More, together.

Defence Science and Technology Strategy 2030

More, together: Defence Science and Technology Strategy

Science Technology and Research (STaR) Shots

August 2020

Defending Australia and its National Interests
www.defence.gov.au

Foreword from the Chief Defence Scientist

More, together: Defence Science and Technology Strategy 2030 outlines a whole of Defence approach to science, research and innovation for the first time. With changes in Australia's security environment occurring more rapidly than expected, the Strategy articulates a 10-year vision and establishes a suite of initiatives to ensure that investment in science and technology (S&T) creates the capabilities Defence needs.

The Defence Science and Technology (DST) Group will lead the implementation of the Strategy on behalf of Defence and in collaboration with the national S&T enterprise. Together, we will focus investment on Defence priorities, concentrating the combined efforts of the nation's scientists, innovators and entrepreneurs on significant and challenging research questions that are critical to the security of Australia. Guided by this focus, we will grow the scale of our scientific capability by partnering, collaboratively and across disciplines, to overcome these challenges. Our success will be measured in terms of the impact generated by our research outcomes being pulled into Defence capability.

Focus, scale and impact are embodied in the Science, Technology and Research (STaR) Shots, which are designed to mobilise S&T expertise and resources around significant and complex challenges. Developed in consultation with Defence and research communities, I am pleased to have launched the initial set of eight STaR Shots. Over time, we will mature this set through a robust approach to making choices and ensuring we deliver leap-ahead capabilities that meet Defence needs.

We are at the start of an exciting journey; one that I am confident will lead to new Defence capabilities, enduring partnerships and continuing pride in Australia's defence science achievements. By growing our S&T capability and focusing investment to create impact for Defence, we will achieve more, together.

Professor Tanya Monro
Chief Defence Scientist

STaR Shots

Science, Technology and Research (STaR) Shots are challenging, inspirational and aspirational S&T missions that will align strategic research to force structure priorities. They will drive the evolution of innovation pathways, from fundamental research and development through to prototyping and transition into capability, to focus the national S&T enterprise on Defence's biggest problems. STaR Shots will aim to deliver new capabilities into the hands of the warfighter and collectively support the overarching objective of equipping Defence to prevail in contested environments.

Launched with the *More, together: Defence Science and Technology Strategy 2030* (the Strategy), the initial set of STaR Shots will bring together expertise from across the national S&T enterprise, building scale through partnerships and guiding their scientific endeavours. However, success will not be achieved simply by answering difficult research questions but by translating those answers into solutions that enable Defence to ensure the security of Australia and protect our national interests to 2030 and beyond.

STaR Shots will not be the only S&T effort within Defence. The Defence Innovation and S&T portfolio will also include other research programs that support Defence operations and provide ongoing advice for the acquisition, sustainment and future-proofing of Defence capability.

SETTING DIRECTIONS (FOCUS)

Guided by force structure priorities, the STaR Shots set the direction for strategic research and development that will generate the capabilities best achieved through Australian investment. Each STaR Shot defines a significant military challenge in terms of the desired Defence capability and potential impact on ADF operations, without presupposing solutions or specifying the research approach. In this way, STaR Shots guide and focus the national S&T enterprise while encouraging new ideas and innovative approaches that will deliver leap-ahead capabilities for Defence.

BUILDING PARTNERSHIPS (SCALE)

Early engagement across the national S&T enterprise is critical to building the scale of expertise and innovation needed to solve the complex problems facing Defence. This will enable partnerships and research activities to be designed and initiated together.

Defence will use mechanisms ranging from organisational-level workshops to share information on potential areas for collaboration through to targeted meetings and working groups to tackle specific challenges. The aim is to have multiple organisations working together to design programs and project activities, and for new partners to join the team as the research progresses, demonstrations are held, and different expertise is required.

Defence will guide arrangements with partners based on measures such as technical capability, security, infrastructure, co-investment, and the ability to collaborate and translate outcomes into impact. This emphasis on early engagement and collaboration will complement existing arrangements for defence industry partners. By combining these activities, Defence will foster a defence industry that is actively undertaking research and development in collaboration with university and government counterparts and creating new technologies.

