



Australian Government
Department of Defence



**Shaping Defence Science
and Technology in the
Joint Domain
2017-2021**



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Shaping Defence Science and Technology in the Joint Domain 2017–2021 is the inaugural Joint Science and Technology Strategy. It outlines areas of focus for science and technology to support Defence's strategy, capability and operations, and identifies which research areas have the potential to support them. To achieve this, consideration has been given to strategic guidance, changes in the future operating environment, and current joint science and technology support to Defence. This document should be used to inform and shape investment in current and future science and technology capabilities and programs.

This Strategy will enable effective balancing and prioritisation of the Defence Science and Technology Group's efforts within the Joint Domain Science and Technology Program. *Shaping Defence Science and Technology in the Joint Domain 2017–2021* has been endorsed by:

Mr Tom Hamilton
First Assistant Secretary Strategic Policy, SP&I Group

MAJGEN Stuart Smith
Deputy Chief Joint Operations Command, JOC Group

AVM Mel Hupfeld
Head Force Design, VCDF Group

RADM Peter Quinn
Head Joint Capability Management and Integration, VCDF Group

MAJGEN Simone Wilkie
Head Joint Enablers, VCDF Group

MAJGEN David Mulhall
CJLOG – Chief Joint Logistics Command, VCDF Group

RADM Tony Dalton
Head Joint Systems Division, CASG

Mohan Aiyaswami
Chief Technology Officer, CIO Group

Ms Kate Louis
First Assistant Secretary Defence Industry Policy, SP&I Group

Dr Richard Davis
Acting Domain Program Manager Joint, DST Group

Introduction

The Government's *National Innovation and Science Agenda*, and *Defence White Paper 2016* (DWP), outline new approaches to investment and collaboration in science and technology (S&T). At their cores are initiatives to increase the level of engagement between industry, academia and Defence to create a seamless link between capability needs, smart ideas and innovation across the Fundamental Inputs to Capability (FIC). The Defence Science and Technology (DST) Group will play a pivotal role in driving Defence's S&T agenda and facilitating this collaboration as part of the national innovation system.

DST Group value proposition 2015: *DST Group provides value to Australia's defence and national security through its capacity to reduce and mitigate strategic and operational risks and to create and maintain a capability edge.*

The *First Principles Review* (FPR) recommendation 2.21 requires Defence, *in partnership with academia and industry, to review its research priorities, their alignment with future force requirements and capacity to leverage allied partners to promote innovation.* The Joint S&T Strategy facilitates S&T for a highly adaptable and integrated joint force by articulating a consolidated set of focus areas and strategic priorities for 2017 through to 2021 that will support the joint S&T stakeholders' objectives and capabilities. The joint S&T stakeholders are:

- Vice Chief of Defence Force (VCDF) Group;
- Strategic Policy and Intelligence (SP&I) Group – strategy and policy elements only;
- Chief Information Officer (CIO) Group;
- Joint Operations Command (JOC); and
- Capability Acquisition and Sustainment Group (CASG).

Joint Domain Science and Technology program vision: *Defence is able to field a joint integrated force, capable of operating in anticipated or identified operational risk environments, which exploits emerging technology and is supported by strong S&T partnerships, knowledge integration and innovation.*

The Joint S&T Strategy provides a lens to focus the S&T resources from a range of organisations to support Joint S&T stakeholders and the Chief Defence Scientist (CDS) achieve Government policy objectives and contribute to Defence strategic outcomes. The Strategy is also intended as a guide to facilitate Defence's engagement and collaboration with Australian defence industry, academia, publicly funded research agencies and international counterparts.

The Strategy is the foundation upon which the DST Group's Joint Domain S&T Program is planned, monitored and reported. Domain Program Manager (DPM) Joint leads the development of the Joint Domain S&T Program and is accountable to CDS for Joint Domain S&T outcomes. The DPM Joint will use the Strategy and guidance from the VCDF, as the Joint Capability Authority, to prioritise the investment in the DST Group's Major Science and Technology Capabilities (MSTC) that contribute to the Joint Domain S&T Program. The Joint Domain S&T Program is considered and balanced collectively with the five other Domain S&T Programs¹. The Investment Committee process, and direction from the Joint Capability Authority, will be used to balance the investment across all Domain S&T Programs.

¹ The other Domain S&T Programs are Maritime, Land, Aerospace, Intelligence and National Security.

The revised joint S&T stakeholder roles developed as part of the FPR and ADF Headquarters Review, and the associated organisational structures, were still maturing when the Strategy was published. For this reason, the initial Joint S&T Strategy has a much shorter time horizon than would be expected and it is anticipated that a review will be needed at the end of the first year of its implementation. The Strategy will then be reviewed every two years for alignment with the Defence Planning Guidance (DPG) through the joint capability governance arrangements of the Joint Warfare Council and Joint Capability Coordination Committee, and maintained by the Joint S&T Working Group. The next update will include areas of leverage and dependencies with the other S&T Domains.

Joint Force capability and direction

The future operating environment for the joint force will become increasingly congested, complex, and contested. The FPR and DWP provide a detailed narrative of the Government's intentions for the joint force and its expectation of how Defence reform will build a stronger and more resilient Australian Defence Force (ADF). Maintaining and improving upon Australia's technological edge and capability superiority over potential adversaries is an essential element of this strategy.

“The Government will ensure Australia maintains a regionally superior ADF with the highest levels of military capability and scientific and technological sophistication. The future force will be more capable, agile and potent. The future force will be more capable of conducting independent combat operations to defend Australia and protect our interests in our immediate region. This force will also enhance Australia's ability to contribute to global coalition operations”. [DWP16 p18]

Beyond the horizon of the DWP, the Future Operating Environment (FOE) document developed by VCDF Group, describes the key features of the operating environment likely to be encountered by the joint force out to 2035 and beyond. The Future Joint Operating Concept (FJOC) analyses the FOE to inform the force design function, options for force structure review and subsequent investment decisions. The FOE and FJOC will guide decision making for the future joint force. The Australian Joint Operating Concept (AJOC) provides a narrative that describes how the planned joint force will operate to meet Government expectations in the DWP, the priorities in the DPG, and the strategy in the Australia's Military Strategy (AMS).

