Australian Government

Department of Defence
Defence Science and
Technology Organisation

ANNUAL REVIEW 2014-15

NOTE

From 1 July 2015, the Defence Science and Technology Organisation (DSTO) has been renamed the Defence Science and Technology Group.

As this Annual Review covers the period 1 July 2014 to 30 June 2015 (i.e. prior to the name change) the term DSTO is used throughout this publication.

This will be the last Annual Review to appear under the DSTO name.

Stars guiding turtles to their breeding site, signifying creativity and innovation. From the *Song of the Seven Sisters* by the Gurreng Gurreng people. Artwork by indigenous artist Anthony Walker was commissioned by DSTO to demonstrate its commitment to cultural diversity.

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DSTO | Science and Technology for Safeguarding Australia

ABBREVIATIONS AND ACRONYMS

ADF	Australian Defence Force
AEW&C	Airborne Early Warning and Control
AMCU	Australian Multicam Camouflage Uniform
ASRAAM	Advanced Short Range Air-to-Air Missile
ATSB	Australian Transport Safety Board
CBRN	Chemical, Biological, Radiological and Nuclear
CDS	Chief Defence Scientist
CIED	Counter Improvised Explosive Device
CSIRO	Commonwealth Scientific and Industrial Research Organisation
CTD	Capability and Technology Demonstrator
DCDS	Deputy Chief Defence Scientist
Defence	The Defence Organisation, including the Department of Defence and the Australian Defence Force
DIF	Defence Innovation Forum
DIO	Defence Intelligence Organisation
DIRF	Defence Innovation Realisation Fund
DMO	Defence Materiel Organisation
DMTC	Defence Materials Technology Centre
Dstl	Defence Science and Technology Laboratory
DSTO	Defence Science and Technology Organisation
HF	High Frequency
HQJOC	Headquarters Joint Operations Command
ICT	Information and Communication Technology
IED	Improvised Explosive Device
IP	Intellectual Property
ISR	Intelligence, Surveillance and Reconnaissance
JORN	Jindalee Operational Radar Network
JSF	Joint Strike Fighter
MoU	Memorandum of Understanding
MSTC	Major Science and Technology Capabilities
NATO	North Atlantic Treaty Organization
Navy	Royal Australian Navy
NICTA	National Information and Communications Technology Australia
NRL	Naval Research Laboratory
OTHR	Over-the-horizon radar
R&D	Research and Development
RAAF	Royal Australian Air Force
RAM	Radar Absorbing Material
RF	Radio Frequency
RPDE	Rapid Prototyping, Development and Evaluation
S&T	Science and Technology
SMiS	Scientists and Mathematicians in Schools
SOCOMD	Special Operations Command
STEM	Science, Technology, Engineering and Mathematics
TTCP	The Technical Cooperation Program (TTCP)
UHF	Ultra High Frequency

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Front cover
Sarah Hibbard preparing for a virtual reality experiment.

Back cover
Wendy Wong assisting Army officer for a research project in the driver simulation facility.

INSIDE THE DSTO ANNUAL REVIEW 2014-15

OVERVIEW FROM THE CHIEF DEFENCE SCIENTIST

The year 2014-15 presented many challenges for DSTO. Among them were the outcomes of the National Commission of Audit, the First Principles Review and the Australian National Audit Office assessment of our research program.

In exploring the option for potentially outsourcing DSTO, the First Principles Review recommended that the organisation remain a government-owned entity within Defence. However, its recommendation to merge DSTO within another part of the Department was not accepted. We have since addressed the recommendations of the review, in particular clearly articulating the value we deliver to Defence outcomes, rationalising our management structure, disbanding the DSTO Advisory Board and expanding our external engagement program with industry and universities. The remaining recommendation on investment processes will be addressed in early 2016.

In this context, our five-year Strategic Plan 2013-18 has served us well in positioning us for the future and improving the management of our client program. During the second year of implementing the Strategic Plan we continued to make significant progress on the 10 strategic initiatives which are highlighted in this Annual Review.

During the year the Australian National Audit Office (ANAO) examined the management of our research and innovation program for Defence. While the ANAO report is yet to be finalised, we are expecting a positive outcome from the audit.

In a continuing effort to benchmark our science and technology against world best practice, we invited international experts to assess nine of our Major Science and Technology Capabilities with more to follow. It was pleasing to see a number of capabilities rated as world leading and exhibiting world practice.

This is a tribute to our people who continue to be recognised in Australia and internationally for their research and technical excellence and the innovative solutions they deliver to Defence.