DEMONSTRATING SUCCESS (IMPACT)

Delivering impact through strategic research is central to the STaR Shots. In this context, impact is created when the outcomes of the collaborative research activities result in advances in Defence capabilities, with flow-on benefits for the national S&T enterprise. STaR Shot teams will show progress towards delivering the identified leap-ahead capabilities through demonstrations of the solutions being developed and testing of their military utility.

These demonstrations will facilitate the innovation pathways that are required to deliver impact. Such pathways transition new ideas into prototypes and refine them into viable technologies integrated within operational systems; they enable the transition of innovative knowledge, technologies and systems into Defence capability. Given that delivering impact is integral to each STaR Shot, the teams and their activities will both create and shape the ways in which research outcomes generate value and strategic advantages for Defence.

Operating in CBRN environments

Enabling the joint force to operate safely and effectively in contested chemical, biological, radiological and nuclear (CBRN) threat environments.

DEFENCE SPONSOR	**LTGEN RICHARD BURR,** CHIEF OF ARMY
LEAD DST CHIEF	**DR PETER SHOUBRIDGE,** CHIEF OF LAND DIVISION
STAR SHOT LEADER	**DR AXEL BENDER**

CONTEXT

The threat of CBRN attacks against military forces and civilian populations is growing. State and non-state actors are increasingly willing to use these indiscriminate methods, and knowledge of CBR agent manufacturing processes is proliferating. The ADF has the ability to survive the surprise created by CBRN weapons and improvised CBR devices, but there is a need to do more.

Our forces must be able to respond faster and more flexibly to CBRN events; achieve enhanced situational awareness; and manoeuvre safely, effectively and unimpeded in complex contaminated environments for prolonged periods of time.

OPPORTUNITIES

- Fast and accurate detection, identification, source localisation and monitoring of low concentrations of CBR agents at long stand-off distances and over large expanses of complex terrain.
- Near real-time integrated and multi-domain threat prediction, warning and reporting that is interoperable with coalition partner and civilian systems.
- Effective CBRN protection for individuals, groups, assets and supply chains that does not impede ADF taskforce operations and freedom of manoeuvre.
- Fast and effective containment of CBRN threats.
- Rapid and efficient decontamination of affected people, sensitive equipment, platforms and infrastructure.
- Significantly enhanced human resilience to exposure and exhaustion.

'Chemical, biological, radiological and nuclear defence is undergoing a global transformation as it adapts to the challenge of multi-threat scenarios. Modern forces need to be equipped to operate within chemical, biological, radiological and nuclear and toxic industrial material threat environments.'
VCDF Directive 04/2019

To get involved in this STaR Shot email **STaRShot_CBRN @dst.defence.gov.au**

Further information available at **dst.defence.gov.au/strategy**
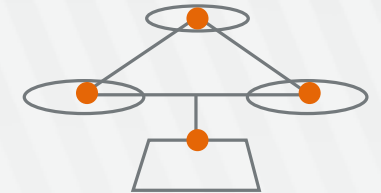
Agile command and control

Through faster and superior decision-making, enable the Australian Defence Force to deliver synchronised effects across all domains and operational levels.

DEFENCE SPONSORS	**LTGEN GREG BILTON,** CHIEF OF JOINT OPERATIONS
	AIRMSHL WARREN MCDONALD, CHIEF OF JOINT CAPABILITIES
LEAD DST CHIEF	**DR LYNN BOOTH,** CHIEF OF JOINT AND OPERATIONS ANALYSIS DIVISION
STAR SHOT LEADER	**DR PAUL GAERTNER**

CONTEXT

Prevailing in complex and contested environments will require the ADF to bring together capabilities from across all domains of warfare (air, maritime, land, space and information and cyber) to achieve complementary and coordinated effects. Future ADF operations will comprise complex, high-velocity manoeuvres that will present multiple dilemmas to any adversary at an unmatched tempo.

