SOVEREIGN INDUSTRIAL CAPABILITY PRIORITY
INDUSTRY PLAN

Combat Clothing Survivability and
Signature Reduction Technologies

December 2019
SICP
IMPLEMENTATION PLAN
Combat Clothing Survivability and Signature Reduction Technologies
We are pleased to release the Combat clothing survivability and signature reduction technologies Industry Plan, which is a key deliverable of the 2018 Defence Industrial Capability Plan.

This Industry Plan was developed in close consultation with experts from industry and Defence to unpack the industrial capabilities that need to be delivered or supported by Australian industry. Identifying the critical industrial capabilities will encourage a framework for investment in these capabilities and provides guide posts to Defence personnel on the importance of maximising Australian industry participation in relevant Defence contracts.

A long-term partnership between Defence and defence industry is key to enabling informed and timely decisions to be made with respect to our defence capability, including necessary investments in workforce, infrastructure or intellectual property.

This Plan addresses workforce and skilling requirements, and forecasts the technological developments that may impact on future defence capabilities. The Plan also outlines the broader defence industry and innovation initiatives available to support capability requirements, and lists key actions for Defence to assist the combat clothing and signature reduction sector.

A key priority for Defence is to ensure that our people receive the support necessary to succeed in their mission to defend Australia and its national interests. Australia’s defence industry is critical to enabling Defence preparedness and delivering warfighting advantage.

We would like to express our gratitude to the many Defence personnel and defence industry representatives who volunteered their time and expertise to support the development of this Plan. We look forward to continuing to build and strengthen our partnership in delivering the products and services needed to support our Defence Force.

Greg Moriarty
Secretary
December 2019

Angus J Campbell, AO, DSC
General
Chief of the Defence Force
December 2019
In 2018, through the Defence Industrial Capability Plan, Government identified the first ten Sovereign Industrial Capability Priorities (priorities). These priorities are critical to Defence and 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 to enable informed and timely defence capability decisions. Defence is focused on access to, or control over, essential skills, technology, intellectual property, financial resources and infrastructure within the Australian defence industrial base to preserve sovereign interests and realise the benefits associated with such interests. This Plan enables both Defence and industry to better understand opportunities and trade-offs associated with sovereign capability, and should be read in conjunction with the Implementation Plan.

Guidance to Government Readers:
This Industry Plan supports Government, Defence project managers, those involved in force design and others focused on 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 Australian industry to support this priority (pages 11-12).
- The capability enablers to protect Australian sovereign interests (pages 13-16). 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 to support planning and consultation, including preparing for and undertaking market solicitation, such as requests for information (pages 18-28).
- The actions to be taken by Government to support development of this priority (pages 25-27 and consolidated in 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 contribute to a priority (pages 8-9).
- Identification of the critical industrial capabilities and capability enablers related to this priority and Defence's intent to access or control particular aspects. This will support industry's business planning and investment decisions, as well as Australian Industry Capability Plans that align with Defence priorities.
- Existing support levers available to industry to develop Defence industrial capability (Annex B) and specific actions to be taken by Government to support this priority (pages 25-27 and consolidated in Annex A).
EXECUTIVE SUMMARY

The Australian industrial base that supports the Combat clothing survivability and signature reduction technologies Sovereign Industrial Capability Priority is a dynamic, diversified industry that has become a recognised world leader and innovator in protective technologies. The focus of this Industry Plan is to sustain current levels of capacity and encourage opportunities for the industrial base in local and international markets.

The industry producing combat clothing survivability and signature reducing technologies must constantly consider and balance issues of competition for skills, supply chain access, and the protection of Australia’s significant strength in research and development (R&D). Among these challenges, there are three specific areas of industry capability which have been identified as critical to capability delivery for Australian Defence Force (ADF). These critical industrial capabilities are:

1. ADVANCED MATERIALS
   The ability to develop and integrate advanced materials, protective element technologies and advanced multi-functional textiles is necessary to maintain a warfighting advantage. This is primarily delivered through protective technologies in the form of helmet systems, soft insert technologies and hard armour plates, utilising materials such as advanced ceramics, composites and advanced textiles.

2. DESIGN AND INTEGRATION
   The ability to integrate advanced, multi-functional materials into the design of the soldier combat ensemble for the purpose of developing stronger, lighter and more durable materials, coupled with cheaper, lower-energy production and manufacturing methods.

3. SIGNATURE REDUCTION
   The ability to develop signature reducing multi-spectral fabrics, coatings and materials which includes the continued exploitation of protection equipment and advanced textiles to integrate signature reducing technologies.

To ensure Australia retains the identified critical industrial capabilities, Government seeks to build the following enabling capabilities in partnership with industry over the next decade, starting with the Government actions listed in this Plan:

- **Test and evaluation**: ready access to domestic testing and evaluation enables Defence to rapidly understand product and integrated performance.
- **Intellectual Property (IP)**: Australian industry ownership of the IP associated with ballistic protection, multi-functional materials and signature reduction technologies is desired.
- **Foster agility and collaboration**: Agile and collaborative approaches are desired for product and system deployment.

The recognition of protective technologies, advanced materials and signature reducing textiles as a Sovereign Industrial Capability Priority provides industry with the confidence to invest in training, research and technologies, which will benefit the men and women serving in the ADF. This Industry Plan also includes support mechanisms available to businesses.
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 survivability, ballistic protection and signature reduction technologies. Success in implementing this Plan will enable the following industrial landscape in 2022-2024:

- The industrial base continues to invest in R&D with respect to materials, manufacturing processes and integrated solutions.
- The pathways to export markets are defined and supported, with Defence providing industry with timely advice and facilitating international business development opportunities.
- Collaboration among and between industry, academia and research organisations continues to increase, alongside enhanced confidence in the protection of IP and other assets.
- There is clarity with respect to Defence priorities, including what is valued most in its endeavour to deliver capability and achieve warfighting advantage (this includes innovation priorities).
- Defence has an agreed, communicable vision for the evolution of soldier protection systems and technologies, and the role of industry in this vision is clear.
- Ongoing engagement between Defence, industry and other contributors to this priority enables that vision to be realised, and by extension, generates benefits for the evolution of the holistic integrated soldier system.
- To the extent possible, barriers to entry for new, innovative start-ups are reduced, and processes to encourage further diversification and cross-sector participation are established.
- Smart Buyer objectives are achieved, in particular, agility and the ability for procurement strategies to be refined as new information – and technologies - become available.

Many of these outcomes require Government support in the form of business advice and advocacy, funding, access to collaborative research opportunities and where possible, user interaction and feedback.
Features of this Industry Plan

This Industry Plan describes the Combat clothing survivability and signature reduction technologies priority and specific sovereign capability requirements across four key areas. These areas are standardised across all Industry Plans, are presented in the diagram below and discussed throughout the Industry Plan.

Sovereign Industrial Capability Priority (SICP)
Combat clothing survivability and signature reduction technologies

- Critical Industrial Capabilities
  - Advanced materials
  - Design and integration
  - Signature reduction

- Enablers
  - Test & Evaluation capabilities
  - Intellectual Property
  - Agility and collaboration

- Government Actions
  - Intellectual Property
  - Support for Research & Development
  - Government opportunities in textiles
  - Access to new or existing markets and international supply chains
  - Defence Industry Security Program

- Available Support
  - Defence innovation programs
  - Other Defence support opportunities
  - External support and collaboration opportunities
# CONTENTS

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>SECRETARY OF DEFENCE AND CHIEF OF THE DEFENCE FORCE FOREWORD</td>
<td>1</td>
</tr>
<tr>
<td>EXECUTIVE SUMMARY</td>
<td>3</td>
</tr>
<tr>
<td>STRATEGIC Context</td>
<td>8</td>
</tr>
<tr>
<td>The case for a sovereign industrial base</td>
<td>8</td>
</tr>
<tr>
<td>Sovereign Industrial Capability Priority development</td>
<td>9</td>
</tr>
<tr>
<td>Policy framework</td>
<td>9</td>
</tr>
<tr>
<td>COMBAT CLOTHING SURVIVABILITY AND SIGNATURE REDUCTION TECHNOLOGIES</td>
<td>10</td>
</tr>
<tr>
<td>The integrated soldier</td>
<td>10</td>
</tr>
<tr>
<td>Critical Industrial Capabilities</td>
<td>11</td>
</tr>
<tr>
<td>Australian manufacture of the Standard Combat Uniform</td>
<td>12</td>
</tr>
<tr>
<td>Enabling the Critical Industrial Capabilities</td>
<td>13</td>
</tr>
<tr>
<td>Future evolution of the integrated soldier</td>
<td>16</td>
</tr>
<tr>
<td>CURRENT AUSTRALIAN INDUSTRY CAPABILITY</td>
<td>19</td>
</tr>
<tr>
<td>Australian industry attributes</td>
<td>19</td>
</tr>
<tr>
<td>Industrial processes supporting priority technologies</td>
<td>21</td>
</tr>
<tr>
<td>Combat clothing value chain</td>
<td>24</td>
</tr>
<tr>
<td>Risks to domestic industry</td>
<td>25</td>
</tr>
<tr>
<td>Australian ownership</td>
<td>29</td>
</tr>
<tr>
<td>ANNEX A. GOVERNMENT ACTIONS</td>
<td>31</td>
</tr>
<tr>
<td>ANNEX B. ADDITIONAL SUPPORT THROUGH INDUSTRY PROGRAMS</td>
<td>33</td>
</tr>
<tr>
<td>Defence Innovation System</td>
<td>33</td>
</tr>
<tr>
<td>Other Defence support opportunities</td>
<td>35</td>
</tr>
<tr>
<td>External support and collaboration opportunities</td>
<td>35</td>
</tr>
<tr>
<td>ANNEX C. ACRONYM LIST</td>
<td>37</td>
</tr>
</tbody>
</table>
STRATEGIC CONTEXT

The case for a sovereign industrial base

Sovereign industrial capabilities are capabilities considered to be operationally critical due to the strategic advantage they provide to the Australian Defence Force (ADF). They must be developed and supported by Australian industry because overseas sources do not always provide the required security or assurances of access and supply. When making capability decisions, Government considers how Australia will develop, maintain or enhance these capabilities and the degree of access to, or control over, we need now and into the future.