Over the next five years, the planning horizon for the initial Joint S&T Strategy, the Integrated Investment Program (IIP) will sustain a range of current Joint Domain capabilities and develop significant next generation capabilities in Command, Control, Communications, Computers and Intelligence (C4I), Intelligence, Surveillance and Reconnaissance (ISR), Space, Electronic Warfare (EW), and Cyber Security. Key enablers for the joint force will also be developed in Health Services, Fuel, Explosive Ordnance, and Training Support and Simulation. The associated capability products will need to be designed to integrate and interoperate as part of future joint and combined task forces responding to a range of potential contingencies. The IIP Joint Domain Program Strategies will provide further capability guidance to situate and relate the role of S&T in supporting capability programs, projects, products and activities.

“There will be more emphasis placed on the joint force – bringing together different land, air, sea, intelligence, electronic warfare, cyber and space capabilities so the ADF can apply more force more rapidly and more effectively when called on to do so. A new permanent future force design function in Defence will strengthen Defence's capacity to deliver joint and integrated capabilities.” [DWP16 p84]

The ability of the ADF to plan, prepare and conduct current operations will continue to be the highest priority for Defence and S&T support. As the operating environment evolves and contingencies arise, S&T plays a crucial role in identifying operational risk, identifying opportunities for S&T injects and providing an evidence base for improved operational decision making.

Focus area framework

The Strategy identifies eight focus areas for S&T support. Whilst the focus areas require enduring attention, a number of priority topics have been articulated throughout the Strategy to address current and anticipated challenges over the next five years. These focus areas and priority topics inform and shape S&T capability investment for Defence and DST Group’s Joint Domain S&T Program.

The focus areas, shown in circles in Figure 1, are designed to reflect the roles of Joint S&T stakeholders whose responsibilities include strategy, concepts, capability and operations, which are underpinned by key enablers and influences. Identified at the interface between focus areas in Figure 1 are some of the artefacts that create shared interests between stakeholders and drive interdependencies between the S&T focus areas.

Figure 1: Joint Domain S&T focus areas, responsibilities and artefacts



S&T support to Current Operations is an enduring Defence priority. Preparing for Emerging Contingencies binds together the fabric of the focus areas to support the next operation. Joint collective training, supported by experimentation, simulation and wargaming, will both prepare the force for the next operation and influence the integration of the joint force by design, a VCDF responsibility. The FPR requires VCDF, as the Joint Capability Authority, to play a much larger role in shaping capability through creating an enduring force design process, responsibility for chairing the Investment Committee (IC), and taking on the new role as a Joint Capability Manager. The strengthened role of the strategic centre will also change the nature of S&T support to SP&I Group in areas such as Defence strategy, strategic policy, contestability and innovation.

Joint Domain science and technology focus areas

Strategic analysis to shape Defence

The Strategic Analysis to Shape Defence focus area relates to the intent of the DWP's most basic strategic Defence interest for a secure, resilient Australia and the FPR recommendation for a stronger and more strategic centre able to provide clear direction and contestability of decision-making. This guidance is amplified through the strategic intent outlined in the AMS and DPG which form a basis for strategic risk and resilience assessments of the Australian Defence Organisation (ADO).

A strong strategic centre that conducts arm's length contestability to ensure strategy, plans and resource allocations are tightly aligned and appropriately prioritised will increase demand for independent and impartial strategy and capability analysis, supported by S&T advice. The contestability function will require S&T input to ensure there is a strong evidence base for decisions, and the methods used to generate the evidence are appropriate.

Priorities

Future Environments – Exploring and articulating potential future environments and generating suitable contexts for future force decision-making

Strategic Resilience – Design and generation of a capable, agile and potent force

Contestability Framework – Contestability advice to ensure Defence's force design, capability needs and requirements are aligned with strategy and resources



Science and technology support

Advice and expertise in risk assessments ranging from technical systems through to strategic policy, will be essential for this focus area. The application of these techniques will provide assessments on Defence capability and resilience issues that are at the core of Defence’s strategy and future planning.

The contestability function will require decision support approaches through the application of techniques such as red-teaming, operations analysis and capability modelling to examine the sensitivity of force performance to key assumptions or the introduction of new technology. This will be enhanced through the alignment of DST Group staff to support the Capability Life Cycle (CLC).

Strategic analysis to shape Defence	
Military objective/capability	Research areas
<ul style="list-style-type: none"> • Strategic guidance development and updates • Defence enterprise resilience in the context of global change • Strategic risk indicators and warnings to prevent surprise • Future contexts and scenarios that frame future force development and operational decisions • Technology futures to inform strategic planning • Strategic contestability of the force structure and portfolio of capability investments • Program, product and project development assurance and contestability • Counter-proliferation of weapons and technologies 	<ul style="list-style-type: none"> • Risk and complex systems sciences to support development of national security policy, strategy and plans • Futures and scenario methodologies • Frameworks for capability dependencies and enablers • Capability modelling and analysis environments • Methods to exploit whole-of-Defence lessons • Data mining, analytics and social media techniques to identify changes and trends • Analysis techniques to assess the implications of Emerging Technologies in the Defence context • Proposing and assessing research and development pathways for future capability



Supporting force design

The force design process is strategy led and orchestrated from the strategic centre. It underpins the Strategy and Concepts Phase of the CLC. Under the guidance of the VCDF as the Joint Capability Authority, the force design process includes identification of joint force gaps and issues, development and testing of operating concepts, identification of emerging threats, and analysing potential responses and trade-off implications.

A continuous force design cycle is important as over time changed strategic circumstances and emerging military threats will mean that changes to the IIP will be required. This will necessitate regular reviews of IIP programs, resources, priorities and progress, to inform updates to investment portfolio plans and program guidance. This will ensure proposals are consistent with Government's requirements of the future ADF. The force design cycle will be centred on joint force capability assessment priorities determined through the Defence Capability Assessment Program (DCAP). The DCAP will drive the priorities for force design deep dives, wargaming, experimentation and innovation.