The ADF already conducts operations across the domains; however, command and control (C2) is currently labour intensive and cognitively complex. Greater agility is needed to deliver operational advantage across the continuum of competition and conflict. The future C2 capability must be robust, resilient, responsive, flexible, adaptive and reconfigurable; and it must be able to handle many concurrent and unforeseen situations.

Developing an agile C2 system designed to work across all operational environments is recognised as an essential capability that enables delivery of tactical and strategic effects. Warfighters need to understand both the environment in which they operate and the effects they want to generate. Our future C2 system will connect, synchronise and integrate capabilities and effects with a variety of partner nations to deliver a force-level advantage to decision-makers at all operational levels, allowing them to understand, shape and dominate the future battlespace. Agile C2 will permit Australia to make better use of its military assets by enabling greater delegation of authority and faster, better-informed decision-making.

'The Joint Command and Control system is our most important warfighting system. It is the glue of the joint fight, turning individual capability elements into a synchronised, coherent force delivering an operational edge to Australia.'
LTGEN Greg Bilton, Chief of Joint Operations, 2020

To get involved in this STaR Shot email **STaRShot_C2 @dst.defence.gov.au**

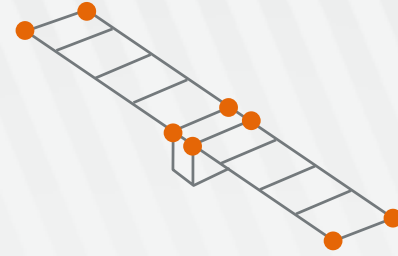Further information available at **dst.defence.gov.au/strategy**

OPPORTUNITIES

- Artificial intelligence, human-machine teaming, autonomy and real-time battle simulation modelling to assist decision-making.
- Organisational structures and cultures that promote greater headquarters agility.
- Information, visualisation, augmented reality and virtual assistants providing enhanced situational awareness and sense-making.
- Architectures for C2 distributed to the warfighter.
- Exploitation through data analytics of vast quantities of increasingly diverse data sets.
- Innovative human, social, cultural, and technical systems enabling agile organisational forms and commanders to rapidly execute command intent.

Resilient multi-mission space

Providing resilient space-based services direct to the warfighter to enable the Australian Defence Force to prevail in increasingly contested operating environments.

DEFENCE SPONSOR	**AIRMSHL MEL HUPFELD,** CHIEF OF AIR FORCE
LEAD DST CHIEF	**MR ANDREW SEEDHOUSE,** CHIEF OF INTELLIGENCE SURVEILLANCE AND SPACE DIVISION
STAR SHOT LEADER	**MR ROD SMITH**

CONTEXT

Space-based systems play a vital role in all ADF and coalition operations, wherever they occur around the world. From providing precise location information and situational understanding of the operating environment to enabling personnel and platforms to stay connected, assured access to satellite services and the freedom to operate in space are critical to the ADF's ability to protect and defend Australia's national interests.

Space is now a warfighting domain. Some countries are developing anti-satellite systems and denial-of-service measures that threaten space-based capabilities. Satellites and space systems used by Defence are becoming more vulnerable as the space domain changes from a benign environment into one that is increasingly congested and contested, where adversaries seek to limit the military advantage provided by space.

An agile and potent future force will rely on assured access to resilient and responsive space services. Seamless interoperability with coalition partners will also be necessary to support diverse missions across multiple locations around the globe.

'Assured access to space is critical to ADF warfighting effectiveness, situational awareness and the delivery of real-time communications and information.'
2020 Defence Strategic Update

To get involved in this STaR Shot email **STaRShot_Space @dst.defence.gov.au**

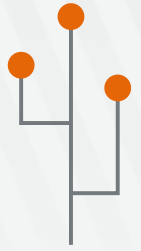Further information available at **dst.defence.gov.au/strategy**

OPPORTUNITIES

- Advanced space-based surveillance capabilities to provide comprehensive situational awareness for superior decision-making.
- Secure and resilient communications delivered from space for a highly networked force.
- Resilient satellite services providing accurate position and timing information to enable precision effects in contested environments.
- Advanced space domain awareness and control for sovereign space operations.
- Autonomous space systems and processing capabilities to dynamically reconfigure and deliver space cloud services at speed and scale direct to the warfighter.
- Space systems hardened against anti-satellite and denial-of-service measures.