Sovereign Industrial Capability Priorities (priorities) are those industrial capabilities assessed as:
- operationally critical to the Defence mission;
- priorities within the Integrated Investment Program (IIP) 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 Priorities² are:

The Australian Government will, on a case by case basis, make judgements as to the optimal level of access to, or control over for each priority. It does not automatically mean the priorities have to be designed, developed, manufactured or maintained in Australia, and for each priority, the level of sovereignty, may vary. Defence sovereignty is made up of many elements, and may include:
- access to resident technical design capabilities, for example, to modify or upgrade systems;
- ability to test and assure equipment is operationally ready for service or to be returned to service;
- a degree of access to, or control over, the facilities, technologies and Intellectual Property (IP) that underpins defence capability within Defence and Australian industry;
- access to allied capability that supports our war fighting advantage; and/or
- ability to protect foreign-sourced, controlled technologies employed by the ADF.

² Full DICP descriptions: * Advanced signal processing capability in electronic warfare, cyber and information security, and signature management technologies and operations ** Surveillance and intelligence data collection, analysis, dissemination and complex systems integration
‘Access’ refers to the availability of key assets within Australia, able to be utilised by Defence, as and when required. ‘Control’ is obtained by Defence through ownership or exclusive rights to a critical asset such as specialist machinery or infrastructure.

The priorities represent a critical Australian defence industry capability. They identify a number of elements of the Australian defence industrial base at a capability rather than a company or technology level. This is to encourage innovation in existing technologies and provide flexibility in supporting the current and future critical industrial capabilities.

Sovereign Industrial Capability Priority development

The priorities were developed through a rigorous assessment framework that 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 (AIC) Program, into Government grants and initiatives to support industry directly. The AIC program remains the critical lever for Australian industry involvement in supporting the priorities and Defence’s broader capability needs.

Policy framework

The 2016 Defence White Paper sets out a comprehensive, long-term plan for the defence of Australia and its national interests. Australian industry will continue to play a major role in delivering on this.

The 2016 Defence White Paper is complemented by:

- the IIP, which outlines $200 billion of Defence capability investment and provides industry with the certainty to invest in people and infrastructure; and
- the Defence Industry Policy Statement (DIPS), which outline how we will strengthen partnerships between Defence and industry with a focus on closer alignment between industry investment and defence capability needs.

Industry’s role as a Fundamental Input to Capability was officially recognised in the DIPS, with Government formalising the pivotal role defence industry plays in generating military capability and supporting the ADF.
Australian industry must possess the ability to provide significant operational advantage through signature reducing characteristics and enhanced ballistic protection, incorporated into the soldier combat ensemble. Australian industry must be positioned to refine, enhance and upgrade stealth and survivability technologies to provide a level of force protection that gives our soldiers a warfighting edge.

The integrated soldier

The combat equipment worn by the soldier consists of various articles of protective and performance enhancing equipment such as a combat helmet, load carrying vest and field packs. Defence’s vision is a fully integrated Australian soldier with enhanced situational awareness, physiological and environmental senses, adaptive protection against ballistic and environmental threats, enhanced lethality, and proactive resupply systems to reduce the load carriage burden, and enable enduring mobility. Integration is a force multiplier that enables the system to deliver a capability greater than the sum of individual parts.

Defence’s focus on the ‘soldier as a system’ has been developed over the past decade. Today, a holistic approach is being taken to the management of the integrated soldier system and delivered through organisations such as Diggerworks and Integrated Soldier Systems Branch within Capability Acquisition and Sustainment Group (CASG), the Defence Science and Technology Group (DST) and a cross section of the Australian defence industry. This Industry Plan supports these Whole-of-Defence activities.

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3 Defence Industrial Capability Plan (2018)
Capability solutions

Survivability and signature reduction technologies are core sovereign industrial capabilities that Australia must have access to, or control over, to ensure ADF combatants have a significant and critical operational advantage. This advantage is generated through survivability and signature reducing technologies incorporated into the Soldier Combat System (SCS).

**Survivability technologies** in the form of steel, ceramic and composite armour plates, and ballistic fibre armour inserts (including aramid, high molecular weight polyethylene and nylon), shield personnel from blast, ballistic penetrators and fragmentation materials. These technologies are worn by individual soldiers as a ‘system-of-systems’ to absorb the impact energy of projectiles and impede fragment penetration from both the projectile and the armour plate itself.

**Signature reducing technologies**. In the context of the soldier, is the concept of avoiding detection by reducing the visual, near-infrared wave and thermal-infrared bands of the ground combatant on the battlefield. Multi-spectral camouflage and concealment includes the use of fabrics, materials, textiles and face paints that passively and actively reduce signatures.

Australian industry provides a number of these capabilities to ADF combatants and collaborates with local partners and overseas suppliers to deliver technological evolutions. The ongoing evolution of the Soldier Combat Ensemble (SCE), and in particular, the Tiered Body Armour Systems, has demonstrated the effectiveness of Defence and industry working together to refine, enhance and upgrade soldier wearable equipment. Working together, equipment can be developed to effectively cater for the different roles and tasks of combatants, taking into consideration feedback from user trials and operational deployments.

Critical Industrial Capabilities

The critical industrial capabilities are the industrial capabilities that underpin the Sovereign Industrial Capability Priorities. They are priority-specific industrial capabilities that Australia seeks a level of access to, or control over. The critical industrial capabilities could be an essential skill, technology, IP, financial resources, infrastructure or some other industrial element. It is these capabilities that we need to protect to ensure the ADF’s capability advantage.

When considering the development and production of the SCE, three critical industrial capabilities have been identified for the Combat clothing survivability and signature reduction technologies priority. These underpin the ability to leverage current, emerging and disruptive technologies to develop capabilities which are ready for acquisition and integration into the existing and future integrated SCE.

**ADVANCED MATERIALS**

The ability to develop and integrate advanced materials, protective element technologies, and advanced multi-functional textiles is necessary to maintain a warfighting advantage.

Protection from fragmentation, blunt impact, blast overpressure, environmental, stab and spike threats are primarily delivered through protective technologies in the form of helmet systems, soft insert technologies, and hard armour plates, utilising materials such as advanced ceramics, composites and advanced textiles.

Australia’s industrial base for these technologies is characterised by strong global integration through the:

- leverage of foreign IP, materials and resources to develop, integrate or modify equipment for different operating environments, as well as a wide range of climatic conditions; and
- manufacturing of components and systems completed either partially or wholly offshore.

**DESIGN & INTEGRATION**

The ability to integrate advanced, multi-functional materials into the design of the soldier combat ensemble.

The pursuit of stronger, lighter and more durable materials, coupled with cheaper, lower-energy production and manufacturing methods is anticipated to facilitate wider use of specialised materials. For ballistic protection, these materials could include ceramics, steel alloys, high strength fibres and ceramic-metal composites. For multifunctional materials, this could include surface functionalisation technologies, metamaterials and biomaterials.

Fundamental to this industrial capability is the possibility that evolving manufacturing technologies and processes can deliver weight reductions and enhanced performance for ground combatants. The supply base needed to generate this capability already exists in Australia.
SIGNATURE REDUCTION
The ability to develop signature reducing multi-spectral fabrics, coatings and materials, which includes the continued exploitation of protective equipment and advanced textiles to integrate signature reducing technologies.

This industrial capability supports the continued exploration of ways textiles and face paints can be used to reduce thermal infrared (IR) signature. This will ultimately protect and prevent the detection of soldiers against multi-spectral and hyperspectral sensor threats in the visual, near IR, short wave IR, mid-wave and long wave thermal IR spectrums.

Traditionally, camouflage printed fabrics have been used to assist combatants avoiding detection in operational environments. Increasingly, more advanced computer and chemical technologies have enabled the development and testing of advanced fabrics which integrate signature reducing technologies into protective clothing. Continued exploitation of these technologies will enable broader application (i.e. modified coatings, different weaves and fabrics) in more diverse environments such as deserts or jungles. While perhaps less critical, reducing radar and ultraviolet signatures also aids in minimising detection.