Those solutions have included the development of force protection equipment and counter-IED units for troops in the Middle East Area of Operations, range-extending wing kits for the Hornet's Joint Direct Attack Munition, remediation of that aircraft's centreline pylons, support leading to the full operational capability of the Wedgetail aircraft, provision of high data rate satellite communications for Navy ships in threat environments, and survivability evaluation of vehicles for future Army acquisitions.

Our expertise was also sought for critical incidents of national significance. We continued to assist the Australian Transport Safety Bureau in the search for the missing Malaysian Airlines MH-370 aircraft, and assisted the Australian Federal Police in the investigation of the MH-17 disaster in the Ukraine and the Sydney siege in Martin Place.

On the international front we entered into a new memorandum of understanding with Singapore, renewing our long-standing cooperation in defence research. With Japan we have signed a historic Letter of Arrangement to undertake joint activities in a broad range of research areas, including hydrodynamics. With our traditional partners in The Technical Cooperation Program (TTCP) it has been agreed to broaden the scope and mechanisms of future joint research to be undertaken under a new Memorandum of Understanding to ensure cost-effective delivery of capabilities to the partners. The program has also established 'challenge groups' to address strategic issues in cyber, autonomy and the contested urban environment.

The year 2014-15 was also notable for our dynamic efforts in external engagement as demonstrated by the resounding success of our first Partnerships Week and our award-winning Defence Science Partnerships initiative which continues to attract more Australian universities to collaborate with us.

In a year of intense scrutiny, external reviews and constant change, DSTO's performance has been reassuringly strong. I thank all our staff for their contributions, our partners for their cooperation, and our clients for their confidence in our ability to deliver a capability edge.

Dr Alex Zelinsky
Chief Defence Scientist
December 2015

MAJOR HIGHLIGHTS

FIRST PRINCIPLES REVIEW

The First Principles Review recommended far-reaching changes in Defence with implications for DSTO. Overall, DSTO has taken on board and responded to recommendations on clearly articulating its value proposition, increasing engagement with industry and academia, and revitalising the research prioritisation and investment process. The First Principles Review implementation team, as part of the One Defence initiative, implemented a change of name for DSTO, replacing Organisation with Group in the title.

RAPID RESPONSE TO IED THREAT

DSTO responded urgently to new improvised explosive device (IED) threats in Afghanistan and Iraq by developing new countermeasure techniques and products, including the Redwing suite of counter-IED equipment.

PRODUCTION WING KITS FOR THE JDAM-ER

A significant milestone was achieved with the delivery of the first production set of wing kits for the Joint Direct Attack Munition-Extended Range (JDAM-ER) weapon. Developed by DSTO, the technology consists of a set of deployable wings which convert a standard JDAM into a long-range glide bomb, capable of striking a target with pinpoint accuracy at up to three times the range of the original weapon.

ACHIEVING FULL OPERATING CAPABILITY OF THE WEDGETAIL

The RAAF's E-7A Wedgetail aircraft achieved Final Operational Capability in May 2015, thanks to many years of advice and support by DSTO.

HIGH DATA RATE SATELLITE COMMUNICATIONS FOR NAVY SHIPS

DSTO developed a technical solution to provide high data rate satellite communications to Navy ships in high threat environments without interfering with the ship's self-protection sensors.

UPGRADE OF RADAR WARNING RECEIVER IN SUPER HORNET

Under the Advanced Passive Surveillance Capability program, DSTO and the US Navy have collaborated to achieve upgrades to the radar warning receiver on the Super Hornet, improving its ability to locate and identify threats.

SERVAL PROJECT

In collaboration with the Australian Geospatial-Intelligence Organisation and with the support of Chief Information Officer Group, DSTO delivered Project Serval, a pilot project providing Defence users with ready access to high-resolution, recently obtained commercial geospatial imagery on demand and at low cost. Serval provides a highly valued service in support of current Defence operations.

Greengum and Greygum devices from the Redwing family of counter-IED equipment.

JDAM-ER fitted to a Hornet aircraft.

Wedgetail aircraft.

F/A-18F Super Hornet and F/A-18 Hornet flying over Iraq.