Information warfare

Delivering information warfare capabilities integrated across human, information and physical dimensions to allow the Australian Defence Force to fight in and through contested information environments.

DEFENCE SPONSORS	**LTGEN GREG BILTON,** CHIEF OF JOINT OPERATIONS
	AIRMSHL WARREN MCDONALD, CHIEF OF JOINT CAPABILITIES
LEAD DST CHIEF	**DR DALE LAMBERT,** CHIEF OF CYBER AND ELECTRONIC WARFARE DIVISION
STAR SHOT LEADER	**DR ANTHONY SZABO**

CONTEXT

The world has transitioned from the Industrial Age to the Information Age. The Industrial Age consisted of human and physical environments in which people directly controlled their industrial machines. The Information Age retains the human and physical elements, but inserts information environments between them. People now perceive, interact with and control their physical world through these information environments.

The increasing reliance on information environments has delivered unparalleled advances in capability, but this opportunity comes with a threat. Information environments are highly contested by a range of actors, from criminals to nation states. Some nations seek to use information warfare to achieve their objectives without exceeding the threshold of war.

Fighting from inside information environments enables:

- control of an adversary's human environments through influence operations
- control of an adversary's information environments through cyber warfare
- control of an adversary's physical environments through electronic warfare.

The success of future ADF operations will depend on its ability to fight in and through contested information environments. In the Information Age, if you control the opponent's information environments through coordinated and integrated influence operations, cyber warfare and electronic warfare, then you control your opponent.

'The ADF must understand, and become masters of, the information environment.'
MAJGEN Marcus Thompson, Head Information Warfare, 2017

To get involved in this STaR Shot email **STaRShot_IW @dst.defence.gov.au**

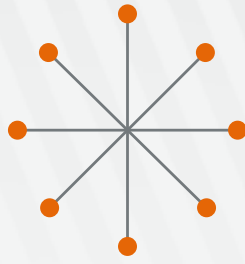Further information available at **dst.defence.gov.au/strategy**

OPPORTUNITIES

- Development of advanced cyber warfare, electronic warfare and influence operations capabilities.
- Integration of cyber warfare, electronic warfare and influence operations into a single information warfare capability.
- Development of new information warfare command-and-control concepts, algorithms and architectures.
- Development of synthetic information warfare environments and approaches to wargaming.
- Application of artificial intelligence and machine learning to deliver information warfare capabilities at speed and scale.

Disruptive weapon effects

Delivering game-changing innovations in weapon technologies to disrupt multi-domain combat and change the way we shape, deter, deny, contest and fight.

DEFENCE SPONSOR	**VADM DAVID JOHNSTON** VICE CHIEF OF THE DEFENCE FORCE
LEAD DST CHIEF	**DR JOHN RILEY** CHIEF OF WEAPONS AND COMBAT SYSTEMS DIVISION
STAR SHOT LEADER	**DR NATHALIE COLINEAU**

CONTEXT

The emergence of advanced and unconventional weapons has transformed the battlefield. Modern weapons are smaller, faster and smarter. They have greater range and are more agile, precise, lethal and resilient to countermeasures. Furthermore, the introduction of novel approaches to applying lethal and non-lethal effects, such as through directed energy or swarm technologies, is disrupting the way we fight.

In this new environment, Defence needs new weapons and counter-capabilities to ensure the ADF can shape and compete in multi-domain combat. This includes the ability to operate in an urban environment while protecting civilians; project force deep into hostile regions and deliver coordinated effects; survive a prolonged high-intensity battle; and apply strategic effects through deterrence and denial.

Achieving operational outcomes depends on providing the future force with the weapons it needs to control the battlespace, enable freedom of manoeuvre, ensure survivability and prevail in highly contested environments.