Technical textiles cover one of the most dynamic and most widespread areas of textiles, materials, processes, products and applications, and the rate of change in technologies and applications is high.

Application to Defence Programs and Projects
The critical industrial capabilities described above are applicable to current and future Defence projects and programs. Based on the 2016 release of the IIP, this includes the following:

- Land 125 Phase 4 Soldier Combat Ensemble; and
- Land 1508 Phase 1 Special Operations Enhancements.

For each of the above projects, the described critical industrial capabilities should be included in the Australian Industry Capability (AIC) Plan requirements which form part of Defence’s procurement documents. In responding to this, industry must acknowledge these AIC requirements in a way that optimises critical industrial capability development in Australia. The evaluation process will continue to address an array of factors in accordance with competitive tender conditions, with value for money, among other key criteria, continuing to represent an enduring Commonwealth requirement.

This priority is enabling progress toward the integrated soldier vision, as is the related Munitions and small arms research, design, development and manufacture priority.

Australian manufacture of the Standard Combat Uniform
On 18 August 2011, the Chief Executive Officer of the Defence Materiel Organisation (DMO, now CASG), approved the Standard Combat Uniform worn by the ADF as exempt from paragraph 5.2 of the Commonwealth Procurement Guidelines (CPGs), thereby mandating Australian manufacture. This means the fabric must be woven, dyed, printed and finished in Australia and the garment cut, sew and trim undertaken in Australia. This exemption from the non-discrimination clause of the CPGs against country of manufacture was done as a “measure necessary for the protection of essential security interests.”

Although general combat clothing is not an element of this priority, the Australian Government’s commitment to Australian manufacture is enduring. It acknowledges the need for surety of supply and uniform development, as well as the protection of technology leakage in relation to fabric production and garment assembly.

The Australian Government does not intend to extend this commitment beyond the Standard Combat Uniform at this time.
RMIT University, School of Fashion and Textiles: Collaboration

The Royal Melbourne Institute of Technology's (RMIT) Centre for Materials Innovation and Future Fashion (CMIFF) is at the forefront of research and innovation in the advanced materials and textiles space. Since 2008 the centre has been involved with numerous joint research initiatives run through the Defence Materials Technology Centre (DMTC), including completion of the high strength fabrics for combat uniform project; the fabrics for chemical and biological resistance project; and the commencement of a new project for the load carriage system.

The high strength fabrics for combat uniform project was a collaborative program aimed at improving the fragmentation protection of combat uniforms against improvised explosive devices. During this project, RMIT collaborated with a number of partners in industry and academia, including Defence Science and Technology Group, Bruck Textiles, Ballistic & Mechanical Testing, Ventou, Commonwealth Scientific and Industrial Research Organisation (CSIRO) and Australian Defence Apparel. Each research partner delivered a specialised set of skills and value-add to the joint initiative. The project was led by CSIRO.

A number of fabrics were developed and evaluated using ‘Velocity-50%' testing. This is a ballistic test where bullets are fired at higher and higher velocities until 50 per cent of the bullets do not penetrate. The best of these tests showed a 40 per cent improvement in fragmentation resistance compared with that used in the current uniforms. The new fabrics also demonstrated significant improvements in strength properties such as tensile, tear and abrasion.

Three fabrics were selected and made into garments, reaching Technology Readiness Level 6. These innovative fabrics are currently being evaluated further by Defence with performance tests and future wearer trials planned for 2020.

Enabling the Critical Industrial Capabilities

Consultation with industry and analysis of the combat clothing value chain (discussed in detail in the subsequent section, Current Australian Industry Capability) identified three key enablers that contribute to Defence’s warfighting and protection capabilities: Intellectual Property (IP), Test and Evaluation (T&E), and Agility and Collaboration (A&C).

The ability to generate each of the critical industrial capabilities identified in this Industry Plan is enabled by a range of tangible and intangible assets, behaviours and other inputs. Like critical industrial capabilities themselves, Government may require access to, or control over, these enablers in order to protect Australia’s sovereign interests.

Recognising the well-established combat clothing and signature reduction industrial sector already present within Australia, this Industry Plan is focussed on sustaining current levels of capacity, as opposed to large scale growth in this part of the sector.

Australian industry ownership of the Intellectual Property (IP) associated with ADF ballistic protection, multi-functional materials, and signature reduction technologies is desired

Ready access to domestic testing and evaluation enables Defence to rapidly understand product and integrated soldier-system performance

Agility and collaboration for product and system deployment is desired
Intellectual Property

Defence, through existing Technical Data (TD) and IP policy and guidance, has provided mechanisms in Defence contracts that enable the protection of IP and encourage greater industrial collaboration to achieve capability outcomes. For example:

- The Defence Innovation Hub’s *Intellectual Property Strategy* underpins the IP and TD provisions in the Innovation Contract to maximise incentives to invest in innovation through collaboration between Defence, industry and other research organisations for the development of leading-edge innovations and technological expertise. This IP Strategy seeks to recognise the contribution of both parties to an Innovation Contract, including IP, expertise, know-how, resources and funding. When Defence invests in new or developing technologies in partnership with industry, it relies on industry sharing its IP with Defence and others and collaborating to support the ADF's capability needs without Defence being unduly restricted by industry's commercial interests.

- The ASDEFCON Technical Data and Intellectual Property Commercial Handbook is a companion to the ASDEFCON suite of tendering and contracting templates and will assist projects and industry to better identify and articulate Technical Data and IP requirements needed over a capability’s life span. While strategies and frameworks are important in providing an agreed approach to IP, the cultures of the organisations involved in projects ultimately influence the outcomes. Both hard and soft skills are necessary factors in leading constructive, enduring and dynamic relationships. Notwithstanding the importance of robust legal provisions and risk controls when commercially sensitive IP and confidential information is involved, both Defence and external organisations must view each other as trustworthy partners and exercise appropriate behaviours. An important aspect of this is understanding the risks that industry and other collaborative partners perceive when they enter into arrangements with Defence.

**CASE STUDY**

**The Defence Innovation Hub: establishing a clear approach to IP and removing perceived risks for industry**

The Defence Innovation Hub’s *Intellectual Property Strategy* seeks to facilitate and support participation in the Innovation Hub by providing clarity to businesses on the Defence approach to the treatment and protection of IP. It recognises there is a substantial financial investment and effort required from industry – often over an extended period of time and without any guarantee of a return – to innovate, and it applies a pragmatic, principle-driven approach to the ownership of the IP that is created in connection with the projects that it funds.

In order to achieve this, the Innovation Hub’s position is:

“Defence will not seek to own innovation IP (including innovation IP created jointly by Defence and participants), unless there are compelling reasons to support Defence ownership.”

Their strategy provides specific guidance on the approach to IP in different circumstances and collaborative environments, and more importantly, it specifies the circumstances in which compelling reasons might exist to pursue ownership of IP. In having specific guidance in the public domain on the way that IP will be approached and managed, industry’s expectations can be managed from the outset, providing a foundation on which a robust, transparent and trusting relationship can be built.
Test and Evaluation

Test and Evaluation (T&E) is a key component of systems engineering and its primary function is to provide feedback to engineers, program managers and capability managers on whether a product or system is achieving its design goals in terms of cost, schedule, function, performance and sustainment. The overarching policy which covers T&E within Defence is outlined in the Defence Capability Development Manual. The Australian standard which applies to the testing of a number of the ballistic technologies comprising this priority is DEF (AUST) 10946 ADF Personal Armour Test Standard, Part 1: Body Armour (Issue 1, 2012).

T&E capabilities are key enablers that must be readily accessible to Defence to support various activities through the life cycle, including product development, introduction into service, and recertification. During consultations with industry to support the development of this Industry Plan, Australian industry reported an inability to access test facilities and skilled resources to undertake the post-test technical assessments needed to assure capability performance and progress R&D. It was noted this was inhibiting their ability to upgrade existing technologies and mature new technologies, which could reduce Defence responsiveness to a change in threat and impede Defence’s capacity to maintain a warfighting edge.

For protective elements, T&E capability is required to support R&D, certification, and batch and life extensions. Defence’s approach to T&E ensures that capabilities fielded are tested and evaluated, and are suitable for ADF operations. This is a critical enabler for the ongoing evolution of the SCE, and while manufacturers, integrators and Defence have in-house test capabilities for the technologies encompassed within this priority, currently only one channel exists for independent, National Association of Test Authorities (NATA) accredited ballistic testing in line with the Australian standard.4

Similarly, while offshore T&E capability exists, accreditation requirements and test practices do vary among nations, and it is unlikely that organisations outside of Australia have sought accreditation to Australia’s ballistic test standard (alternatively, the United States’ National Institute of Justice Standards are most commonly used worldwide). The expense, coupled with the limited application of this accreditation is a disincentive for industry. Where such a facility may exist offshore, Defence may be hesitant to share test requirements and expose performance data, particularly where protection of intent is required. The ability for Defence to be agile and responsive to changes in the environment, and to ensure all aspects of R&D can be undertaken through a qualified and competent, local T&E capability is critical for protecting ADF combatants and maintaining a warfighting edge.