A key output of force design deliberations will be Capability Program Narratives (CPNs) which form endorsed program level guidance. Joint Capability Narratives, produced by Force Design Division, will provide additional project oriented detail and cross program guidance not captured in CPNs. This is a tasking statement for the Capability Manager to develop a Joint Capability Needs Statement and Project Execution Strategy aligned with the strategic intent for the capability and the anticipated project complexity. The force design process will ensure these statements are consistent with government requirements to achieve the best fit in capability, preparedness and sustainment, including all FIC elements. Consideration of high-level capability integration requirements to maintain the integrity of the future force structure will also be articulated through the generation of CPNs.

Priorities

Force Design Forward Work Plan – Planning and prioritisation to inform the development of the force design cycle, coordination of resources and forecasting of future activities for the Defence Capability Assessment Program

Portfolio Decision Science – Development of a planning and prioritisation methodology, and tools, that determine IIP priorities and provide an assessment and visualisation of the joint force impacts

Force Design Body of Knowledge – Data relationships and content for informing force design activities, decisions and products based on a single source of truth

Force Design Process – Maturation of the Joint Concepts Framework and the Joint Experimentation Framework, establishment of the partnerships that will enable successful application of the frameworks, and experimentation with the Australian Joint Operating Concept and Future Joint Operating Concept

Science and technology support

S&T support to the force design process is a key enabler of robust and objective analysis that will deliver evidence-based and transparent advice to build a thorough understanding of options and their relative benefits, relationships, trade-offs and implications. Analysis and simulation capabilities are required to support concept development, force options development, capability assessment, capability integration, force posture development, and balance of investment.

Capability prototyping and demonstrations will provide deeper insights into the potential impacts on force design of new technologies and organisational innovations across the FIC. S&T is critical to delivering independent, impartial and timely decision support advice across the functions of the force design process.

- Analysis of the Force-in-Being and the Planned Force to provide decision-makers with a current baseline of capability gaps, issues, risks and opportunities for informing key joint force investment and posture decisions;
- Experimentation tools and techniques to understand how the Force-in-Being, Planned Force and Future Force will be employed in current and future operations as part of a conceptually-led, capability-based and affordable force;
- S&T to support the timely development of broad options to address gaps, issues, risks and opportunities identified by both Force Design, Capability Manager or Enabler Group Heads;
- Assessments of the FOE, FJOC, AJOC, strategic guidance and intelligence to develop options for the design of the Planned Force and Future Force; and
- Analytical methodologies, data integration and tools to support the prioritisation, management, monitoring, reviewing, reporting and traceability of joint force capability development and delivery progress in support of Portfolio management activities.

Supporting force design	
Military objective/capability	Research areas
<ul style="list-style-type: none"> • Futures and joint concept development to identify gaps, risks, issues and opportunities for the Future Force • Anticipating future technologies and the impact upon the force design • Joint experimentation and analysis for force design • Contextualising, prioritising and recommending Defence innovation topics • Joint lessons and evaluation to support the Defence wide lessons learnt program • Joint doctrine development incorporating concepts and lessons • Force structure options assessment and Capability Program Narrative development • Force design planning and prioritisation with links to joint integration planning • Investment portfolio decision support and monitoring • Joint force balance of investment • Coordination of force design assessment, adjustment and evolution 	<ul style="list-style-type: none"> • Conceptual models and architectures to support force design management and evolution at portfolio, program and project levels • High-level systems of systems design and integration • Technology maturity, complexity and risk assessment • Simulation, experimentation and wargaming for force design • Operations research and operations analysis of military capability systems • Strategic balance of investment analysis and prioritisation • Capability modelling including trade-off between cost, risk and delivery schedule • Business analysis for portfolio management • Data analytics and visualisation of capability interdependencies

Enhancing Joint Capability Management and Integration

Enhancing Joint Capability Management and Integration relates to the design, acquisition and management of capability throughout the CLC to deliver an integrated joint force by design. Adopting a whole of life view through the management of capability at the project, program and portfolio levels, and including integration with Enabling Capabilities, is a key feature of the CLC.

This focus area will be affected by the emerging roles of VCDF as the Joint Capability Authority and Joint Capability Manager, as follows:

- As the Joint Capability Authority VCDF is responsible for Integration and Interoperability (I2) across the capability lifecycle, Command, Control, Communications, Computers & Intelligence, Surveillance, and Reconnaissance (C4ISR) Design, and Joint Test and Evaluation.
- As the Joint Capability Manager VCDF is responsible for joint programs and capabilities including C4I, ISR, EW and cyber security, all of which will require enduring S&T support. An expanded Joint Counter Improvised Threat Task Force remit will increase demands for S&T across the counter improvised explosive device (CIED), chemical biological and radiological (CBR) defence, and emerging threats. Future Defence Innovation will define joint capabilities related to C4ISR systems, cyber, and EW which will create new demands on S&T support.

These new roles, along with force design, will significantly expand the responsibilities of VCDF and will change how programs, projects and products are managed in the new CLC with support from the acquisition agencies.

Priorities

C4ISR Design Authority – Establish the functions of the C4ISR Design Authority to define and assure the joint warfighting environment, architecture and interoperability requirements

Joint Force Integration – Realise the integrating objectives for the Force-in-Being and the Objective Force in specific Joint Domain programs and projects: networked, partnered, compatible, survivable and designed for change

Joint Counter Improvised Threat – To identify the scope of potential future emerging improvised threats and the options to counter them

Science and technology support

Defence undertakes a range of S&T activities within the Joint Domain that contribute to understanding the military capabilities of the joint force and how it might be improved to meet future demands. S&T plays a key role in providing informed specialist advice and solutions in support of the CLC.

Determining which integration and interoperability needs and requirements are essential for what capability and conducting trade-off decisions is fundamental to achieving an integrated joint force by design. The structure and content of the Integrating Operational Concept Document has been the product of a close collaboration with DST Group which will continue to evolve as a key guidance for projects.

