna manufacturing	Almost half of all inputs into the professional, scientific, computer and electronic equipment manufacturing industry are from the same industry, with almost all of the inputs being imported. The other major inputs come from wholesale trade and professional, scientific and technical services, almost all of which are sourced domestically. This industry group consists of a large number of occupations, including product assemblers, electronics trade workers and technicians and logistics clerks. Review of the industry group shows it does not appear to require any significant government actions to ensure long-term domestic sustainability.	• There are 1,300 computer and electronic equipment manufacturing businesses identified nationally, with approximately one third located in NSW and one third in Victoria. 82 per cent of all businesses in this group are located on the east coast. Businesses tend to be relatively small, with 44 per cent employing one to 19 workers while just under eight per cent employed 20 or more workers. • The industry is relatively small, with a highly educated workforce, comparatively high average salaries, and an industry annual output valued at over $50 billion. The potential loss of domestic capability in this industry is low.
Electrical equipment manufacturing	A significant amount of inputs from the electrical equipment manufacturing industry are sourced from overseas, including within the industry group, professional, scientific, computer and electronic equipment manufacturing and non-ferrous metal manufacturing. Occupations in this group include electricians, production assemblers and workers.	• There are just under 1,400 electrical equipment manufacturing businesses identified nationally, with 33 per cent located in NSW and 84 per cent concentrated on the east coast. • Only 66 per cent of the workers in this group have completed qualifications outside of high school education, and 38 per cent have completed qualifications in engineering and technology. The average salary of workers in this industry in 2017-18 was approximately $70,000 per annum. There is a diverse spread of occupations within this category, with the top 10 occupations making up less than 45 per cent of the employment in this industry. The largest group, electricians, only make up nine per cent of this workforce.

Area	Summary	Observations
Machinery and equipment repair and maintenance	Less than 30 per cent of all inputs in the 'other repairs and maintenance' industry are imported. Most imports come from the professional, scientific, computer and electronic equipment manufacturing, and specialised and other machinery and equipment manufacturing industries. The industry comprises trade workers and support staff such as clerks and service managers. Review of the industry considerations below shows that the low average salaries and limited occupational roles may result in a potential vulnerability to workforce sustainment.	• There are over 15,000 machinery and equipment repair and maintenance businesses identified nationally, with almost 33 per cent located in NSW and 78 per cent concentrated on the east coast. 12 per cent are located in Western Australia. • 50 per cent of all workers in this group have some form of engineering and technology qualification, while 24 per cent have a high school education. The average salary of workers in this industry in 2017-18 was approximately $46,000 per annum. The workforce is concentrated, with the top six occupations in this industry accounting for 50 per cent of all workers. The largest categories are metal fitters, machinists and air conditioning and refrigeration mechanics. • While there are a large number of businesses, the average salary is low, the types of roles are limited and the focus on individual physical capability may lead to challenges in maintaining domestic workforce capability.
Specialised machinery and equipment manufacturing	A significant portion of the inputs in the specialised machinery and equipment manufacturing industry come from imports from within the industry and from iron and steel manufacturing. The largest two inputs, professional scientific and technical services and wholesale trade are sourced domestically. More than 50 per cent of the outputs are for the capital goods industry. The industry consists of occupations such as metal fitters, machinists and store persons. With a large output into the capital goods industry and a competitive average salary, domestic capability in this industry is expected to be sustainable, though reliance on imports such as iron and steel may affect the size and effectiveness of the industry.	• There are over 3,600 specialised machinery and equipment manufacturing businesses identified nationally, with 76 per cent concentrated on the east coast. Six per cent of specialised machinery and equipment manufacturing businesses employ 20 or more workers. • 75 per cent of the workers in this industry group have completed qualifications outside of high school education, with 29 per cent having completed qualifications in mechanical and industrial engineering and technology. A further 21 per cent have qualifications in some other form of engineering and technology. The average salary of workers in this industry in 2017-18 was approximately $67,000 per annum. The top 10 occupations in this industry make up less than 45 per cent of the employment, with the largest category, structural steel and welding trades workers, making up 13 per cent of the workforce.

Data source: Australian Bureau of Statistics catalogue number 81650

National capability overview

Aerospace platform deeper maintenance and structural integrity facilities are predominantly co-located with the main operating base for the platform, or close to operations. Structural maintenance requirements for the platform, together with the underlying airspace and runway limitations associated with the movement of aircraft, are the main factors driving co-location. To date, an in-country representative of the platform's original equipment manufacturer typically undertakes the majority of deeper maintenance. Component-level maintenance is more widespread, where respective component original equipment manufacturers or their approved organisations provide the majority of component maintenance.

Assets and infrastructure

Significant investment is necessary to establish facilities for aerospace platform deeper maintenance and structural integrity management, as well as for developing and using specialist skills. Commonwealth, State and Territory Governments have supported regional technology parks around Defence bases and industry-led deeper maintenance activities. Examples include Albatross Aviation Technology Park near Nowra and facilities around RAAF Base Richmond. Achieving the right balance of incentives to ensure long-term viability once these facilities are established can be challenging.

The majority of the aerospace industry is along the east coast of Australia. 31 per cent of this industry sector (over 300 enterprises) is located in Queensland, predominantly in south eastern Queensland. Original equipment manufacturers that support multiple platforms are usually dispersed, with a head office generally in Canberra or Brisbane. Small-to-medium enterprises often group around respective platform locations. A notable challenge in this context is establishing appropriate investment and facilities when the life of a new facility is generally beyond the life of respective platforms (approximately 20 to 35 years) and well beyond the duration of support contracts (typically between 5 to 10 years).

Global markets and access to supply chains

As outlined earlier in this Plan, Australia predominantly sources Defence's aerospace platforms from international partners. Acquisition arrangements for these platforms are either commercial or through Foreign Military Sales. Sustainment and aerospace platform deeper maintenance scope are now considered in the early phase of the capability life cycle. Coupled with the intellectual property constraints around advancing technologies, aerospace platform deeper maintenance and structural integrity increasingly relies on the international supply chain for component maintenance. In-country support for aerospace platform and component deeper maintenance is heavily reliant on access to intellectual property and relationships with the platform and component original equipment manufacturers.