Agility and Collaboration

The benefits of collaboration are clear in an industry where cost of entry is high, the domestic market is relatively small, the right skills and experience are scarce, and broader application of specific technologies is limited.

Industry, academia and research organisations play a key role in assuring Australia’s sovereign industrial capabilities. Many avenues for collaboration are available in the defence sector, including:

- Joint ventures;
- Public private partnerships;
- Joint research;
- Joint development, prototyping and evaluation of solutions;
- Shared data and information for the purposes of design, operations and service delivery (of particular benefit for this priority);
- Integrated supply networks and value chains geared to building capability;
- Peer networks and formal interaction; and
- Shared assets and resources of particular relevance to this priority, which is dependent on technology trajectory, technical disciplines, and availability and agility of the supporting skills and resources.

As Defence organisations around the world look to transform their relationships through the production cycle, segments which rely on high levels of global integration, either through their leverage of foreign IP, offshore

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4 Australian Defence Test and Evaluation Office (ADTEO) has test capability at Monegeetta in Victoria, but there is only one independent, NATA accredited testing authority for this standard within Australia, which exists within industry. Furthermore, in addition to accreditation, much of the technical ballistic testing knowledge and experience required to support this critical industrial capability resides within industry.
manufacturing, raw materials or resources to craft Australian-tailored solutions, also benefit from a reciprocated Defence focus on these channels.

Threats are evolving constantly and there is a need for Australian industry to be poised to respond through R&D. R&D is expensive and often a lower priority relative to filling orders, particularly where contracts are not specific on the nature and type of ongoing development that is required. When industry and Defence work collaboratively to optimise outcomes, as has been demonstrated in recent years with the SCE, world leading status in this domain is a realistic aspiration.

CASE STUDY

The Defence Science Institute: removing barriers to collaboration

“The key is open and continuous communication — real connections between people and organisations — not just electronic portals.” Annette McLeod, Defence Science Institute

The Defence Science Institute based in Melbourne facilitates relationships between academia and industry for research and development addressing Australia’s defence and security needs.

The institute connects people and institutions, builds skills and showcases academic research and development and innovation capabilities to industry. So far it has assisted more than 100 universities, SMEs, primes, start-ups, funders and government agencies to identify potential partners, and funded and supported more than 60 projects and 3 major collaborative research initiatives.

The Defence Science Institute doesn’t have a ‘bucket of money’. Instead, it looks to remove barriers to collaboration with small amounts of funding or in-kind support, or to facilitate activities that will lead to larger projects, sustained with other funds. Every dollar that it has put into facilitating a collaboration has been multiplied 12-fold from other sources.

What makes the Defence Science Institute so effective? Its success is down to its deep local expertise and wide network across academia, Defence and industry. It uses that expertise to uncover barriers to collaboration and apply resources to it. It draws on its relationships to build cooperation on new initiatives. Importantly, it also takes a neutral position with no stake in the IP, investing instead in collaboration, rather than its products.

Future evolution of the integrated soldier

This Industry Plan focuses on a three to five year time horizon, and describes the need for investments in the future soldier system that incorporate stronger, lighter, and more durable materials, manufactured using more innovative, lower-energy production methods. As indicated through the critical industrial capabilities, Defence anticipates that the ballistic elements of this priority will increasingly be produced using advanced and composite specialised materials, such as ceramics, titanium and carbon fibre. These processes and materials, among others, will provide opportunities for industry to contribute to the evolution of the soldier system in the immediate term. It is important to note that no significant ‘leap steps’ in technology relevant to this priority and identified critical industrial capabilities are anticipated to be introduced to the market as technically ready solutions in the five year horizon.

The implications of this forecast technological evolution must be considered early, alongside R&D activity and prototyping. In developing and introducing such technologies into service, particularly those which collect data, store energy or include automated functionalities, the Defence community will need to navigate many technological, policy, regulatory, and potentially ethical challenges.

Where Australia is to pursue these innovations there will need to be coordination across Government and support provided to companies, manufacturers, academia and research organisations.

Australia: a global leader in advanced soldier systems?

The opportunity for Australia to be a global leader in the development of soldier protection systems became apparent during the development of this Industry Plan, in particular as it relates to integrated helmets. Broader than this, and beyond the focus of this priority, there is an opportunity for Australian industry to embed competitive advantage and position itself as the leading provider of integrated soldier systems on the world stage.

This ambition is consistent with the commentary of military officers, scientists and research organisations in Australia and in allied nations as operational tempo over the past decade generated continued evolution of the integrated soldier system.

In particular, the ongoing enhancements to the SCE, recent investments in future technologies that include full body armour suits and integrated helmet systems, and the continued focus of organisations such as Diggerworks to deliver warfighting edge through the evolution of the soldier as an integrated system, strengthen our global leadership potential.

The size and composition of the ADF supports this endeavour, providing an effective proving ground for R&D, prototyping and T&E, enabled by agility and responsiveness. Government investments in innovation (as discussed further in the industry programs section of this Industry Plan) provide the foundation, with an innovative and export orientated industrial base driving the commercialisation of technologies to be used by the ADF, militaries and law enforcement agencies around the world.
Technology and Innovation through to 2040

Towards 2040, the vision for the integrated soldier becomes increasingly sophisticated. Today, the components of the soldier system are, in simple terms, discrete protective elements worn in an optimised configuration. In the future, it is anticipated that many of these elements will merge, creating a fully integrated capability, tailored for different body types and combat environments. Over the next decade, it is expected that ballistic technologies will advance through the use of additive manufacturing and 3D printing, which are already available in the commercial market with evolving military applications.

The diagram below describes the potential future evolution of the SCS, beyond the time horizon of this Industry Plan. It focuses on those elements within the scope of this priority and also considers those soldier capabilities related to the priority which were tested during this Industry Plan’s development.

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Figure 1: Evolution of Technology and Trends Impacting ADF Capability

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CURRENT AUSTRALIAN INDUSTRY CAPABILITY

Australia has a well-established industrial sector, including businesses, academia and research institutions, which provides leading edge combat clothing and signature reduction technologies to the Australian Defence Force (ADF). This sector is highly diversified, supplying personal protection capabilities to adjacent markets such as police and law enforcement, mining and gaming in different geographic markets. The ADF is a preferred customer to many, but for most, not the only customer.

Australian industry attributes

The findings from extensive consultation undertaken directly and through the National Defence Industry Survey Report 2018-19, as well as research and analysis into the composition and characteristics of Australia’s industrial base has produced insights as to Australian industry’s current capabilities. The data used in this section reflects those organisations who completed the survey and indicated an ability to generate the Defence Relevant Industrial Capabilities applicable to this priority.

Size and Composition

The sub-sector supporting the generation of ballistic and blast technologies is represented by a relatively large number of suppliers despite relatively low Defence demand, with excess supply identified in terms of R&D and operational generation of these capabilities. These observations do not extend to the textiles sub-sector.

- The Survey indicated that less than 10 respondents have capabilities in textile manufacturing relevant to Defence, and approximately half are yet to obtain a Defence contract. This reinforces the economy-wide evidence of a market decline and presents an opportunity for Defence to take a more active role in supporting these companies transition into Defence and to invest in the skills base, while retraining a diversified customer base.
- More than 50 per cent of the organisations generating industrial capabilities specific to this priority (e.g. body armour, combat helmets, textiles) reported revenue in excess of $10 million annually. In contrast, annual revenue for those generating other soldier-centric capabilities (e.g. chemical, biological, radiological and nuclear equipment, night vision equipment, and webbing) appears to be comparatively lower, with two thirds of respondents reporting $10m or less.

Strong Small-to-Medium Enterprise (SME) Base

Unlike other major defence sub-sectors, there is no ‘Prime’ supporting this sector - in contrast, Australian SMEs dominate. Consistent with the broader economy, the Survey indicates businesses in this sub-sector are typically 20 employees or less.

7 The survey, administered by the Centre for Defence Industry Capability (CDIC) 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 (referred to as Defence Relevant Industrial Capabilities). Approximately 1,800 organisations responded to this survey and the self-reported data was not validated through other sources; accordingly there are limitations in terms of data bias and representation of the sector.

8 The National Defence Industry Survey Report 2018-19 categorises organisations as: micro (up to 4 employees), small (5 to 19 employees), medium (20 – 200 employees) and large (200+ employees).
Geographic Distribution of Companies

Organisations developing ballistic, blast protection and signature reducing technologies align broadly with the distribution of Australia’s industrial manufacturing capabilities, with high concentrations in New South Wales and Victoria. The distribution of manufacturing appears to be positively correlated with those states who have indicated support to defence manufacturing in their most recent defence sector strategies. In Victoria, research into combat clothing and defence material technologies has been specifically noted as an area of expertise and investment, while in Queensland, opportunities in ballistic protection for personnel and multidisciplinary material science are identified.