OPPORTUNITIES

- Directed energy and other novel technologies.
- Small, smart, networked and low-cost guided missiles.
- Intelligent teaming, swarming and collaborative weapons.
- Coordinated delivery of effects for enhanced lethality with minimal collateral damage.
- Thrust-on-demand propulsion and highly agile systems.
- Advanced reconfigurable warheads.
- Moral and ethical weapons.

> 'Emerging and disruptive technologies will be rapidly translated into weapon systems – such as sophisticated sensors, autonomous systems and long-range and high-speed weapons – reducing decision times and improving weapon precision and lethality.'
> *Defence Strategic Update, 2020*

To get involved in this STaR Shot email **STaRShot_Weapons @dst.defence.gov.au**

Further information available at **dst.defence.gov.au/strategy**

Battle-ready platforms

Achieving the timely and sustained presence of critical warfighting functions in contested environments.

DEFENCE SPONSORS	**VADM MICHAEL NOONAN,** CHIEF OF NAVY
	LTGEN RICHARD BURR, CHIEF OF ARMY
	AIRMSHL MEL HUPFELD, CHIEF OF AIR FORCE
LEAD DST CHIEF	**DR KATERINA AGOSTINO,** CHIEF OF AEROSPACE DIVISION
STAR SHOT LEADER	**MR DAVID HOLMES**

CONTEXT

A nation's ability to commit to a war and endure a campaign of protracted battles depends on the availability, preparedness and sustainability of its warfighting machines. For a modestly sized defence force, efficiently sustaining battle platforms to a high level of readiness is critical to providing the Government with credible options in times of crisis.

Modern warfare is complex, increasingly lethal and contested in many dimensions. Proliferation of advanced weapon systems with precision and reach will challenge the viability of support arrangements, including for forward operating bases and linear supply chains. Joint commanders must have confidence in their platforms in terms of battle-readiness, and all aspects of resilience, such as survivability, agility, sustainability and endurance. They also require the flexibility to dynamically reconfigure the joint force in the event of battle damage or changing needs, informed by platform state and threat intelligence.

The BRP Star Shot aims to demonstrate the ability of the combined power of digital engineering (DE) and artificial intelligence (AI) to enable the ADF to be both ready when needed and fit for purpose in a rapidly evolving threat environment. BRP will employ science and technology advancements to shift the current approach of managing platforms to a new digital lifecycle management concept to enhance the speed and accuracy of design, verification, modification, and sustainment of Defence platforms.

OPPORTUNITIES

- Intelligent optimisation and automation of asset management for enhanced platform availability
- Platform development, sustainment and/or operational digital twins
- AI and machine learning for advanced system state awareness
- Digital engineering toolsets to enable virtual conceptual and detailed design and verification
- Digital engineering design, test and evaluation of rapidly deployable systems
- Advanced decision-making aids for sustainment and operational use

> 'Make no mistake; the pace of change is increasing and will challenge us all. Doing nothing, or waiting for allies to solve our requirements, is not an option.'
> *Vice Admiral Michael Noonan, AO, co-sponsor of the Battle-Ready Platforms STaR Shot*

To get involved in this STaR Shot email **STaRShot_Platforms @dst.defence.gov.au**

Further information available at **dst.defence.gov.au/strategy**

Remote undersea surveillance

Securing Australia's maritime interests through the provision of persistent and responsive undersea domain awareness.

DEFENCE SPONSOR	VADM MICHAEL NOONAN, CHIEF OF NAVY
LEAD DST CHIEF	DR SHANE CANNEY, CHIEF OF MARITIME DIVISION
STAR SHOT LEADER	DR SAMUEL DAVEY

CONTEXT

Australia's vast maritime expanse is critical for trade, natural resources and a wide range of activities supported by Navy. Situational awareness of the undersea domain is essential to protecting these interests. The underwater environment is complex and is becoming increasingly congested with a greater density and variety of undersea vessels (both civilian and military). Potential threats such as submarines, mines and autonomous underwater vehicles are developing rapidly, incorporating new technologies to aid teaming and collaboration, avoid detection and enable stand-off capabilities that allow them to act at much longer ranges.