Commercial imperatives and the bespoke nature of supported components are driving global supply chain structures in line with economies of scale. This has offered pockets of opportunity for industry seeking to engage in the regional/global supply of products through leveraging Defence platform acquisitions. One such example is the resurgence of second and third-tier aircraft component manufacturing under the Joint Strike Fighter program. Importantly, opportunity exists for Australian industry to supplement global supply chains as a second source supplier and offer redundancy and resilience to common platforms operating in the Indo-Pacific region. This increase in resilience is of shared strategic importance to Australia and international partners. The COVID-19 pandemic and an increasingly contested environment shapes and promotes this opportunity for Australia.

CASE STUDY

TAE Aerospace – Providing specialist Australian-based support to global original equipment manufacturers

TAE Aerospace is an Australian-owned maintenance and repair organisation, originally established in 2003 as Tasman Aviation Enterprises, which provided workshop services for the F-111 aircraft operated by the Royal Australian Air Force. TAE became an independent company in 2015 and has grown through work demand and acquisition of smaller businesses. Its core business is largely focused on military gas turbines, and, to a lesser extent, on smaller, commercial aircraft gas turbines, wheels and brakes.

TAE currently employs 350 people across Australia and the United States, providing a range of maintenance and repair services to military gas turbine engines for domestic and international customers. These include Australian aircraft and armoured vehicles, Indonesian and Malaysian aircraft, and United States aircraft engine support, as well as wheels and brakes for Qantas and Virgin Australia passenger aircraft.

TAE's core strategy is to position themselves to align with original equipment manufacturers as an independent maintenance and repair organisation, focusing on building open, long term relationships, and earning the trust of both Defence and the original equipment manufacturers.

Intellectual property protection is a major consideration, especially when TAE is engaged on several integrated products from multiple original equipment manufacturers in the same facility. The requirements for protection of intellectual property are often developed in consultation with the original equipment manufacturer, with consideration for TAE's specific circumstances, and can involve a variety of measures such as physical isolation, staff training, information communication technology systems, and regular audits.

"We understand gas turbine engines, we understand the relationships, the rules and the market… we'd like to become a propulsion centre of excellence for Defence and prime companies, so they don't need engineers in-house to do propulsion".

TAE partners with a variety of original equipment manufacturers, including General Electric, Pratt & Whitney, Rolls Royce, and Honeywell, providing original equipment manufacturer-endorsed solutions. Their independent capabilities, along with the Australian Industry Capability requirements, have led to TAE being approached by various original equipment manufacturers to engage on potential opportunities.

Aircraft manufacturing

Table 3 (below) shows a sample of total direct expenditure on goods and services by the Australian aircraft manufacturing industry sector in financial year 2016-17. During this time, this sector used over $3.1 billion of goods and services from other industries. Of the purchases from other industries, this industry group relies the most on professional, scientific and technical services, as well as wholesale trade, with these two industries being almost wholly domestically sourced, importing below five per cent of the sales in question.

Approximately 30 per cent of all inputs used by this industry are imported. These imports are largely from foreign providers of manufactured goods such as within-industry purchases and metal manufacturing.

Table 3: Aircraft manufacturing and related product direct expenditure on goods and services, 2016-17

Product	2016-17 ($m)	% imported
Basic non-ferrous metal manufacturing	153	83%
Professional, scientific, computer and electronic equipment manufacturing	123	82%
Electrical equipment manufacturing	73	91%
Aircraft manufacturing	72	62%
Other fabricated metal product manufacturing	41	58%

Source: Australian Bureau of Statistics input–output table (2016-17)

Consultations with industry and Defence have shown that while aerospace platform deeper maintenance shares similar underlying skills with aircraft component manufacturing, there is limited transition from manufacturing to maintenance. This is largely due to much of the manufacturing capability being several tiers down in the supply chain, well away from the point of integration. Defence and industry need to work collaboratively to seize increased opportunity for sustainment as the longest element of the capability life cycle.

Workforce and technical skills

In the commercial sector, aerospace platform deeper maintenance is predominantly performed offshore. However, aerospace platform deeper maintenance for Defence is normally undertaken at (or close to) the main operating base for the aircraft fleets, and the workforce tends to be localised and have a platform-specific focus. As a result, there is little cross-pollination or movement between commercial and defence industry workforces.

The aerospace platform deeper maintenance and structural integrity management workforce is ageing, with a limited influx of new talent to the sector. Enterprises tend to draw from one another, from the same limited pool of resources. This is in part due to the outsourcing of aerospace platform deeper maintenance for Defence platforms to industry since the 1990s, creating a reliance on industry in terms of hands-on maintenance skills. The conventional career path since then has been through Defence training or, more recently, through apprenticeship programs.

Industry cited challenges in retaining apprentices until the completion of their trades, obtaining necessary specialist skills over and above the basics that Aviation Australia offers, and the limited pool of apprentices that are drawn in through the Brisbane-based training organisation. This approach to apprentice training needs to be extended to equivalent initiatives in other states.

This Plan includes a government action on workforce skilling that endeavours to provide stability in the future workforce pipeline. The government action includes a focus on developing expert and specialist skills, investigating opportunities for enhanced workforce exchange models between Defence and industry, and aligning academia with areas of research and development that enhance the critical industrial capabilities of this Priority.

Industry will be also supported through the Government's JobTrainer skills package. This package, in partnership with the states and territories, will invest $2 billion in retraining and upskilling the Australian workforce, funding additional training places, and expanding and extending the Supporting Apprentices and Trainees wage subsidy. The wage subsidy is aimed at employing 100,000 new apprentices or trainees as part of the Government's economic recovery plan.