Innovation and Collaboration

The survey indicates organisations that generate the most revenue generally reinvest more in R&D, a theme that is consistent throughout the value chain. Other observations include:

- A number of large organisations reinvest as little as 2.5 per cent in R&D while other organisations spend up to 20 per cent.
- Organisations producing protective equipment tend to invest more in R&D than those focused on producing the textile components related to this priority, consistent with a declining market that has restricted access to specialist resources.
- Approximately 11 per cent of respondents indicate they had the ability to generate the products related to this priority as well as the underpinning industrial capabilities used in the manufacturing and assembly processes. This suggests a small amount of vertical integration and potential for increased supply chain collaboration.

Global Connectivity

Ballistic protection is a relatively stable sector with a number of longer-term incumbent providers to the ADF, a range of export-orientated businesses and a number of new entrants wanting to enter the Australian defence sector.

- Half of the respondents generating products related to this priority currently supply directly or indirectly (through another company) to the ADF; the other half report that they have previously, or have never, supplied to the ADF.
- One third of respondents indicate that they are currently, or have previously, generated the industrial capabilities relevant to this priority for an overseas defence customer. Narrowing the focus to those organisations producing ballistic protection or textiles products, almost 40 per cent indicate an export capability. This is consistent with the information shared during the industry consultations conducted when developing this Industry Plan, which suggested a number of Australian companies were actively exporting the end products being produced.
- Approximately 30 per cent of respondents are currently generating revenue through defence related export sales, with more than half earning up to $250,000 annually from foreign sources. The vast majority of these companies also indicate revenue generated through the Australian defence sector as less than $1 million annually, suggesting diversification and global outlook is an important part of the business for the smaller organisations in this sub-sector that support the ADF.

9 Defence Technologies Sector Strategy, released March 2016
10 Queensland Defence Industries 10 year Roadmap and Action Plan, released June 2018
Across the Australian economy, many organisations undertake the industrial processes required to produce the capabilities within this priority, albeit not always with a Defence application or outcome in mind. It is important for Defence to understand where these capabilities reside, which other industries they support and how readily commercial activity could be channelled towards military applications where the Defence demand requires it.

The Defence apparel industry includes organisations able to undertake those industrial processes that support production of equipment-type wearable items such as body armour and helmets. The industry is difficult to define when looking across the Australian economy as the four classifications that underpin this priority do not directly or specifically address the nuanced application required by the priority. In fact, they support capabilities outside of the scope of this priority and the Defence environment. Despite this, understanding of the composition of the broader industrial group provides insights for combat clothing, as this sub-sector of apparel shares access to workforce, raw materials and opportunity. The following four industrial processes, leveraging the Australia New Zealand Standard Industrial Classifications (ANZSIC) are:

- Textile manufacturing;
- Basic polymer manufacturing;
- Polymer manufacturing; and
- Ceramic product manufacturing

Textile Manufacturing

Synthetic textile manufacturing includes, but is not limited to, manufacture of woven fabric including elastic and synthetic fibre; fibreglass fabric; laces and cords; yarns; and synthetic fibre. These are used in the integration of technology and component parts of the soldier combat system. The textiles used in armour systems are complex and are designed, developed, tested and assessed at various levels from the molecular level, to fibres, yarn and woven fabric. Textile manufacturing considers construction of the product to maximise strength, including the coatings and other additives that impact textile properties.
Industry observations

- Textile manufacturing has a strong concentration in Victoria where 42 per cent of the businesses within this industrial classification are located, followed by New South Wales and Queensland with 22 per cent and 18 per cent respectively.

- Of the 138 relevant businesses identified, approximately half are “non-employing businesses” with an additional 38 per cent employing 1-19 workers. Within employing businesses, the most common occupation is textile and footwear production machine operator, comprising 11.3 per cent of the industry's workforce. This is closely followed by canvas and leather goods makers at 10.4 per cent of the total workforce.

- The highest qualification obtained for almost half of the workers in this industry group is year 12 or below and analysis undertaken by the Australian Industry and Skills Committee (AISC)\(^\text{11}\) indicates the textile sector in Australia is in decline. This could mean that intervention is required to ensure that those skill sets relevant to Defence continue to be accessible, and that the industry remain relevant to the manufacture of combat clothing and other specialist applications. With a high degree of vocational workforce, and without a consistent stream of employment, these workers are likely to reskill in other industries as up-stream businesses seek more affordable sources of supply offshore.

- AISC also reports a significant decline in the rate of enrolments in apprenticeships and trainee programs although completion rates within the programs have increased. The specialisations and skills which are integral to the advanced materials element of this priority are highly technical and are in great demand due to their broad application to other industries. Similar to the vocational workforce, if there is not a constant volume of investment and production in this industry, competition for these skills from other sectors with technical textile requirements (e.g. agriculture, medical, sports and recreation) may present a risk to this priority.

Basic Polymer Manufacturing

Basic Polymer Manufacturing is the largest industrial classification contributing to this priority. Basic polymers are inputs to both the armour and fabric technologies although the precise materials, technologies, and manufacturing processes applied by different manufacturers varies significantly. Basic polymer manufacturing includes, but is not limited to, resins such as thermoplastic resins used for coatings, polyvinyl chloride, polyethylene, polypropylene, carbon fibre, including Kevlar, cellulose fibre and filaments (rayon or viscose), nylon, polyester and synthetics.

Polymers are used in a wide variety of industries and applications, and as an input material to the generation of survivability and signature reduction technologies. Polymers are readily available from various global sources and have not traditionally presented sourcing challenges. However, ensuring access to quality materials will continue to be critical for continuity of the industrial base supporting this priority.

Industry observations

- Basic Polymer Manufacturing has its strongest concentration in Victoria, with 36 per cent of businesses located in the state, compared with 18 per cent in Queensland and 22 per cent in New South Wales. There are a small number of manufacture providers in Western Australia (8 per cent), Tasmania (4 per cent) and the Northern Territory (2 per cent).

- Basic Polymer Manufacturing has the highest spread of occupations across the four selected industrial classifications used in this analysis. Chemical, gas, petroleum and power generation plant operators (7.7 per cent), and plastics and rubber production machine operators (7.1 per cent) are the two largest groups.

- Over one-third of workers in this industry segment have attained year 12 or below education, and almost 30 per cent have completed studies in engineering and technology related fields. Mechanical and industrial engineering, and technology qualifications make up almost 10 per cent of this group's workforce. Many attributes of this workforce are similar to that of the Textile Manufacturing industrial classification.

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Polymer Product Manufacturing

Polymer Product Manufacturing includes hard and soft plastics, foam products used in helmets, insulation and cushioning, sheet foam, resilient plastics used in gloves, and high-density safety equipment used in helmets. While there is an abundance of workforce contributing to the generation of polymer products across the country, from a Defence perspective, there is a need to continue to invest in those parts of the workforce that support military capabilities such as soldier protective equipment.

Industry observations

- Businesses involved in Basic Polymer Manufacture are concentrated in Victoria (32 per cent), New South Wales (28 per cent) and Queensland (20 per cent).
- Over 11 per cent of businesses in this category employ more than 20 workers, which is higher than the other classifications considered in this analysis.
- The most prominent occupation for Polymer Product Manufacturing is plastics and rubber production machine operator. This accounts for almost 10 per cent of the jobs within this industry group, followed by production managers at 5.7 per cent.
- Unlike Textile Manufacturing and Basic Polymer Manufacturing, due to the broad application of polymer manufacturing, the workforce is able to be sustained with a relatively predictable volume of production.

Ceramic Product Manufacturing

Ceramic Product Manufacturing includes the production of ceramic plates and accessories used for manufacture. Ceramic and composite armour plates are produced using technical ceramics such as silicon carbide and are worn within load carriage vests, alongside soft armour inserts to provide ballistic protection. Manufacturing technologies for ceramics require high furnace temperatures which are energy intensive and expensive to produce. Increasingly, ways of producing ceramics for armour plates at lower temperatures are being developed, progressively lowering the cost of manufacture. Manufacturing techniques that allow for customisation of the shape of ceramic plates also present an opportunity for this industry.

Like polymer products, ceramic products are used in a wide variety of industries and applications, and the underpinning manufacturing processes are transferrable to the Defence environment. Unlike polymer products, the workforce generating these capabilities is much smaller and the sector is dominated by commercial applications such as building and construction. From a Defence perspective, continuing to professionalise this workforce and invest in on-the-job ballistic and blast training, and formal training where accessible, will be important for retaining a sovereign industrial base.

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12 Economic analysis on the Defence Apparel sector within Australia utilising Australian Bureau of Statistics (ABS) 2016-17 data sources
Industry observations

- The Ceramic Product Manufacturing industry is the second largest of the four industrial classifications analysed (behind Basic Polymers).
- The industry is concentrated in New South Wales (31 per cent) and Victoria (31 per cent).
- Almost 15 per cent of the jobs in the industrial classifications are attributed to clay, concrete, glass and stone processing machine operators. Consistent with the other identified industry groups, engineering and technology related fields of study, including building and construction account for almost 24 per cent of all workers, while business and management workers account for 6 per cent.
- The number of workers with year 12 or below account for around 44 per cent of the total workforce.
- Similar to polymer production, there is broad industry application for ceramic manufacturing. However, as is evident across each of the industrial processes supporting Defence apparel and the broader manufacturing base in Australia, the workforce pipeline is diminishing. Closer monitoring may be required to encourage workers into, or to remain within the industry, in order to retain defence specific skill sets and corporate knowledge within this industrial process.