The ADF needs advanced undersea surveillance capabilities to deal with the complexities of a congested and highly contested underwater environment, particularly to support future theatre anti-submarine warfare. Fully integrated sensor systems and networks will provide persistent coverage over wide expanses of ocean over long periods of time. They will have the capacity to be rapidly and flexibly deployed to areas of interest, have sufficient endurance, and operate effectively over a range of conditions in deep water and shallow littoral environments. They will complement, work cooperatively and integrate with other ADF undersea warfare capabilities and support interoperability with coalition partners.

OPPORTUNITIES

- Integrated undersea surveillance systems and networks for wide-area coverage and persistence over long periods of time.
- Advanced sensor technologies.
- Trusted unsupervised detection, classification, localisation and tracking algorithms.
- Application of autonomous systems to extend the reach of submarines, surface task groups and maritime air operations.
- Network and sensor resilience.

> 'Protecting Australia's large exclusive economic zone requires understanding of the maritime environment under our control, sustained presence, and adapting to new technological developments that could increasingly complicate our ability to keep Australian interests safe in the Maritime domain.'
> *Force Structure Plan, 2020*

To get involved in this STaR Shot email **STaRShot_Undersea @dst.defence.gov.au**

Further information available at **dst.defence.gov.au/strategy**

Quantum-assured position, navigation and timing

Ensuring the ADF and its coalition partners can operate in complex and contested environments with uninterrupted access to position, navigation and timing information.

DEFENCE SPONSOR	AIRMSHL WARREN MCDONALD, CHIEF OF JOINT CAPABILITIES
LEAD DST CHIEF	DR DALE LAMBERT, CHIEF OF CYBER AND ELECTRONIC WARFARE DIVISION
STAR SHOT LEADER	DR DAVID BIRD

CONTEXT

Since its inception in 1978, the US Global Positioning System (GPS) has had a revolutionary impact on military capability. It has enabled precise navigation and manoeuvre on the battlefield, allowed the development of precision-guided weapons and provided an unprecedented ability to coordinate and synchronise a distributed force. This dependence on global navigation satellite systems (GNSS) has carried over to the civilian and commercial sectors.

Deep reliance on GNSS by armed forces represents a critical vulnerability as adversaries might seek to degrade or deny access by electronic jamming and deception or through anti-satellite systems. This threat extends beyond restricting the ability to navigate, potentially affecting other fundamental capabilities such as secure communications, intelligence collection and the synchronisation of distributed military systems and networks.

The ADF and coalition partners must have assured position, navigation and timing (PNT) capabilities that would enable uninterrupted operation in GNSS-degraded or denied conditions. This includes in contested environments and complex terrain where obtaining satellite reception is challenging (such as in subterranean, mountainous, underwater or dense urban settings).

The ADF's assured PNT capability will integrate emerging quantum technologies with conventional solutions to provide sensitivity, accuracy and precision over extended timeframes and under a range of operationally relevant conditions in the absence of GNSS signals.

OPPORTUNITIES

- Development, miniaturisation and maturation of quantum clocks, accelerometers, magnetometers and gravimeters.
- Advances in classical technologies to improve sensitivity, accuracy and precision; and reduce drift over long durations.
- Integration and fusion of quantum and classical solutions for timing and navigation.

> 'Position, navigation and timing data are essential for the command and control of deployed forces. These systems enable the sharing of real-time operational and logistical information and for the placement, navigation and synchronisation of Defence assets.'
> *Force Structure Plan, 2020*

To get involved in this STaR Shot email **STaRShot_PNT @dst.defence.gov.au**

Further information available at **dst.defence.gov.au/strategy**

More information

For more information about *More, together: Defence Science and Technology Strategy 2030*, please visit www.dst.defence.gov.au/strategy. You can also follow us through social media and view the videos from the launch of the Strategy on our YouTube channel.

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We invite you to share with us your thoughts, feedback and insights on the implementation of the Defence Science and Technology Strategy 2030 via email: Strategy2030@dst.defence.gov.au.

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