To achieve an affordable C4ISR design requires mechanisms that help Defence understand the joint battlespace, how to choose which projects to pursue, and how to provide guidance on systems development. Modelling, prototyping and operational test and evaluation all inform these trade-off decisions.

The continuing development and emergence of new and innovative technologies and approaches will inform Defence in making often difficult and complex trade-off decisions and enable optimum joint Defence capability. Through the Defence Innovation initiatives, new and novel integration and interoperability solutions developed by industry will converge to realise the Joint Battlespace Networked Environment.

DST Group has a mix of mature and emergent S&T programs that contribute to this focus area. The work on cyber defence has been in progress for over a decade and has delivered many advanced technical solution to Defence. Over a similar timeframe, the development of decision support tools for joint C2 and logistics planning have transitioned into use by Defence. The same long term commitment to research by DST Group, in collaboration with partners, will be required to address emerging challenges in the areas of integrated air and missile defence, joint counter improvised threats and military use of space.

Enhancing Joint Capability Management and Integration

Military objective/capability	Research areas
<ul style="list-style-type: none"> • Through life joint capability design, management and evolution • Joint capability integration and interoperability requirements • Joint test and evaluation • Joint C4ISR architecture design • Defensive cyber operations • Information activities • Military use of space • Joint C4ISR for integrated air and missile defence • ISREW • Leadership and coordination of joint counter improvised threats 	<ul style="list-style-type: none"> • Model-based approaches to capability architectures • Systems-of-systems design, analysis and engineering to enhance joint force integration • Accelerated systems and system-of-systems thinking and engineering training approaches • Design, management and integration of federated modelling simulation environments • Next generation C2 and machine learning techniques • Sources of technical risk and interdependency • Mission-centric cyber security and defence • Trusted autonomous systems • Platform self-protection • Pervasive wide area surveillance • High power lasers and microwave • Distributed EW warfare concepts and technologies • Explosives, force protection electronic counter measures and other counter improvised threat research



Preparing for emerging contingencies

To meet preparedness requirements, the joint force must be able to be deployed and sustained on operations in a timely and effective manner. The joint force must be adaptable to changing circumstances to ensure it maintains a competitive advantage over potential adversaries. The current Government has directed an increase in the ADF's preparedness level, based on raising its overall capability and improving its sustainability on operations. Emerging contingencies will drive joint force generation through planning, training and certification activities and inform the joint force's sustainment requirements across the FIC.

The ADF needs to be a smart buyer and a smart user supported by sound S&T advice. Enhancement of in-service weapons systems together with improved safety, availability, reliability, and effectiveness of these systems are critical factors in maintaining an effective and superior operational capability. Both of these requirements are clearly highlighted in the DWP, which also indicates Defence sustainment costs will grow 25% over the next 10 years due to a more active and regionally engaged ADF. Preparedness requirements for new capabilities must also be considered and understood during the Strategy and Concepts phase of the CLC.

Priorities

Preparedness – The ADF must have higher levels of preparedness so that it can quickly and effectively respond to emerging circumstances and be better able to manage strategic and operational risk. An increase in the ADF's preparedness level is based on raising its overall capability and improving its sustainability on operations

Science and technology support

S&T support will play a key role in providing informed specialist advice and solutions in support of the capability lifecycle, logistics and safety. The continuing development and emergence of new and innovative technologies and approaches will inform Defence in making often difficult and complex decisions and enable optimum Defence capability for Australia's investment.



S&T for generating and sustaining the joint force ranges from techniques that support the characterisation of the emerging Joint operating environment, and anticipation of operational S&T requirements, through to technical advice on the sustainment and continued operation of key joint Defence assets. Support can also take the form of analytical teams undertaking operational evaluations and recommending enhancements to the future structure and procedures of headquarters. All activities in this focus area are enhanced through DST Group embedded staff and partners within joint stakeholder organisations whose role is to enhance the delivery of S&T, help raise the preparedness of the joint force, and engage external S&T partners to Defence.

S&T support will be used in the identification and contextualisation of future operational risk, proposing S&T options to address risk, and providing an evidence base for improved operational planning. Assessment of cultural and human terrain in potential operating environments will further enhance the preparation of the joint force. The design and conduct of joint training exercises and trials provides the mechanisms to collect data, generate evidence, and inform preparedness decisions.

S&T contributes to the ongoing sustainment of joint capability across the FIC and the development of innovative solutions that address current integration and interoperability challenges. Research that anticipates risks to systems and tests the effectiveness of mitigation strategies is also essential to manage the costs associated with sustaining the joint force. The ongoing efforts of DST Group’s Project S&T Advisers, and the networks of industry and international experts with whom they engage, is an essential component in generating and sustaining the joint force.

Preparing for emerging contingencies

Military objective/capability	Research areas
<ul style="list-style-type: none"> • Anticipate changes in the operating environment including improvised threats • Improve operational contingency planning • Defence preparedness requirements development and analysis • Joint collective training and certification • Force generation activities • Joint force sustainment 	<ul style="list-style-type: none"> • Operations research, red-teaming, and risk analysis for emerging operational contingencies • Simulation and evaluation support for joint exercises • Operational lessons and evaluation support • Scientific and technical advice on the sustainment and enhancement of joint systems and warstock • Performance and effectiveness enhancements to weapons systems and explosive ordnance • Development and testing of systems, capabilities and procedures to counter anticipated threats



Support to current operations

Support to current operations includes the planning, control and conduct of military campaigns, operations, and other activities in order to meet Australia’s national objectives and the DPG. In line with the Strategic Defence Interests, the Government has determined that Defence must be better prepared to meet a broader range of security challenges in the coming years.