Combat clothing value chain

The value chain, shown at Figure 2, presents the activities involved in the design, development, production and through life support of the industrial capabilities identified within this priority. Enablers and inputs to each activity are assessed for their relative impacts with a view to understand the strengths and weaknesses of the domestic industry. This includes determining if action and/or closer monitoring needs to be taken to ensure that Australia has access to the critical industrial capabilities in the quantity and timeframe required to meet Defence needs.

To support further analysis of the industrial base, the generic Defence value chain is presented alongside those value chain steps Defence considers critical for sovereign capability – refine, enhance and upgrade – as described in the Defence Industrial Capability Plan.

Positively, Australian industry's current capabilities broadly align with those value chain functions Defence sees as critical. With respect to the ballistic and blast protections elements of this priority, there appears to be sufficient supply relative to Defence demand (perhaps even an over-supply when considering ADF requirements in isolation).

In key areas of production, where there are multiple inputs of significance, Australian industry must be supported to ensure that the sovereign industrial capability is maintained. The most vulnerable areas are identified in Figure 2 on the following page through the requirement of multiple enablers and inputs is the manufacturing process. Further analysis of the enablers and inputs identifies three key areas are critical to maintaining industrial capability. The industrial processes available in the broader economy relevant to this priority are discussed in the section below, alongside a more detailed analysis of risks identified in the value chain as they relate to the critical industrial capabilities.
Risks to domestic industry

Raw materials
Raw materials are critical to this priority, in particular ballistic protection, because many of the raw materials required to produce these capabilities are characterised by high global demand, constrained access and availability, and limited opportunities to substitute. Large consumers have better assurance of supply because of scale and this creates uncertainty for Australian manufacturers. In turn, this leads many business who generate elements of the priority towards integration rather than production across the value chain.

Within this context, current technologies and manufacturing methods render an Australian sovereign manufacturing position – while possible – unrealistic and high risk. Delivery of the industrial capabilities within this priority relies on Defence’s continued tracking of global supply and control of raw materials, and pursuit of assured channels for support, either of raw materials or component parts.

Component manufacture
Component goods are used in the production or manufacture of final products. These goods are important to this priority as many business models within the industry rely on imports of component parts, which they then integrate and customise for Australian conditions.

As described in the raw materials section, inconsistency in the supply chain of some of the raw materials used in this priority means that Australian industry often adopt business models as either importer or integrator. Some also pursue offshore manufacture for reasons of cost, with cheaper labour and production available in other parts of the Asia Pacific region.

Intellectual Property and system design
Given the relatively small size of the Australian market for the technologies which support this priority, collaboration and knowledge-sharing is necessary to stay ahead of the curve, especially in disciplines with a high technology dependence. Industry reported that collaboration does not occur naturally or easily within this segment. Where collaboration does exist among industry, predominately this is usually within an organisation’s own established supply chain, and formalised through normal commercial mechanisms.

To the extent possible, Defence must be assured of access to the IP associated with the critical industrial capabilities in this priority. The case for IP access is based on the need to evolve these technologies as part of the broader integrated soldier combat system in response to changing environmental and ballistic threats. Where Australian industry has the depth of capability to generate its own IP, or the ownership or licence to modify IP sourced from partners within its supply chain, Defence is better able to respond to such changes and work collaboratively with industry.
Operational test and evaluation

Operational test and evaluation (OT&E) is conducted under realistic operational conditions with representative users of the system, in the expected operational context, for the purpose of determining its operational effectiveness and suitability to carry out the role and fulfill the requirement that it was intended to satisfy.

OT&E is a critical enabler of this priority. This input enables the evaluation and objective assessment of a capability system with known confidence, and allows determination of acceptable risk boundaries across all phases of a system’s life cycle.

In accordance with the capability life cycle, at the project level, test concepts support Gate 1 approvals, and an OT&E strategy is required for Gate 2 approval. OT&E provides the Capability Manager’s representative and project team with objective quality evidence of the suitability and effectiveness of the capability system before that system is employed in an operational role. This also assists in developing doctrine and procedures for its employment. The results of OT&E are also used to inform business case closure, providing a comparison of the capability outcomes as delivered against the capability approved at Gate 2. While OT&E also informs sustainment decisions, due to the nature of this priority, systems are ordinarily sustained through one-for-one replacements.

Supply chain (including deployed force)

For this priority, the requirements of the supply chain depends on the operating model adopted by industry. As outlined within the raw materials and component manufacture sections, Australian industry increasingly adopts, either in part or in whole, offshore manufacturing models for Australian integration and/or customisation.

Whether an importer, integrator or manufacturer, and regardless of the size of the operation – all industry contributing to the generation of this priority are globally integrated to a degree. Global integration occurs through the leverage of foreign IP, the sourcing of resources or assets, and attracting talent with the right skills and experience.

For reasons of cost and volume, it is not feasible for Australian industry to manufacture the entire product/system in this sub-sector. Integration activities draw on domestic value-added industries such as textiles and coatings, and some Australian operations have high value-add production activity based in Australia. In these cases, raw materials and component/sub-component level inputs (many essential and hard to substitute) are typically imported.

Government opportunities in textiles

To enhance tender submissions and promotional activities, Defence will continue to provide letters for industry that confirm the ADF’s use of their products.
Chiron Global – Diversifying into the Australian Defence Sector

Global Pty Ltd (Chiron) is an Australian company innovating in the combat sports, gaming, Defence and law enforcement sectors through the development of a unique high-tech body armour called the ‘Lorica’ and its supporting software.

The Lorica is an innovative carbon fibre body armour suit that is flexible enough to enable a full range of close quarter martial arts techniques, but strong enough to protect the user from damage during full force close quarters combat (CQC) strikes. The Lorica is embedded with force measurement sensors that relay data back to the supporting software system during CQC. The software, Chiron Armour Technology System (CATS), is based on medical injury research data and immediately determines the location and extent of the damage a strike would deliver to an unprotected body. The damage is then displayed in real time on a video screen using computer graphics.

Chiron has spent around seven years researching and developing its technology solution after being initially told by force measurement companies that it could not be done. This was due to the complexity of integrating sensors into a malleable body armour and accurately measuring impact forces and relaying the data in real time. However, Chiron persisted with its research and has transitioned from an early proof-of-concept prototype to a first generation and now second generation solution. Using platforms such as social media, Chiron was able to show the world its new technology with controlled trials in a test environment.

After the success of the trials, Chiron received enquiries from military organisations (specifically special forces) around the world asking how they could adapt the Lorica and CATS to enhance CQC training, as well as combat simulation with the potential for seamless force continuum training using the one suit. Based on the strong demand from Defence, Chiron is currently undertaking an investment raise in order to adapt the armour’s capabilities to capture simulated munitions/man-marking round impacts and to customise the suits for Defence personnel. Over time, data from the suits can be used to identify trends in training effectiveness, to improve current training practises and outcomes and to help reduce costs and injury risks. The ability to capture this data and train with 100 percent force will ultimately provide a more realistic training experience. There has also been wider interest from regular military for a simplified version of the Lorica both for training and deployment in field exercises.

Chiron is an example of an innovative technology originally designed for a specific purpose having application for a range of different sectors and uses. Chiron has developed a technology that has clear application for a range of customers within Defence with the ability to save lives, reduce personnel downtime and enhance training outcomes.

Access to new or existing markets and international supply chains

Defence, through the Australian Defence Export Office, will seek to provide export opportunities for Australian industry specialising in defence textiles via international defence tradeshows. In 2020, Team Defence Australia will prioritise the introduction and support of export-ready companies with high value-add textile production capabilities to international contacts, networks and key international decision-makers.

Expressions of interest will open closer to these events. Interested companies should email cdic_exports@industry.gov.au for more information.

Security Concerns

The Defence Industry Security Program (DISP) assists in securing Defence capability through strengthened security practices in partnership with industry, and enhances Defence’s ability to manage risk in an evolving security environment.

Defence provides DISP members with security information, guidance and services, including personnel security vetting, certification and accreditation of facilities and/or Information Communications Technology (ICT) systems. This enables members to be ‘Defence-ready’ by establishing security practices for tending opportunities; as well as providing best practice knowledge to ensure DISP members’ interests are protected from threats and foreign interference.
Government Action

Defence Industry Security Program

Defence will continue implementing the reformed DISP to strengthen security practices in partnership with industry.

DISP supports industry to protect their interests from threats including foreign interference, and increases opportunities to compete for work with Defence and international partners by becoming ‘Defence Ready’.

Defence provides DISP members with access to security information, guidance and services, including personnel security vetting, certification and accreditation of facilities and/or ICT systems. In certain circumstances, Defence can also provide an assurance to international partners of an entity’s DISP membership, promoting Australia’s sovereign capability internationally.