MAJOR HIGHLIGHTS

CENTRELINE PYLON REMEDIATION IN THE F/A-18 AIRCRAFT

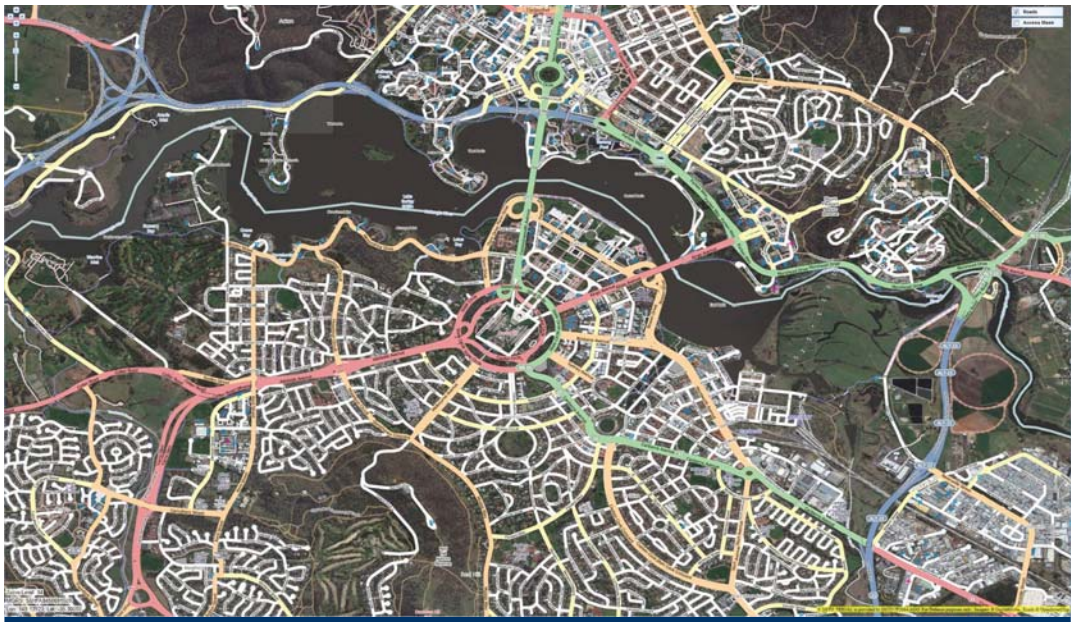
The remediation of invisible cracking in the centreline pylons of the F/A-18 aircraft enabled their recovery and resulted in the resumption of deployments to the Middle East.

MARKER BAND TECHNIQUE APPLIED TO JSF DURABILITY TESTS

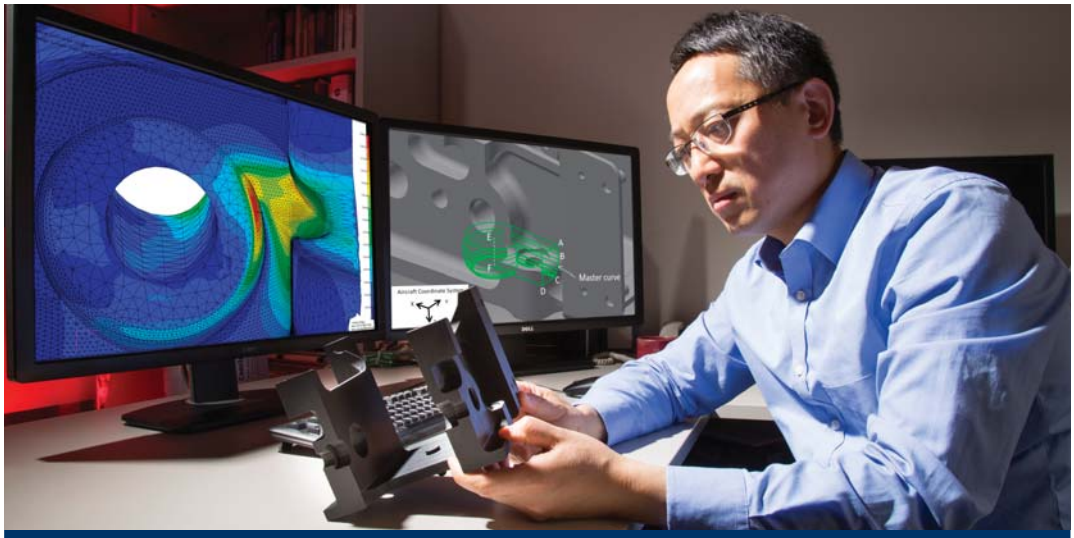
The 'Marker Band' technique, developed by DSTO, provides a substantially more efficient and simpler means of measuring crack growth. Applying the technique has enhanced the F-35 airframe durability testing and interpretation program, helping to reduce the technical risk of the Joint Strike Fighter acquisition.