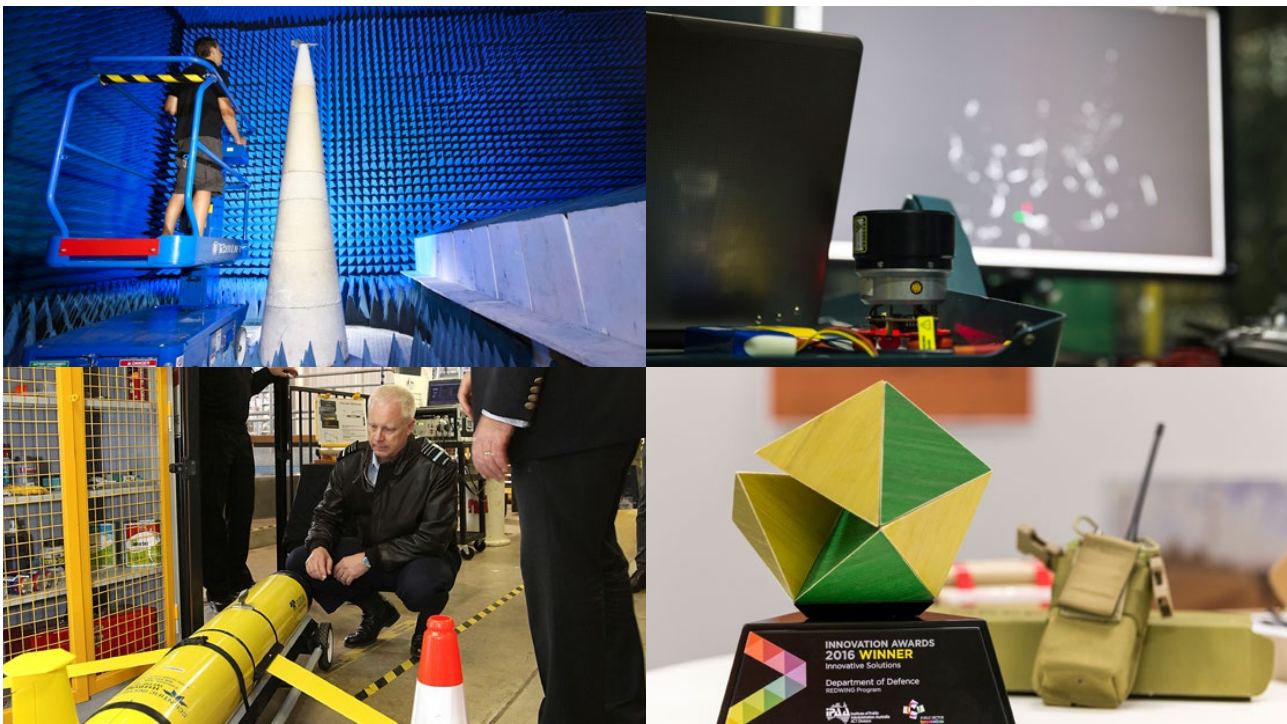
Mission success in current joint operations is enabled through a mixture of deliberate and dynamic planning undertaken across multiple organisations to support the command of assigned forces in a range of potential operational environments and contingencies. S&T support to current operations includes activities designed to enhance ADF mission effectiveness and mitigate operational risk.

Priorities

Joint Operations – The joint force must be able to operate effectively and with a minimal level of risk across a range of operational environments within an increasingly contested battle space

Science and technology support

S&T support to this focus area is operationally urgent, possibly high risk but with significant benefits to deployed forces, and will ultimately shape thinking about future joint force capability through evaluation and lessons. Defence undertakes a range of science, technology and analysis activities in support of current operations. Capability managers, acquisition agencies, and DST Group prioritise responses to the needs of deployed forces, and partner with Australian defence industry, academia, publicly funded research agencies and international counterparts to deliver innovative solutions. Internally to Defence, organisations such as Diggerworks, Land Network Integration Centre, Air Warfare Centre, Maritime Warfare Centre, Joint Counter Improvised Threat Task Force and the DST Group Operations Support Centre (DOSC) all coordinate and deliver a range of solutions



including modelling and simulation of improved tactics, analysis and exploitation of operational data, forecasting emerging threats and insertion of innovative technology solutions into theatre, to enhance the conduct of current joint operations and safety of deployed ADF personnel. It is likely that succeeding in mastering the complexities at the boundaries between these (and other) organisations will deliver a significant S&T effect to the joint force whilst on operations.

The DOSC is the vehicle through which DST Group delivers urgent S&T support to the planning, conduct and evaluation of joint, combined and interagency operations. Its mission is to enhance ADF operational effectiveness and mitigate operational risk. The DOSC:

- Coordinates the deployment of DST Group personnel on operations and major joint exercises;
- Provides reachback analysis in support of deployed staff;
- Manages, structures and exploits operational data;
- Facilitates threat anticipation and mitigation within operational theatres; and
- Provides expedited access to relevant DST Group MSTCs in response to operationally-urgent requests, including national security crises and contingencies.

Support to current operations

Military objective/capability	Research areas
<ul style="list-style-type: none"> • Conduct joint, combined and interagency operations • Anticipate and mitigate operational risk • Situational awareness and decision making on operations • Ensure safety, performance and reliability of weapons in-theatre • Prevention, prediction, detection, neutralisation, mitigation and exploitation of improvised threats • Evolve the DOSC to provide project management, coordination and crisis response for current and future operations 	<ul style="list-style-type: none"> • Techniques to enhance the delivery of deployed S&T to operational theatres • Operational analysis, decision support tools and operational data exploitation • Operational intelligence fusion, database design and analysis • Human terrain, conflict analysis and campaign assessment • S&T support to maritime surveillance • S&T support to joint effects • Specialist scientific advice and response for operationally-urgent explosive ordnance safety and performance issues • Technology insertion into operational theatres to improve mission effectiveness and mitigate risk • Operational threat mitigation such as improvised threats • Specialist S&T support to force protection issues on operations • Exploitation of devices recovered from operations

Integrating information across the Defence Enterprise

Successfully integrating information across the Defence Enterprise will provide Defence with decision superiority spanning all aspects of the CLC including strategy, concept development, force design, capability needs and requirements, and support to the ADF on operations. In order to deliver decision superiority, Defence has to have access to world class information systems and the tools that exploit information that is collected and stored across the Defence Enterprise. One of the core challenges for Defence is how to effectively integrate and maintain selected information systems that support strategic policy, contestability, capability development and acquisition, and commanders deploying and operating the joint force.