The implementation of the Defence Aviation Safety Regulations closely aligns maintenance of Defence aerospace platforms with commercial aviation safety regulators, such as the Australian Civil Aviation Safety Authority and the European Aviation Safety Authority. The Government expects this new Defence Aviation Safety regulatory framework to enable skills development and certification through more commercially aligned practices.

Technical skills and workforce requirements within aerospace platform deeper maintenance and structural integrity management are also extending into specialist supply and logistics skills, technical data management, avionic, airframe, engines and life support fitters.

CASE STUDY

F/A-18A/B Classic Hornet structural refurbishment – sovereign skills driving efficiency and improving capability

Structural refurbishment of Defence's ageing Classic Hornet fleet through Phase 3 of the AIR 5376 Hornet Upgrade Program provides an example of the considerable value a sovereign aerospace platform deeper maintenance and structural integrity capability can deliver. This value is expressed in terms of affordable and optimal sustainment solutions for a critical Defence capability.

AIR 5376 Phase 3 was tailored to the unique capability needs of Australia's Classic Hornets and focused on assuring fleet safety, reducing cost and optimising aircraft availability through to the platform's planned withdrawal date. The project was delivered by Defence Science and Technology Group, QinetiQ and Boeing Defence Australia in partnership with the Capability Acquisition and Sustainment Group and the Defence Aviation Safety Authority.

Phase 3 was designed to rectify fatigue degradation in the airframe's fracture critical aluminium structure accrued during the first half of the airframe's design service life, and initially comprised multiple phases of discrete structural modifications and inspections as well as the planned replacement of the airframe's centre barrel on up to 49 of Defence's 71 Classic Hornet aircraft. Centre barrel replacement was to be completed overseas at a cost of over $10 million per airframe and required the removal of each aircraft from service for over a year.

Following a technical risk assessment conducted by Defence Science and Technology Group, an opportunity was identified to optimise the Phase 3 program for Australian requirements through the establishment of a world-leading Australian structural integrity science and technology program. In response, the Defence Aviation Safety Authority and Defence Science and Technology Group devised a comprehensive full-scale fatigue test and structural analysis program, which was completed by a joint Defence and industry team.

Ultimately, the Phase 3 program was able to increase airframe life limits by 10 per cent and significantly reduce the scope of required structural modifications with only 10 of 49 planned centre barrel replacements required to meet planned withdrawal date objectives. The total benefits realised under Phase 3, including avoided modification costs and aircraft availability savings, have been estimated at $443 million[7].

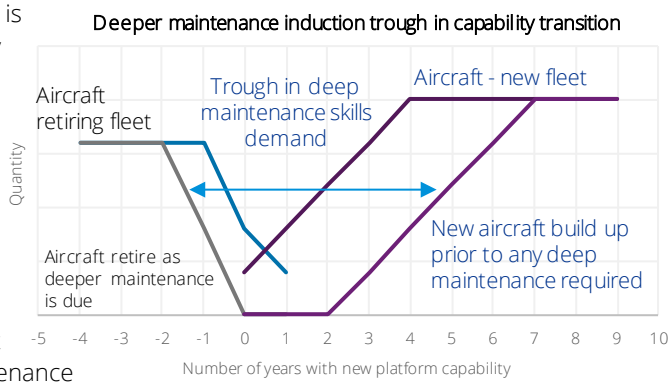
Defence's ability to generate such high impact structural integrity and deeper maintenance solutions was a direct result of the cumulative depth and breadth of structural integrity experience, infrastructure and specialist technical staff in Australia.

[7]ACIL Allen Consulting (August 2015), Economic Impact Case Studies: Establishing The Broad Economic Value of the Defence Science and Technology Program

Risks to domestic industry

Workforce clustering and demand in capability refresh cycles

While maintenance accreditation within Defence is platform-specific, there is a general tendency and ability for the aerospace platform deeper maintenance workforce to transition from one platform to the next iteration. The Defence Aviation Safety Regulations may further support this trend and alleviate some of the previous transitional challenges from old to new platforms. Nevertheless, there is a skills demand trough as one platform is decommissioned and another enters service. As platforms are decommissioned, workforce numbers reduce. Aircraft are also generally retired just prior to major aerospace platform deeper maintenance servicing. This typically leads to aerospace platform deeper maintenance skills demand declining a few years prior to Defence withdrawing all remaining aircraft from service.



New aircraft brought in to replace the old (assuming continuation of the core capability) are generally introduced gradually and do not require any aerospace platform deeper maintenance to be conducted for their first few years of service. These two factors create a two to five-year trough in demand, during which time much of the workforce either moves to another platform, which may be in another location, or is lost to the aerospace sector altogether.

A significant focus on staff skills retention through redeployment or temporary transfer of skills is necessary to maintain a robust pool of skilled resources, together with a significant investment in up-skilling of new and old staff in transitioning to a new capability. Timing across operational and support organisations (Defence and industry) are key elements to ensure the experienced 'trough' does not significantly diminish the skills base.

Australian-based support

While industry conducts aerospace platform deeper maintenance in Australia, overseas venues generally conduct component and specialised maintenance in support of aerospace platform deeper maintenance. Some aerospace platform deeper maintenance skills are becoming more specialised in line with ongoing advancements in technology and processes. Training through the respective original equipment manufacturer is often the only channel to develop these skills, over and above the basic skills of an aviation maintenance technician. Together with an ageing workforce, Australian industry is at risk of falling behind the skills curve and becoming solely reliant on overseas capability alternatives.

Further, global and regional support solutions and supply chains are a commercial reality for the highly specialised components within Defence aerospace. The establishment of Australian-based support solutions can be commercially challenging for industry, with relatively high wages and infrastructure costs cited as key factors. Notwithstanding these challenges, Australian-based skills add key value and flexibility in delivering and supporting capability, particularly with respect to customised and integrated elements within the unique Australian environment.