More information on DISP can be found at https://www.defence.gov.au/dsvs/industry/default.asp

Workforce and technical skills – what does industry say?

The industrial capabilities which underpin the Combat clothing priority and most of the enablers and inputs are delivered largely by a vocational workforce with high technical and industrial machining skills and expertise. These workers are supported by a broad spectrum of engineers (including chemical, mechanical and systems) involved predominately in product and process design, and test and evaluation activities. A range of administrative and business orientated professionals enable company operations.

During the industry consultation undertaken to develop this Industry Plan, industry reported there is currently limited availability of skilled workers with the required experience. The niche, technical expertise required was often only satisfied by a small number of individuals within Australia. This is mitigated where organisations have built their own talent from the ground-up, attracted it from competitors, or recruited in from abroad. Industry described the workforce as being fluid due to the relatively small size of the Australian market and the restrictions on importing talent for roles where security clearances are required.

With respect to the providers of ballistic protection, consultations also revealed significant fluctuation in workforce numbers in response to securing or losing an ADF contract. In this scenario, many organisations cited a workforce impact as great as 50 per cent (increase or decrease, dependent on the scenario).

Anecdotally, on-the-job training was cited as the key source of learning and development in the sectors supporting this priority, with core competencies requiring on average six months to achieve. In Australia, there is no dedicated tertiary education or qualification required for these roles, nor are there specialised courses targeted at up skilling those in the sector. This has a compound effect on the talent pipeline, where low demand for technically niche areas of study in turn restricts the courses offered by universities. For example, one university reported that an undergraduate degree in fashion and textiles was removed from the curriculum due to low demand. This is one of the skillsets directly contributing to signature reduction capabilities.
Australian ownership

Australia as the place of manufacture is not a pre-requisite or requirement for this priority.

The high cost of production of some of the technologies associated with this priority, particularly those which are high in energy consumption, coupled with high cost of entry to the market, means that offshore production is more attractive to Australian companies. It is noted however that in-country manufacture may also have benefits, for example, enabling Australian industry to cross-subsidise and to reinvest in innovation.

Domestic production ultimately has an impact on price, and the trade-off is one which must be understood in relation to the capabilities retained within the country. For example, without a large supply base, the high cost of entry for domestic production of boron carbide plate technology is not commercially viable. Market participants in the textiles sub-sector have exited the Defence in recent years and as such, many that remain are focused on differentiating themselves from lesser quality foreign alternatives.
Craig International Ballistics (CIB) specialises in engineering, researching, developing, and manufacturing ballistic protection products. Queensland-based CIB is an established company in the ballistic protection space and the leading supplier of body armour to the ADF and police forces, providing a number of products, including aircraft armour panels, armoured vehicles and structural armour products.

In 2018, CIB partnered with Rhino Linings and Honeywell Spectra Shield to upgrade the advanced armour protection for the new CH-47F Chinook heavy-lift transport helicopters. In order to meet Army’s needs, CIB has developed an advanced new design that is considerably lighter, thinner and more durable than similar armour panels fitted previously. This complex design carefully integrates Honeywell Spectra Shield composite fibre materials with boron carbide ceramics and Rhino Linings REXAR protective coatings. The armour panels have been rigorously tested and independently certified as meeting the highest Australian and international standards. This is a clear example of innovation through collaboration.

CIB has a number of other Defence contracts such as LAND 125-3B Soldier Combat Ensemble – Protection Elements. Despite being an existing supplier, the company continues to invest in innovation to provide the ADF with the best means to protect itself. The company has invested in a state-of-the-art facility at Arundel in Queensland, which includes digital conveyorised cutting equipment, x-ray equipment, computer controlled cutting machines and heavy-duty hydraulic presses. The revenue from existing contracts allowed CIB to heavily reinvest into capital acquisition and innovation, with an aim to begin exporting their high quality ballistic protection products. This will help to stabilise the “peak and trough” nature of operating in the defence industry. CIB’s success and strive for innovation is a clear case of family owned company looking towards the future. CIB is expanding Australia’s sovereign industrial capability in ballistic technologies through collaboration and continuous investment in capital acquisition and innovation.
This Industry Plan includes the following actions to be taken by Defence and/or Government to support the Combat clothing survivability and signature reduction technologies priority. Although responsibility has been attributed to a particular branch, group or agency, it is expected that a broader group of Defence and Government stakeholders will participate in, or contribute to, an action.

Not included in this list are the actions which may be taken within Defence to support preparedness of the Government workforce and infrastructure supporting this priority.

<table>
<thead>
<tr>
<th>Topic</th>
<th>Action</th>
<th>Responsible</th>
<th>Timeframe</th>
<th>Key Performance Indicators</th>
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<tbody>
<tr>
<td>Intellectual Property (IP)</td>
<td>Defence will develop guidance for industry on best practice regarding IP, including hints and tips for working with Defence and the range of existing IP strategies and requirements.</td>
<td>Strategic Policy and Intelligence Group</td>
<td>Quarter 4 2020.</td>
<td>Delivery of the guidance material.</td>
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<td>Support for Research &amp; Development</td>
<td>Defence will:</td>
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<td></td>
<td>• Continue to provide opportunities to industry through Diggerworks with access to Defence to obtain feedback on developmental equipment related to this priority.</td>
<td>Capability Acquisition and Sustainment Group</td>
<td>Ongoing.</td>
<td>Increase in the number of partner participants at Diggerworks.</td>
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<td></td>
<td>• Provide access to the Combat Application Lab, which was recently established within Army Headquarters as part of the Soldier Combat System Program. The Lab will provide a platform for Industry to engage with end users and subject matter experts across the Defence portfolio, including Defence Science and Technology Group, Capability Acquisition and Sustainment Group and Capability Manager representatives.</td>
<td>Army Headquarters</td>
<td>As required.</td>
<td>Increase in the quality and frequency of collaboration efforts between Defence and industry.</td>
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<td></td>
<td>• Continue to host forums and initiatives such as Army Innovation Day to provide Australian industry opportunities to display and pitch proposed innovations to assessors, Capability Managers and Defence Innovation Hub personnel.</td>
<td>Strategic Policy and Intelligence Group,</td>
<td>As required.</td>
<td>Future approaches to market reflect a more informed end user and greater appreciation of the application of emerging disruptive technology.</td>
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<td>Army Headquarters</td>
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<td>Government Opportunities in Textiles</td>
<td>To enhance tender submissions and promotional activities, Defence will continue to provide letters for industry that confirm the ADF’s use of their products.</td>
<td>Capability Acquisition and Sustainment Group</td>
<td>90 days from receipt of request</td>
<td>Request for letters of support are</td>
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<td>Topic</td>
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<td>Timeframe</td>
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<td><strong>Access to new or existing markets and international supply chains</strong></td>
<td>Defence, through the Australian Defence Export Office, will seek to provide export opportunities for Australian defence textile industry providers via international defence tradeshows. In 2020, Team Defence Australia will prioritise the introduction and support of export-ready companies with high value-add textile production capabilities to international contacts, networks and key international decision-makers. Expressions of interest will open closer to these events. Interested companies should email <a href="mailto:cdic_exports@industry.gov.au">cdic_exports@industry.gov.au</a> for more information.</td>
<td>Strategic Policy and Intelligence Group</td>
<td>2020.</td>
<td>Increase in the number of export-ready textile companies participating in defence tradeshows.</td>
</tr>
<tr>
<td><strong>Defence Industry Security Program</strong></td>
<td>Defence will continue implementing the reformed DISP to strengthen security practices in partnership with industry. DISP supports industry to protect their interests from threats including foreign interference, and increases opportunities to compete for work with Defence and international partners by becoming ‘Defence Ready’. Defence provides DISP members with access to security information, guidance and services, including personnel security vetting, certification and accreditation of facilities and/or ICT systems. In certain circumstances, Defence can also provide an assurance to international partners of an entity’s DISP membership, promoting Australia’s sovereign capability internationally. More information on DISP can be found at <a href="https://www.defence.gov.au/dsvs/industry/default.asp">https://www.defence.gov.au/dsvs/industry/default.asp</a></td>
<td>Associate Secretary Group</td>
<td>Ongoing.</td>
<td>Increase in the number of DISP members.</td>
</tr>
</tbody>
</table>
ANNEX B. ADDITIONAL SUPPORT THROUGH INDUSTRY PROGRAMS

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

Defence Innovation System

The Centre for Defence Industry Capability (CDIC), Defence Innovation Hub (DIH) and the Next Generation Technologies Fund (NGTF) comprise the integrated Defence innovation system, helping encourage innovation and growth in the Australian industry sector. This system will support companies that contribute to the generation of this priority to innovate further, and position them to better support the Australian Defence Force (ADF).

Next Generation Technology Fund

Science and technology is a significant priority for Defence. Defence has to be prepared for the next revolution in the way war is fought. To do this, the Government is investing approximately $730 million over the ten years to 2026, through the NGTF. This forward-looking program focuses on research and development in emerging and future technologies for the ‘future Defence Force after next’.