This focus area encompasses the infrastructure (communication and computing networks), information systems, databases, management systems and security, including computer network defence, that enable the single operating environment at a range of security classification levels. The enabling and integrating systems are vital for Defence to bring capability elements together to deliver more potent and lethal joint combat effects. Enabling and integrating systems such as ISR systems, information and communications technology (ICT), ensure Defence gets maximum performance from the ADF's platforms.

Priorities

Enterprise Information Management – Modernisation of enterprise systems, including enterprise program management, a force design repository, and logistics, health and personnel management systems for new ways of delivering support and sustainment to joint operations

Tactical networks – The joint force must pass information and data automatically and rapidly between components, platforms and systems in contested environments. As Defence becomes more reliant upon advance information systems to support joint operations, enhancing the robustness and resilience of future networks will be a key joint force enabler

Intelligence Mission Data – Management and integration of Intelligence Mission Data (IMD), for pre-programming advanced platforms



Science and technology support

S&T contributions to a more resilient and assured enterprise network, and more reliable tactical communications, underpins this focus area.

Research and development to integrate information across the Defence Enterprise includes:

- Systems supporting ISR, EW, strategic logistics, including the defence information environment, and software architectures; and
- Outcomes from research into trusted autonomy, cyber security, distributed EW and information fusion.

Integrating information across the Defence Enterprise	
Military objective/capability	Research areas
<ul style="list-style-type: none"> • Information technologies (e.g. cloud computing, open source, data analytics) • Information and systems integration to deliver joint capabilities (e.g. deployable C2, Amphibious Capability) • Network and data architectures to support joint capabilities • Logistics and weapons applications and systems • Improved Joint HQ efficiency and effectiveness • IMD systems and services • A consistent and coherent force design data model from concept to operations 	<ul style="list-style-type: none"> • Interoperability and networked information management for combat mission systems • Autonomous, self healing communications networks • Protected communications links and networks • Assessing operational effectiveness of combat enablers • Analytical techniques for command decision making • Data quality and combat effectiveness • Proposing and assessing approaches to developing and maintaining a force design data model • Trustworthy ICT development and assurance



Supporting the Joint Enablers

Joint Enabler organisations include Joint Logistics Command, Joint Health Command, the Australian Defence College, the Cadet, Reserve and Employer Support Division and the Australian Civil-Military Centre. The Joint Enablers deliver direct enabling support to CMs, Joint Operations Command and International Policy Division to enable Defence operations, preparedness, sustained capability and international engagement objectives to be achieved. Joint Enablers also have policy and capability coordination responsibilities, playing an increasingly important role in achieving coherent enterprise approaches to the Joint Enablers including management of the joint programs and capability for Health Services, Fuel, Explosive Ordnance, and Training and Education Support, and Simulation.

The Joint Enablers deliver services and functions in support of Defence capability including:

- Logistics supply and management (including fuels and explosive ordnance);
- Garrison and deployable health services;
- Delivery of joint professional military education and joint individual training and enabling learning systems;
- Reserves, cadets and youth programs; and
- Civil-military-police engagement.

The DWP articulates the need to upgrade logistic systems, fuel and explosive ordnance facilities, training and learning systems, testing facilities, health services and supporting ICT.

Priorities

Medical Countermeasures – Ensure that Military personnel health is protected from chemical agents, toxic industrial chemicals, biological agents (naturally occurring or deliberate release), and radiological material

Joint Logistics – Planning, acquisition, storage and distribution of the fuels and explosive ordnance

Military training and Education – Analysis of lessons learned to support future training and education capabilities to meet operational objectives



Science and technology support

S&T has a significant impact in this focus area and due to the broad nature of the Joint Enablers, the S&T support is a combination of DST Group programs and S&T provided by external agencies and through international engagement. This model allows for S&T to meet the broad requirements to obtain relevant S&T advice from national and international partners, or from within DST Group, on specialist and sensitive aspects of Defence projects.

DST Group S&T provides significant input into international program arrangements. The Medical Countermeasure Consortium is a four-eyes partnership involving the Departments of Defence and Health. The Consortium seeks to develop medical countermeasures including drugs, vaccines and diagnostics to assist with all-hazard preparedness and response. The emphasis of the Consortium is on Defence and public health-related issues such as Chemical, Biological and Radiological (CBR) threats affecting civilian and military populations and has been expanded to include emerging infectious diseases and pandemics. The work conducted at DST Group is augmented by the S&T outputs from international partners to provide a holistic S&T program managed by the Consortium.

VCDF Group maintains responsibility for all Defence explosive ordnance, and S&T will continue to play a crucial role across the complete munition lifecycle. Defence’s increased emphasis on the CLC will be manifested in increased demand for research aimed at improving munition safety, availability, reliability, and performance, as well as life extension, failure investigations, and improvements in environmental footprint. Science investment will also be required to enable product realisation from Australia’s explosive ordnance manufacturing capability, and to support complex introduction and integration of weapons acquired from abroad.

Defence fuel installations are vital enablers for the generation of Defence capability. S&T provides a critical input into remediation of Defence’s fuel storage and distribution installations and improve Defence’s fuel resilience and capacity to transport bulk fuel to support military bases and operations. There have been significant savings to Defence delivered through advice on alternative fuel specifications and quality testing.

Supporting the Joint Enablers	
Military objective/capability	Research areas
<ul style="list-style-type: none"> • CBR defence • Medical countermeasures • Health and human performance • Defence strategic logistic capability • Food and Nutrition • Physical Employment Standards • Support to future learning methods and media for military education and training • Critical joint supplies (e.g. fuels and oils, explosive ordnance etc) • Civil-military-police engagement • Safe and effective weapons and explosive ordnance for the ADF 	<ul style="list-style-type: none"> • Medical countermeasure assessment and development • Validation and testing of CBR defence capabilities (e.g. Personal Protective Equipment, Detection capabilities) • Bio-Medical Sciences • Future logistic concepts and operations • Enhanced Combat Feeding • Food delivery and packaging methodology • Military nutrition and delivery development • Human physiology • Human science training and education • Fuel integrity, energy management and alternatives • Research supporting safety, availability, reliability and performance of explosive ordnance • Advancements in methods and technologies for munition in-service surveillance and life extension • Simulation supported training techniques and technologies

Identifying and responding to technology change

Safeguarding Australia against the strategic surprise of emerging and disruptive technologies is becoming more challenging due to rapid advances in technology and potential for dual use technologies. Maintaining a regionally superior joint force is essential for Defence, especially with increased military research and development budgets across the Indo-Pacific region, rapid convergence between commercial and military technology, particularly in ICT. Over the next two decades, technological advances such as quantum technologies, advanced and agile manufacturing, hypersonics, directed energy weapons, and autonomous systems are likely to lead to the introduction of new capabilities into the region.