CASE STUDY

Applied Fasteners and Tooling – an Australian company providing big value across platforms and domains

Applied Fasteners and Tooling provides fasteners, tooling, and support and test equipment across multiple platforms and domains, including other industries delivering aerospace platform deeper maintenance. In recent years, this has included Defence land vehicles, various maritime fleets and the F-35 Joint Strike Fighter program. They also service a variety of sub-contractors in the Australian defence industry. Applied Fasteners and Tooling has expanded from a modest offering when it formed in 2014, to now providing whole of life support with design, prototyping and early stage manufacture of high-end assemblies and fasteners, as well as through life support for their products.

By positioning their business between platform integrators and original equipment manufacturers, it has developed a value proposition not only to Defence, but also to defence industry and the broader commercial market. This type of diversification creates synergy and a pipeline of opportunity as Defence looks more to industry and commercial markets to address sustainment issues, including deeper maintenance, in innovative ways.


RESCUE

BUILDING INDUSTRIAL CAPABILITY

Industry capability enablers

The ability to generate each of the critical industrial capabilities identified in this Plan relies on a range of enablers, tangible and intangible assets, behaviours, and other inputs. Like the critical industrial capabilities themselves, these enablers may need to be accessed or controlled by Defence in order to protect our sovereign interests.

Broad consultation with Defence and industry, analysis of the aerospace deeper maintenance value chains, and consideration of the ADF's outlook, identified the following seven enablers that contribute to aerospace platform deeper maintenance and through that, to Defence's warfighting capabilities.

- Access to design, engineering, and maintenance-related intellectual property technical data and operational performance condition data supporting aerospace platform and component deeper maintenance.
- National multi-purpose and cross-platform infrastructure development for the conduct of aerospace platform deeper maintenance and structural integrity management.
- Innovative, flexible contracting that promotes and enables contracts across multiple platforms and encourages the realisation of economies of scale for management facilities established within Australia.
- Sustainment focus through the Smart Buyer approach in the early stages of the capability life cycle to ensure critical elements are established under commercial, cooperative and Foreign Military Sales programs.
- Working cooperatively with partner nations to establish shared management capability to leverage and enhance Australian skills, experience and capability.
- Enhanced collaboration between educational institutions and industry to enhance skills transfer that develops areas of critical need.
- Enhanced collaboration between Defence Science and Technology Group and academia to support relevant research and development.

It should also be noted that Australian-based component repairs offer bolstered supply chain resilience for platforms acquired and commonly operated with the United States, especially in the Indo-Pacific region. Through Government engagements, such the Australia United States Ministerial Consultations Defence Acquisition Committee, demand signals around initiatives and opportunities for Australian industry are becoming increasingly viable. Australian industry should continue to seize opportunities and investment through collaboration with United States primes and international suppliers.

Access to design, engineering and maintenance-related intellectual property and data supporting aerospace platform deeper maintenance

While the acquisition process provides access to some intellectual property, such as that incorporated or delivered through technical manuals, ongoing access to design-related intellectual property through the original equipment manufacturer is necessary to enable and manage the deeper maintenance on respective platforms. The ability to return the platform to serviceable status is constrained without this access. Securing greater access will enhance maintenance engineering analysis and skills through insights to the underlying fault mechanisms, lifting and operational limits.

Intellectual property access and the ability to transfer intellectual property to third parties (Australian subsidiaries and independent third parties) is therefore a key enabler for Australian industry participation.

Understandably, original equipment manufacturers keep tight control over their intellectual property. Aside from protection from competition, a rightful concern for original equipment manufacturers relates to ensuring potential industry participants have the necessary security infrastructure, process and discipline to protect and manage accessed intellectual property, all of which have cost implications. Defence will continue to work with industry to ensure enablers are available to provide improved sovereign industry capability for Australia.

Reliance on a single channel for all aspects of aerospace platform deeper maintenance increases supply chain fragility, and may limit the drive to efficiency and cost effectiveness. Improving access to intellectual property is key to building greater competition in the market, enabling Australian industry participation, improving skilling opportunities, and reducing that fragility in supply.

Government action

Intellectual property protection

Defence will review guidelines for acquisition of ongoing access to intellectual property underpinning deeper maintenance management requirements across the capability life cycle. This includes Defence transfer to third parties, to enhance Australian industry opportunities in deeper maintenance execution, structural integrity management, and innovation associated with deeper maintenance process and practices.

Timeframe for implementation: Mid-2021

Government action

Big data exploitation

Defence will explore opportunities to work with Australian industry to improve deeper maintenance efficiency and effectiveness through exploitation of data with emerging technologies such as artificial intelligence, digital twins and machine learning.

Timeframe for implementation: Late-2021

National multi-purpose and cross-platform infrastructure development for the conduct of aerospace platform deeper maintenance and structural integrity management

Infrastructure supporting aerospace platform deeper maintenance is expensive and specialised. Aerospace platform deeper maintenance facilities are characterised by specialist machinery and test equipment, repair and handling equipment, aviation fuel and specialist chemical management, security, and cyber security constraints integrating flight line operations and aircraft movement. Significant long-term investment is required to address the high capital costs associated with the establishment of such facilities. Defence typically determines what infrastructure is needed to support aerospace platform deeper maintenance at the point of acquisition. Defence determines this solution well in advance of the mature state of sustainment capability; the sustainment solution itself is usually secondary to underlying platform capability considerations during the acquisition process.

A sustainment focus and mindset from the earliest stages of the capability life cycle are critical to addressing these complexities. This will provide greater consideration of sustainment requirements and aligned industry capabilities at acquisition under both commercial and Foreign Military Sales programs. Consideration of sustainment solutions cannot be confined to individual project requirements and should consider the ability to take advantage of existing sustainment solutions and facilities. Where there remains a requirement for new facilities, opportunities should be sought for these facilities to be accessed by other programs.

The high cost of maintenance infrastructure presents a challenge for industry on a project-by-project basis. Small fleet sizes and increasingly reliable components compound this problem, making a return on investment unachievable unless high per-unit costs are accepted by Defence.