The NGTF supports a number of collaboration initiatives such as the Emerging Disruptive Technology Assessment Symposium and the Grand Challenges. These aim at getting the best thinkers in Australia on a particular topic together and facilitating collaboration between Defence, industry and academia. There are also a number of funding initiatives managed through the NGTF that companies who contribute to this priority may wish to leverage. These include:

- **The Small Business Innovation Research for Defence (SBIRD)** program provides opportunity to Australia’s SMEs to undertake research projects that will benefit Defence in the future. Successful SBIRD project outcomes might be commercialised directly by the participant, be the subject of a separate development support application with the DIH, or be adapted to support other NGTF ventures such as a Grand Challenge.

- **The Small Business Exploratory Program** will accelerate promising science and technology interests to Defence, from early-stage concept to a point where a proposal could be submitted to the DIH. The CDIC gives advice as to whether a technology idea could be eligible for NGTF funding.

Defence Innovation Hub

The DIH, or ‘The Hub’, brings together Defence industry, academia and research institutions to collaborate on innovative technologies that can be developed into capability for Defence. Funded at $640 million to 2025-26, the DIH 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.

Each year, the DIH reviews and publishes its innovation priorities to help innovators plan their research and development activities. The DIH’s innovation and investment priorities can be found at the following link: https://www.business.gov.au/centre-for-defence-industry-capability/defence-innovation/defence-innovation-hub/defence-innovation-hub-priorities.

Diggerworks

Diggerworks is a unique, multi-disciplinary team tasked with providing innovative and integrated solutions for the ADF’s Soldier Combat System (SCS) including scalable tiered body armour, ballistic body armour plates, helmets, load-carriage systems (including a prototype exoskeleton trial), soldier-worn power management and flexible battery systems.

It conducts ongoing development of SCS capabilities, ensures integration of new capabilities and contributes to the future modernisation of the SCS, and assures integration with the broader Joint Land Combat System. Diggerworks maintains an agile approach that seeks out and trials new products and capabilities to enable the adaptive acquisition of equipment that can be readily incorporated into the SCS.
Diggerworks actively engages with industry, providing a critical access point for industry to engage Defence stakeholders to better develop the technology edge for warfighters. Diggerworks facilitating communication between industry and the end user helps develop Australian industry in the combat clothing and signature reduction technology sub-sectors.

Diggerworks’ methodology mandates they conduct the following critical functions:

- Close engagement with ADF close combatants and commanders to identify SCS capability gaps;
- Leverage industry to identify SCS capability trends and emerging technologies;
- Maintain an agile, adaptive, responsive and rigorous approach to problem solving that harnesses Diggerworks’ unique, multi-disciplinary team;
- Focus on short to medium term SCS capability gaps but monitor the long term for technology pull opportunities;
- Integrate components and manage contributions to the configuration of the SCS;
- Maintain an active SCS related engagement with allies and regional partners; and
- Contribute to the broader, Army-led, modernisation of the SCS.

ADF close combatants require a continual enhancement of the SCS in order to successfully conduct complex operations in demanding environments against adaptive enemies. Through the collaboration of Army, Capability Acquisition and Sustainment Group (CASG) and Defence Science and Technology Group (DST) Group, Diggerworks provides the ability to identify, analyse, develop and provide system level assurance of SCS solutions that enhance the capabilities of the ADF close combatant.

Centre for Defence Industry Capability

The Centre for Defence Industry Capability (CDIC) is funded by Defence and delivered by the Department of Innovation, Industry and Science. The CDIC supports Australian businesses either working in or looking to enter the defence sector, by providing advisory and facilitation services and grants to eligible Australian businesses to support them to deliver Defence capabilities. The CDIC’s national network of specialist Defence Industry Facilitator and Defence Business Advisers can be contacted to discuss opportunities for business related to this priority. They also provide guidance on business improvement, skills development, defence market preparedness, exports and supply chain participation.

The CDIC administers Capability Improvement Grants of between $5,000 to $250,000 on a co-contribution basis for Small and Medium Enterprises (SMEs) to fund part of the cost to engage a consultant or expert to implement business improvements.


Sovereign Industrial Capability Priority Grants

In November 2018, the Government launched the Sovereign Industrial Capability Priority Grants program. The Grants program allows Defence to improve the resilience of a priority by providing funding to industry to ensure that Australian SMEs have the appropriate capacity and resilience to support Defence’s critical capabilities.

Grants of up to $1 million are be 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 $3 million over three years and are delivered through the CDIC. These grants directly subsidise the growth of industry in the critical industrial capabilities underpinning the priorities. This type of funding is for more mature companies that are able to fund at least 50 per cent of the funding and directly support the increased sovereignty outcomes for a particular priority.

Other Defence support opportunities

Australian Defence Export Office

The research, analysis and consultation undertaken to develop this Industry Plan provided evidence of the number of Australian companies already pursuing export opportunities or supplying to overseas customers. The development of the Defence Export Strategy is intended to support these companies in their endeavours, and to encourage more SMEs to pursue export opportunities.

The Strategy, released in 2018, outlines the government's plan to support Australian defence industry to achieve greater export success to build a stronger, more sustainable and globally competitive defence industrial base to support Australia's Defence capability needs. Increasing access to international markets, through exports, will assist in reducing 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.

External support and collaboration opportunities

Industry is able to access further support and collaboration opportunities with respect to this priority through the organisations below. The list provided below is intended to focus on those opportunities specific to this priority, and not intended as exhaustive. It is acknowledged that other schemes and programs are available at academic institutions and across industry.

Defence Materials Technology Centre

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

The DMTC 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, DMTC works closely with Defence agencies such as DST Group and Force Design Division (within Vice Chief of Defence Force Group) to identify Defence capability changes and future needs. The DMTC then engages with industry and research partners to find solutions with advancing key technologies.

The DMTC focuses on the following capabilities:

- 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 light weighting materials;
- Advanced ceramics and coatings; and
- Smart textiles and fabric technologies.

Defence Science University Network

The Australian Defence Science University Network is made up of four state based organisations that are designed to link university research and development capabilities with local small to medium enterprises. These organisations can provide advice and advocacy, assist building collaborations and partnerships, identify opportunities, and in some cases, provide funding support.

- Defence Science Institute (Victoria and Tasmania)
www.defenceinnovationinstitute.com

- Defence Innovation Partnership (South Australia and Northern Territory)
  www.defenceinnovationpartnership.com

- Defence Innovation Network (New South Wales)
  www.defenceinnovationnetwork.com

- Defence Science Centre (Western Australia)
## ANNEX C. ACRONYM LIST

<table>
<thead>
<tr>
<th>Acronym</th>
<th>Description</th>
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<tbody>
<tr>
<td>ABS</td>
<td>Australian Bureau of Statistics</td>
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<tr>
<td>ADF</td>
<td>Australian Defence Force</td>
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<td>ADTEO</td>
<td>Australian Defence Test and Evaluation Office</td>
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<tr>
<td>AIC</td>
<td>Australian Industry Capability</td>
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<td>AISC</td>
<td>Australian Industry and Skills Committee</td>
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<tr>
<td>ANZSIC</td>
<td>Australian and New Zealand Standard Industrial Classifications</td>
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<tr>
<td>ASDEFCON</td>
<td>Australian Standard Defence Contract</td>
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<tr>
<td>CASG</td>
<td>Capability Acquisition and Sustainment Group</td>
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<tr>
<td>CDIC</td>
<td>Centre for Defence Industry Capability</td>
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<tr>
<td>DCDM</td>
<td>Defence Capability Development Manual</td>
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<tr>
<td>DMTC</td>
<td>Defence Materials Technology Centre</td>
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<tr>
<td>DICP</td>
<td>Defence Industrial Capability Plan</td>
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<td>DIH</td>
<td>Defence Innovation Hub</td>
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<tr>
<td>DSTG</td>
<td>Defence Science and Technology Group</td>
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<tr>
<td>ICT</td>
<td>Information Communications Technology</td>
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<td>IIP</td>
<td>Integrated Investment Program</td>
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<tr>
<td>IP</td>
<td>Intellectual Property</td>
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<tr>
<td>NATA</td>
<td>National Association of Test Authorities</td>
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<tr>
<td>NGTF</td>
<td>Next Generation Technologies Fund</td>
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<tr>
<td>OT&amp;E</td>
<td>Operational Test &amp; Evaluation</td>
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<tr>
<td>R&amp;D</td>
<td>Research &amp; Development</td>
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<tr>
<td>SBIRD</td>
<td>Small Business Innovation Research for Defence</td>
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<tr>
<td>SCE</td>
<td>Soldier Combat Ensemble</td>
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<tr>
<td>SCS</td>
<td>Soldier Combat System</td>
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<tr>
<td>SME</td>
<td>Small-to-Medium Enterprise</td>
</tr>
<tr>
<td>T&amp;E</td>
<td>Test and Evaluation</td>
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Please direct any questions on the Sovereign Industrial Capability Priority policy or the information contained in this Industry Plan to:
defence.icp@defence.gov.au