Monitoring, forecasting and reporting on global developments in emerging S&T will provide Defence, National Security and policy makers with insight into potential opportunities and threats. Defence Innovation Initiatives such as the Centre for Defence Industry Capability, the Defence Innovation Hub and the Next Generation Technology Fund, combined with increased leverage of the national innovation system, will position Defence to maintain its capability and decision superiority. DST Group will take the leading role in conducting and integrating research for the next generation technologies and will provide enduring support as part of One Defence to the Defence Innovation Hub and the Centre for Defence Industry Capability.

Priorities

Early Indicators and Warnings – Investigate sources of potential technological strategic surprise to afford Defence the opportunity to develop and respond to emerging opportunities and threats

Strategic Technical Risks – Identify and assess risks arising from proliferation of military technology and dual use technology from both state and non-state actors

Defence Innovation – Seed and shape the Defence Innovation Initiatives that will over time enable Defence to field a joint integrated force utilising emerging technology and capable of operating in anticipated, or identified, operational risk environments

Science and technology support

The role of S&T expertise in understanding and demonstrating emerging and potentially disruptive technologies, and the impact on capability options and effectiveness, will contribute to all stages of the CLC. High-quality, science-based technology foresight, forecasting and futures advice will contribute to the identification and evaluation of the potential impact of emerging and disruptive technologies. This advice will be derived through the application of horizon scanning, concept development, experimentation, prototyping and impact assessment.

The issue is more complex in the Joint S&T Domain as many disruptive capabilities are delivered through integration of systems and much of the underpinning technology is commercially derived. The implication of this is that disruptive military capability in the Joint Domain can appear rapidly and the agility of the organisation to respond, capitalise or develop countermeasures, is critical.

The Defence innovation enterprise will expand the range of organisations contributing to this focus area. Maintaining a coherent view of the confluence of innovations will be a key element. SP&I and DST Group will have leadership roles in ensuring the implications of technology developments are assessed and leveraged within the Defence context.

The Defence Innovation Hub, Next Generation Technology Fund and DST Group's Strategic Research Initiative Program provide important elements for assessing the risks and benefits from potentially emerging and disruptive technologies. The outcomes from strategic research investment can be used to understand options for future military capability or to assess the likely threats from hostile use of technologies.

Identifying and responding to technology change

Military objective/capability	Research areas
<ul style="list-style-type: none"> • Emerging and disruptive technology impact on strategy, policy and capability • Defence innovation opportunities related to ISR, Space and Cyber challenges • Assessment of the Future Operating Environment • Frameworks for science diplomacy, partnership and engagement to enable innovation • Technology transfer through Defence Innovation Hub 	<ul style="list-style-type: none"> • Technology foresighting and threat estimation • Development, demonstration and transition of next generation technologies: <ul style="list-style-type: none"> – ISR – space capabilities – enhanced human performance – medical countermeasure products – multidisciplinary material sciences – quantum technologies – trusted autonomous systems – cyber – advanced sensors, hypersonics, and directed energy capabilities. • Future trends in computing, communication and information security • Techniques for collaboratively developing, assessing and realising integrated technology concepts to support the IIP



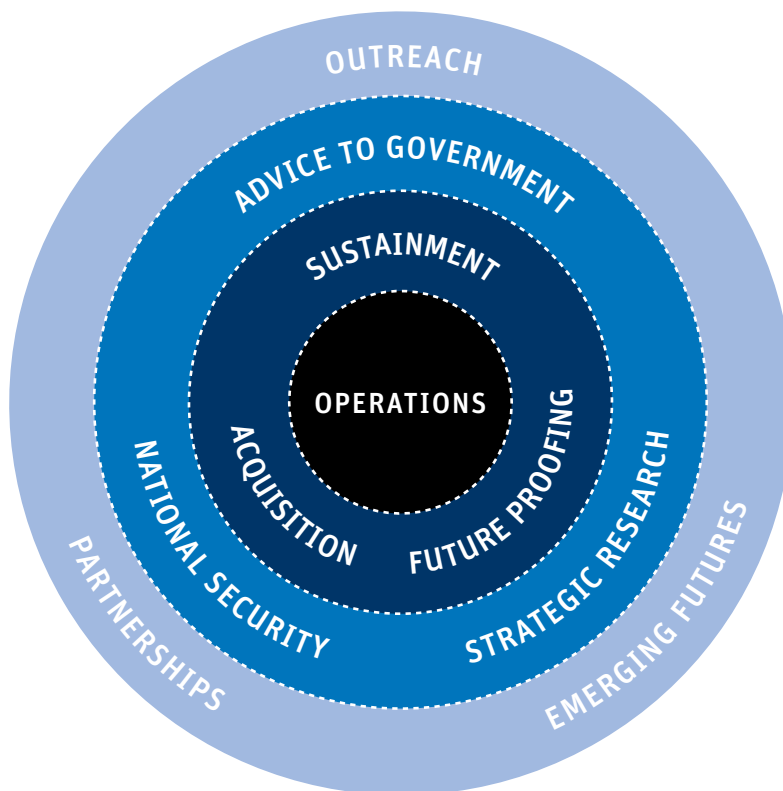
Delivering the science and technology

DST Group is a national leader in safeguarding Australia by delivering valued scientific advice and innovative technology solutions for Defence and national security. Its core roles are centred around providing expert and impartial advice and support for the conduct of operations, for the current force, and for acquisition of future Defence capabilities. See Figure 2 below.