Government action

Commercial derivative deeper maintenance

Defence will undertake a review of deeper maintenance requirements for Boeing 737 derivative aerospace platforms (E-7 Wedgetail and P-8A Poseidon). This review will decide whether there are advantages to co-locate deeper maintenance of these platforms, including whether there are related advantages for Australian industry in this approach to deeper maintenance.

Timeframe for implementation: Late-2021

High facility establishment and operating costs can be mitigated by securing additional work through global or regional maintenance support contracts where other countries are operating the same platform. Confidence to proceed with a facility build under these circumstances also requires that other countries are willing to conduct this work offshore and are prepared to engage Australian suppliers when considering sustainment options. Alternatively, high facility costs can be more broadly distributed through the development of multi-platform facilities where similar components are supported across an array of ADF platforms.

Government action

Propulsion system expertise

Defence will explore potential synergies between aerospace propulsion and other industrial sector propulsion systems (e.g. energy and mining) to promote further growth in this area.

Timeframe for implementation: Late-2021

The effective management of structural integrity across a platform's life cycle also requires access to specific, high cost infrastructure. These facilities are primarily associated with the physical testing, both component and full scale, and analysis of airframe structure, propulsion systems, and mechanical components. Such infrastructure is currently shared across Defence Science and Technology Group, defence industry, and academia. The costs associated with the establishment and operation of this infrastructure can be mitigated through collaborative approaches and the development of multi-user facilities.

Government action

Enhance horizontal contracting opportunities

Defence will review how it develops acquisition strategies, conducts approaches to market, and uses Defence contracting templates in the aerospace domain to incentivise the exploration of cross-platform support opportunities developed by industry, including:

- early engagement with industry to enable and develop horizontal capability initiatives;
- providing opportunities across the acquisition process for cross-platform aerospace platform deeper maintenance and structural integrity management initiatives to be considered and explored with industry to inform development of support solution options; and

working with industry to develop contracting mechanisms that provide suitable investment timelines and drives capability performance.

Timeframe for implementation: Late-2021

The F-35 Lightning II Joint Strike Fighter sustainment opportunities are an exemplar of early participation in a program with a concentrated collaboration across government and industry to secure global and regional opportunities in manufacture and maintenance. Defence will work with industry to identify key decision points and strategies to incentivise infrastructure investment to support the ADF.

These opportunities can develop substantial sovereign capability if the significant complexity of implementation is managed across the enterprise. Solutions to bridge contractual, intellectual property, technical data, and cultural barriers will need to be developed collaboratively. Resolving these challenges will be important to ensure that the significant sovereign and overall value-for-money benefits are realised across the platform life cycle. This will also require agility through the development of fit for purpose and flexible support contracts.

Government action

Facilitation role in acquisition

Defence will review aerospace acquisition processes with a specific focus on:

- acting as a facilitator in driving the inclusion of local industry consideration through the early stages of the life cycle. This will enable the identification of sovereign industry options for inclusion in acquisition and sustainment solutions; and
- the level of Australian industry participation in cross-platform and aerospace platform deeper maintenance and structural integrity opportunities.

Timeframe for implementation: End-2021

Attraction of labour into the sector and development of targeted specialist skills

The highly technical nature of new-age platform components is changing workforce demands in terms of the skill sets necessary to conduct aerospace platform deeper maintenance.

Modern defence aviation platforms are characterised by complex integration of high-end flight, mission, and weapons systems. The nature of integrated systems requires the development of skill sets in the following areas:

- multi-function fault analysis;
- non-destructive testing;
- maintenance determination analysis;
- reliability and maintainability analysis;
- maintenance planning;
- the use of big data and artificial intelligence;
- fleet planning; and
- logistics analysis to understand and leverage supply chains.

Some of these skills, such as non-destructive testing and fault-finding, are routinely developed through trade programs. Others, such as maintenance requirements determination, data mining, data analysis, and spares optimisation, lend themselves to a mix of trade and tertiary education. Conversely, some specialised skills are component and trade-specific with local training and, at times, specialist training only attainable or able to be accredited through overseas original equipment manufacturer facilities.

Government action

Workforce skilling

Defence will facilitate relationships and joint investments between industry, aerospace education and training providers, academia, and ADF technical trade training establishments. The intent of this collaboration is to:

- attract, educate, and qualify new talent to defence aerospace industry, to provide stability in the future workforce pipeline;
- develop expert and specialist skills aligned to the critical industrial capabilities, including investigating opportunities for enhanced workforce exchange models between Defence and industry; and
- align academia to areas of research and development to enhance the critical industrial capabilities identified in this Plan, and include the critical science and technology capabilities related to this Priority in the One Defence Science and Technology Capability Pillar.

This action seeks to build a collaborative approach to the attraction and training of new talent into the aerospace sector and the ongoing professionalisation of those already in the sector.

Timeframe for implementation: Late-2021

CASE STUDY

Lockheed Martin Australia – supporting sovereign capability through small-to-medium enterprise engagement

Lockheed Martin Australia is the subsidiary of United States-based global aerospace, defence, security, and advanced technology company engaged in research, design, development, integration and sustainment of advanced systems, products, and services. Just under half of Lockheed Martin Australia's employees are directly involved in aerospace.

Lockheed Martin Australia's work in Defence covers combat systems integration of fixed and rotary wing systems, together with sustainment and surveillance across air, land, sea, and space domains. Aerospace projects include deeper maintenance of the PC-21 Pilatus trainer and MH-60R Seahawk fleets (both sub-contracted), the C-130J Super Hercules and F-35 Joint Strike Fighter, as well as ground systems such as the Tactical Air Defence Radar System, engineering support for the Jindalee Operational Radar Network, AIR 5428 Pilot Training System, and the AIR 6500 Joint Battle Management System.