DST Group focuses its research on areas where it has extensive, unique domain knowledge and S&T excellence, and where Defence must retain a sovereign capability. Its core strategy emphasises the essential role of external partnering to strengthen its ability to integrate knowledge and innovation for Defence and national security capability.

DST Group accesses and leverages world-leading science, technology, knowledge and innovation, through collaboration with industry, academia and international agencies. DST Group works closely with these partners in order to provide quality advice and innovative solutions for Defence and national security.

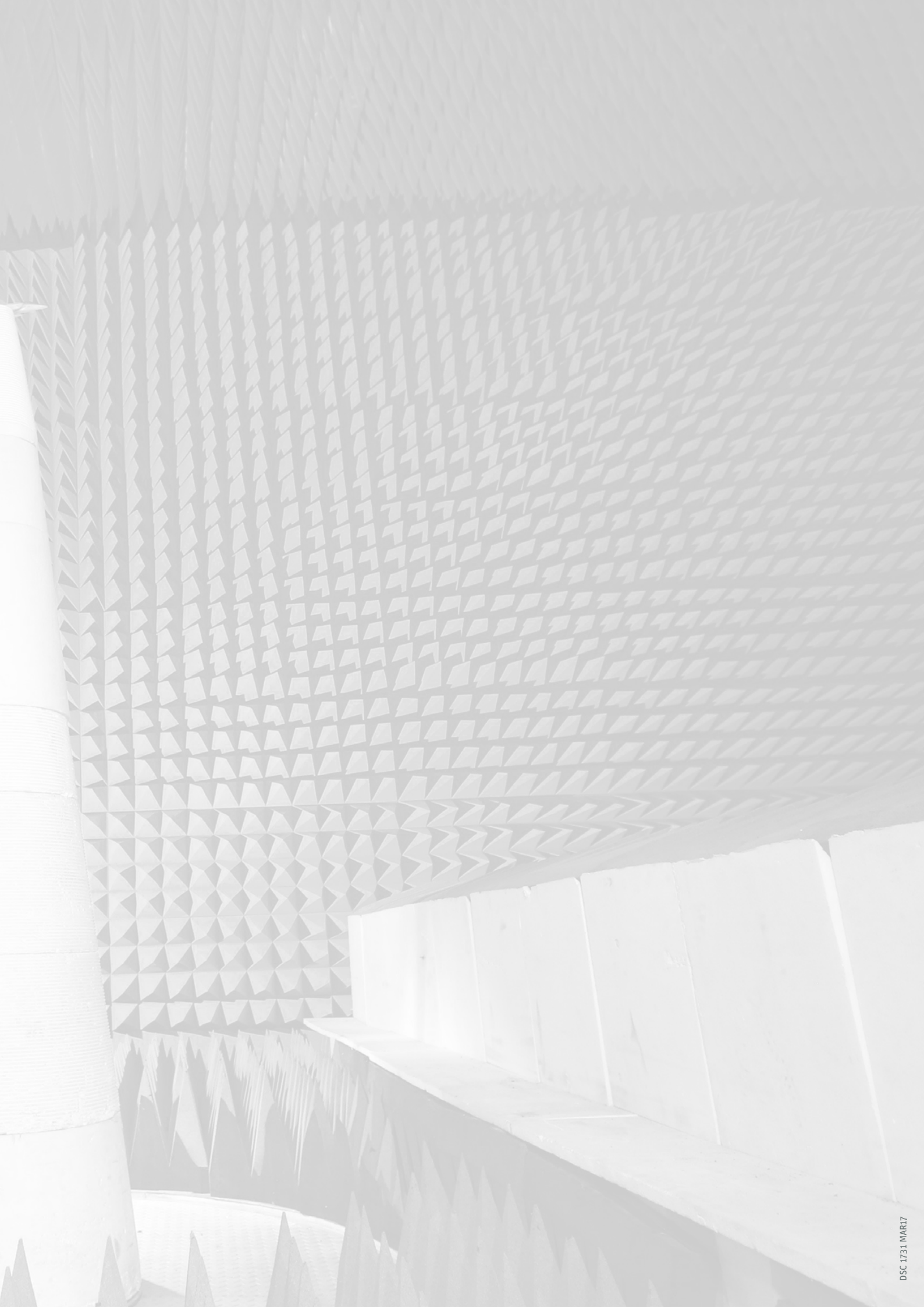
Figure 2: DST Group Roles



Definitions and acronyms

ADF	Australian Defence Force
ADO	Australian Defence Organisation
AJOC	Australian Joint Operating Concept
AMS	Australian Military Strategy
C2	Command and Control
C4	Command, Control, Communications and Computers
C4I	Command, Control, Communications, Computers and Intelligence,
C4ISR	Command, Control, Communications, Computers & Intelligence, Surveillance, and Reconnaissance
CASG	Capability Acquisition and Sustainment Group
CBR	Chemical Biological and Radiological
CDS	Chief Defence Scientist
CIED	Counter Improvised Explosive Device
CLC	Capability Life Cycle
CM	Capability Manager
DCAP	Defence Capability Assessment Program
DOSC	DST Group Operations Support Centre
DPG	Defence Planning Guidance
DPM	Domain Program Manager
DST Group	Defence Science and Technology Group
DWP	Defence White Paper
EW	Electronic Warfare
FIC	Fundamental Inputs to Capability
FJOC	Future Joint Operating Concept
FOE	Future Operating Environment
FPR	First Principles Review
I2	Integration and Interoperability
IC	Investment Committee
ICT	Information and Communications Technology
IIP	Integrated Investment Program
IMD	Intelligence Mission Data
ISR	Intelligence, Surveillance and Reconnaissance
ISREW	Intelligence, Surveillance, Reconnaissance, and Electronic Warfare
JOC	Joint Operations Command
MSTC	Major Science and Technology Capability
S&T	Science and Technology
SP&I Group	Strategic Policy and Intelligence Group
VCDF Group	Vice Chief of Defence Force Group







For further information
please contact the
Joint Scientific Adviser