Lockheed Martin Australia routinely looks to leverage Australian small-to-medium enterprise expertise to apply innovative and agile thinking to niche problems. They support their small-to-medium enterprise partners' capability growth by offering mentoring and support. This support has included sponsoring research, providing access to software systems, and offering advice to small-to-medium enterprises on how to manage intellectual property and business growth.

Small-to-medium enterprise partnerships with major primes can enable Australian industry to grow its experience and work on projects otherwise difficult to access. Funded research and development objectives can be invaluable to growing the sophistication of a smaller business, which have agile skill sets but require the support of a larger prime to ensure commercialisation and business viability.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ANNEX A. GOVERNMENT ACTIONS

This Industry Plan includes the following actions to be taken by Defence to support this Priority. Although responsibility has been attributed to a particular branch, group or agency, it is expected that a broader group of government stakeholders will participate in, or contribute to, an action. Funding of the government actions will be taken from existing departmental funding.

The actions which may be taken within Defence to support preparedness of the government workforce and infrastructure supporting this Priority are not included in this Plan.

Topic	Action	Responsible	Timeframe
Intellectual property protection	Defence will review guidelines for acquisition of ongoing access to intellectual property underpinning deeper maintenance management requirements across the capability life cycle. This includes Defence transfer to third parties, to enhance Australian industry opportunities in deeper maintenance execution, structural integrity management, and innovation associated with deeper maintenance process and practices.	Capability Acquisition and Sustainment Group	Mid-2021
Big data exploitation	Defence will explore opportunities to work with Australian industry to improve deeper maintenance efficiency and effectiveness through exploitation of data with emerging technologies such as artificial intelligence, digital twins and machine learning.	Capability Acquisition and Sustainment Group	Late-2021
Commercial derivative deeper maintenance	Defence will undertake a review of deeper maintenance requirements for Boeing 737 derivative aerospace platforms (E-7 Wedgetail and P-8A Poseidon). This review will decide whether there are advantages to co-locate deeper maintenance of these platforms, including whether there are related advantages for Australian industry in this approach to deeper maintenance.	Air Force	Late-2021
Propulsion system expertise	Defence will explore potential synergies between aerospace propulsion and other industrial sector propulsion systems (e.g. energy and mining) to promote further growth in this area.	Capability Acquisition and Sustainment Group	Late-2021

Enhance horizontal contracting opportunities	Defence will review how it develops acquisition strategies, conducts approaches to market, and uses Defence contracting templates in the aerospace domain to incentivise the exploration of cross-platform support opportunities developed by industry, including: • early engagement with industry to enable and develop horizontal capability initiatives; • providing opportunities across the acquisition process for cross-platform aerospace platform deeper maintenance and structural integrity management initiatives to be considered and explored with industry to inform development of support solution options; and • working with industry to develop contracting mechanisms that provide suitable investment timelines and drives capability performance.	Capability Acquisition and Sustainment Group	Late-2021
Facilitation role in acquisition	Defence will review aerospace acquisition processes with a specific focus on: • acting as a facilitator in driving the inclusion of local industry consideration through the early stages of the life cycle. This will enable the identification of sovereign industry options for inclusion in acquisition and sustainment solutions; and • the level of Australian industry participation in cross-platform and aerospace platform deeper maintenance and structural integrity opportunities.	Capability Acquisition and Sustainment Group	Late-2021
Workforce skilling	Defence will facilitate relationships and joint investments between industry, aerospace education and training providers, academia, and ADF technical trade training establishments. The intent of this collaboration is to: • attract, educate, and qualify new talent to defence aerospace industry, to provide stability in the future workforce pipeline; • develop expert and specialist skills aligned to the critical industrial capabilities, including investigating opportunities for enhanced workforce exchange models between Defence and industry; and • align academia to areas of research and development to enhance the critical industrial capabilities identified in this Plan, and include the critical science and technology capabilities related to this Priority in the One Defence Science and Technology Capability Pillar. This action seeks to build a collaborative approach to the attraction and training of new talent into the aerospace sector and the ongoing professionalisation of those already in the sector.	Air Force/ Defence Science and Technology Group	Late-2021


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ANNEX B. SUPPORT THROUGH INDUSTRY PROGRAMS

This section discusses the support available to current and aspiring defence industry contributing to this Sovereign Industrial Capability Priority and other Defence capabilities.

Defence innovation system

The Centre for Defence Industry Capability, the Defence Innovation Hub and the Next Generation Technologies Fund comprise the integrated Defence innovation system, helping encourage innovation and growth in Australian industry. This system will support companies that contribute to this Priority to further innovate and position themselves to better support the ADF. The *2020 Force Structure Plan* aims to bridge the divide between technology development and acquisition by strengthening the link between Defence's capability plans with industry policy initiatives, Defence's reform program, the *More, Together: Defence Science and Technology Strategy 2030* for innovation, and clear resourcing plans. These programs have been bolstered by various measures in the Government's economic recovery package; aimed at supporting economic recovery from COVID-19 through targeted investment in key manufacturing, construction and high-tech sectors of defence industry, and increased funding for Defence innovation, industry grants, and skilling.

Centre for Defence Industry Capability

The Centre for Defence Industry Capability remains the entry point for Australian businesses either working in, or looking to enter the defence sector. They provide advice to industry on what initiative will best assist them, depending on their stage of product development. The Centre has specialist business facilitators situated in capital cities around Australia who can be contacted to discuss opportunities related to this Priority. The Centre also provides guidance on business improvement, skills development, Defence market preparedness, and export and supply chain support.

The Centre administers multiple grant programs, including:

- Capability Improvement Grants of between $4,000 to $240,000 for small-to-medium enterprises to fund part of the cost to engage a consultant or expert to assist with skills and training, build the capability of the existing workforce, and meet specific business needs. Under the *Defence Industry Skilling and Science, Technology, Engineering and Mathematics Strategy*, the Centre will be offering skilling support grants to defence industry small-to-medium enterprises to reduce barriers of skills and retraining their workforce.
- Defence Global Competitiveness Grants of $24,000 to $240,000 for small-to-medium enterprises to fund up to half the cost of projects that are building their defence export capability. The grants aim to promote a stronger, more sustainable and globally competitive Australian defence industry.
- Sovereign Industrial Capability Priority Grants program was established in November 2018. The grants program allows Defence to improve the resilience of a Priority by providing funding to industry to ensure that Australian small-to-medium enterprises have the appropriate capacity and resilience to support Defence's critical capabilities. Grants of up to $1.4 million are available to fund capital equipment purchases (including specialist software and security infrastructure), non-recurring engineering costs, design activities directly related to the project; and workforce training and accreditation directly related to the project. The grants are capped at $4.2 million over three years. These grants directly subsidise the growth of industrial capabilities underpinning the Priorities and are for more mature companies that are able to fund at least 30 per cent of the funding.
- Skilling Australia's Defence Industry grants provide businesses servicing the defence sector with funding of up to $500,000 to undertake upskilling and training opportunities to build skills capacity and capability to meet current or future Defence needs. These grants will reduce the barriers faced by defence industry in upskilling or retaining their people, by offering financial support for training in trade, technical and professional skillsets.

More information is available at: https://www.business.gov.au/CDIC/Grants-for-defence-industry and https://www.business.gov.au/Grants-and-Programs/Skilling-Australias-Defence-Industry

Defence Innovation Hub

The Defence Innovation Hub brings together defence industry, academia and research institutions to collaborate on innovative technologies that can be developed into capability for Defence. Funded at over $800 million over the next decade, the Defence Innovation Hub accepts proposals that are ready to enter the engineering and development stages of the innovation process, from concept exploration and technology demonstration to prototyping and integrated capability demonstration and evaluation. The Defence Innovation Hub regularly reviews and publishes its innovation priorities to help innovators plan their research and development activities.

More information is available at: https://www.business.gov.au/centre-for-defence-industry-capability/defence-innovation/defence-innovation-hub/defence-innovation-hub-priorities

Next Generation Technology Fund

Science and technology is a significant priority and Defence has to be prepared for the next revolution in the way war is fought. The Government has invested more than $164 million in 204 research activities and will make further investments worth approximately $1.2 billion over the next decade, through the Next Generation Technology Fund. This forward-looking program focusses on research and development in emerging and future technologies for the 'future Defence Force after next'.

The Next Generation Technology Fund supports a number of collaboration initiatives such as the Emerging Disruptive Technology Assessment Symposium and the Industry Competitive Evaluation Research Agreement Initiative. These aim at bringing together the best thinkers in Australia on a particular topic and facilitating collaboration between Defence, industry and academia. There are a number of funding initiatives managed through the Next Generation Technology Fund that companies who contribute to this Priority may wish to leverage. These include:

- The Small Business Innovation Research for Defence Program provides opportunity to Australian small-to-medium enterprises to undertake research projects that will benefit Defence in the future. Successful project outcomes might be commercialised directly by the participant, be the subject of a separate development support application with the Defence Innovation Hub, or be adapted to support other Next Generation Technology Fund ventures, such as the Industry Competitive Evaluation Research Agreement Initiative.
- The Small Business Exploratory Program accelerates promising science and technologies of interest to Defence, from early-stage concept, to a point where a proposal could be submitted to the Defence Innovation Hub. The Centre for Defence Industry Capability gives advice as to whether a technology idea could be eligible for funding from the Next Generation Technology Fund.

More information is available at: https://www.dst.defence.gov.au/NextGenTechFund

Capability Acceleration Fund

To ensure Defence's innovation system has the capacity to meet the demands of future technological developments, a new Capability Acceleration Fund will be introduced from the middle of this decade. Through this fund, the Government will invest over $130 million to support the intensive development of key disruptive technologies beyond the early-stage research and demonstration stages, taking promising technologies all the way through to acquisition. This will bring together industry participants, Defence personnel and technical subject-matter experts to provide the support needed to build prototypes to demonstrate capability, and set requirements for future projects.

More information is available at: https://www.defence.gov.au/StrategicUpdate-2020/docs/2020_Force_Structure_Plan.pdf

Other Defence support opportunities

Australian Defence Export Office

The *2018 Defence Export Strategy* supports companies in their endeavours, and to encourage more small-to-medium enterprises to pursue export opportunities. The Strategy outlines the Government's plan to support Australian defence industry to achieve greater export success to build a stronger, more sustainable and globally competitive industry to support Australia's Defence capability needs. Increasing access to international markets through exports will reduce the risk to industry of having a single customer in the ADF. It will also support industry's ability to sustain and grow their business through the peaks and troughs of domestic demand.

The Australian Defence Export Office provides a focal point for delivering the key initiatives of the strategy. The Office provides a coordinated approach to export support, working closely with Austrade, the Centre for Defence Industry Capability, the Department of Foreign Affairs and Trade, Export Finance Australia, state and territory governments, and Australian defence industry, to realise export success.

Support is tailored to industry on a case-by-case basis, including through the Australian Military Sales, Team Defence Australia, and policy and engagement functions. The Australian Defence Export Office has a number of initiatives that can be leveraged by industry, including:

- international advocacy for Australian defence industry exports;
- assistance from dedicated business development managers in key markets;
- attendance at Team Defence Australia trade shows;
- targeted international trade missions;
- government-to-government sales and transfer of equipment;
- inclusion in the Australian Military Sales Catalogue;
- Defence Global Competitiveness Grants (administered by the Centre for Defence Industry Capability);
- landing pads (administered by Austrade);
- Defence Export Facility (administered by Export Finance Australia); and
- market intelligence.

All companies seeking to export should be aware of their export control obligations.

More information is available at: https://www1.defence.gov.au/business-industry/export/australian-defence-export-office

Australian Industry Capability Program

The Australian Industry Capability Program has been established to support Australian involvement in Defence programs. The Government understands that Australian companies need to be incorporated into the supply chain of major contracts, particularly in the Sovereign Industrial Capability Priorities, to build an Australian industrial base. This strengthened Program supports industry via:

- requiring tenderers to have a transparent plan on how they intend on supporting innovation, technology transfer, research and development, veteran employment and indigenous businesses, prior to awarding a contract;
- independently auditing contractors' in delivering against their contracted Australian industry obligations; and
- providing greater contractual and non-contractual mechanisms to enforce Australian industry capability.

The Australian Industry Capability Program was expanded in 2019 to include non-materiel and infrastructure procurement.

More information is available at: https://www1.defence.gov.au/business-industry/programs/australian-industry-capability

Defence Civilian Undergraduate Sponsorship

The Defence Civilian Undergraduate Sponsorship is open to aspiring university students who wish to pursue a degree through the University of New South Wales – Canberra campus, at the Australian Defence Force Academy. There are no military service obligations or requirements - this is a sponsorship for civilian students who may be interested in a civilian career in Defence.

Defence takes applications annually, with undergraduate degree disciplines to be offered subject to change. In 2020, applications were being sought for the following options:

- Bachelor of Computing and Cyber Security (3 years); and
- Bachelor of Engineering (Mechanical, Electrical and Aeronautical) (4 years).

Eligible applicants will have the full tuition costs of their degree covered by a Defence sponsorship agreement, and receive a generous annual allowance to cover the cost of textbooks and equipment.

During the sponsorship students may have the opportunity to participate in paid work placements within Defence, which will provide exciting opportunities and give an insight into how one of Australia's largest organisations conducts business.

More information is available at: https://www1.defence.gov.au/jobs-careers/civilian-undergraduate-sponsorship

Defence TAFE Employment Scheme

The Defence TAFE Employment Scheme offers students a head start for their career in Defence by supporting their vocational education with practical, paid work experience that contributes to the protection of Australia's national interests.

As a participant on the Defence TAFE Employment Scheme, students will work as part of the Australian Public Service, where they will be provided with practical, relevant and high-quality work on a part time basis, while continuing their vocational education, and being paid a full-time salary.

In 2020, the following disciplines relevant to this Plan are being sought (noting these will continue to evolve):

- Victoria: Engineering – Mechatronics, Software Communications, Electrical, and Electronics;
- Australian Capital Territory: Engineering, Database Design and Development, Software Development and Logistics;
- South Australia: Engineering - Electronics and Communications, and Logistics;
- New South Wales: Engineering Database Design and Development, and Software Development; and
- Western Australia: Engineering.

More information is available at: https://www1.defence.gov.au/jobs-careers/TAFE-employment-scheme

External support and collaboration opportunities

Industry is able to access further support and collaboration opportunities with respect to this Priority through the organisations below. These opportunities are specific to this Priority, and not intended as exhaustive. Other schemes and programs are available at academic institutions, and across industry.

Modern Manufacturing Strategy

Make it Happen, the Australian Government's Modern Manufacturing Strategy notes the importance of the manufacturing for Australia, and outlines a range of activities the Government is delivering to drive productivity and create jobs for Australians, both now and for generations to come. Defence is listed as one of the six National Manufacturing Priorities, highlighting the importance of defence industry to the broader manufacturing sector.

More information is available at https://www.industry.gov.au/data-and-publications/make-it-happen-the-australian-governments-modern-manufacturing-strategy

Defence Materials Technology Centre

The Defence Materials Technology Centre facilitates cooperation with Australian industry, research and government agencies to advance technologies in Defence, and related sectors in manufacturing engineering and applied science. The Defence Materials Technology Centre aims to strengthen Australian industrial capacity, and Defence and national security capabilities.

The Defence Materials Technology Centre operates through a co-investment model, applying the funding from Defence or other Commonwealth agencies, and leverages additional contributions from industry and research partners. Because of this, the Centre works closely with Defence to identify capability changes and future needs. The Centre then engages with industry partners to find solutions with advancing key technologies.

The Defence Materials Technology Centre focuses on the following capabilities relevant to this Priority:

- new manufacturing technologies;
- performance modelling, simulation and validation;
- design, production and joining of new materials;
- component repair and fabrication technologies;
- robotics and automation technologies;
- repair and life extension technologies;

- prognostics and defect detection capabilities;
- weight reduction, design integration and lightweight materials;
- advanced ceramics and coatings; and
- smart textiles and fabric technologies.

More information is available at: https://www.dmtc.com.au/

Defence Science Institute

The Defence Science Institute was established in 2010 within the University of Melbourne and is funded by the Government of Victoria, Defence Science and Technology Group, and the University of Melbourne. The Institute harnesses the capabilities of Victoria's universities to deliver integrated, multi-disciplinary solutions for the defence sector and facilitate the growth of defence science research networks between academia, Defence Science and Technology Group, and defence industry. It aims to be a primary source for facilitating research and development connections that foster a globally engaged, competitive and innovative defence and national security sector.

The Defence Science Institute, guided by its advisory board and a research leaders' forum, oversees five research programs that align to Defence research priorities. These programs include human protection and performance, propulsion and energy storage, simulation and modelling, surveillance and autonomy, and cyber and information technology security. Each program is led by a senior researcher from Defence Science and Technology Group or academia, whom oversee the establishment of the relevant Defence Science Institute research projects.

The Institute does this by:

- enhancing Defence-relevant research and development engagement between universities, industry and Defence;
- identifying Defence-relevant research and technology development opportunities on behalf of Defence stakeholders;
- providing advice on the Defence research and development environment (priorities, capabilities, needs and gaps);
- connecting small-to-medium enterprises to research and expertise in order to strengthen their participation in Defence business; and
- promoting and showcasing research and development and innovation in the private and public sectors.

More information is available at: https://www.defencescienceinstitute.com/

Please direct any questions on the Sovereign Industrial Capability Priority policy or the information contained in this Industry Plan to:

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