PARTNERSHIPS WEEK

The inaugural Partnerships Week (5-8 May 2015) at the South Australian laboratory drew over 250 delegates, strengthening engagement with universities and industry and opening new opportunities for research collaboration.



Geospatial image of Canberra for the Serval project.



Xiaobo Yu examining the 3D printed model of the centreline pylon section in preparation for testing and remediation of the hotspot seen on the screen.

Delegates at the opening of Partnerships Week.

SECTION 1

Our Organisation

ABOUT US

DSTO is Australia's second largest publicly funded research organisation. It is part of the Department of Defence and provides the Australian Government with scientific advice and innovative technologies to meet Australia's Defence and national security challenges.

Headed by the Chief Defence Scientist, Dr Alex Zelinsky, DSTO has an annual budget of around $420 million (2014-15) and employs approximately 2200 staff, predominantly scientists, engineers, IT specialists and technicians.

DSTO staff are located in nearly every state and territory in Australia. Internationally, it has liaison offices in Washington DC, London and Tokyo, and research scientists located around the world, working on postings, exchanges, fellowships and joint research projects. A small number of DSTO personnel operate in the Middle East, providing direct support to Australian operations.

OUR PURPOSE

DSTO provides the Australian Government with scientific advice and innovative technologies to meet Australia's Defence and national security challenges.

The core roles are focused on supporting Australian troops on the ground, sustaining and enhancing existing Defence capabilities, ensuring Defence is a smart buyer of Defence equipment and future-proofing Defence to ensure that the Australian Defence Force (ADF) can meet the challenges of the future.

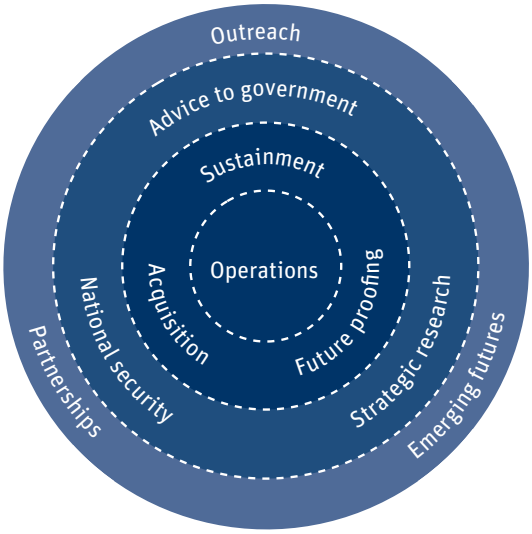
DSTO has a role in providing expert, impartial advice to government on defence and national security matters, as well as coordinating the delivery of whole-of government science and technology support for national security.

As a science and technology organisation DSTO conducts strategic research to identify high-impact areas for Defence and monitor emerging technologies to assess their potential impact on Defence capability.

Underlying all of its activities is an increased emphasis on external engagement and collaboration. This includes taking a stronger role in knowledge and innovation integration, strengthened through partnerships with industry and academia.

OUR ROLES

ROLE	DESCRIPTION
CORE	
Operations	Supporting operational capability with science and technology expertise.
Sustainment	Providing support to Defence to sustain and enhance current capability.
Acquisition	Providing support throughout the genesis, development, acquisition and introduction into service of major capability projects.
Future proofing	Investigating client-focused future concepts, contexts and capability.
EXTENDED CORE	
Advice to government	Shaping defence and national security strategic policy through expert and impartial advice.
National security	Leading the coordination and delivery of science and technology to enhance whole-of-government national security.
Strategic research	Conducting research into high-impact areas for future Defence capability.
SUPPORTING	
Emerging futures	Scanning the environment to gain an understanding of emerging science and technology threats and opportunities.
Partnerships	Enhancing its impact by collaborating with research and industry partners, nationally and globally.
Outreach	Promoting defence science and education in the broader Australian community.



DSTO LEADERSHIP TEAM AS @ 30 JUNE 2015

Dr Alex Zelinsky
Chief Defence Scientist

Dr Janis Cocking
A/Chief Strategy and Program

Dr Len Sciacca
Chief Partnerships and Engagement

Mr Peter Lambert
Chief Research Services

Mr Kevin Gaylor
A/Chief Maritime Division

Dr Simon Oldfield
Chief Land Division

Dr Ken Anderson
Chief Aerospace Division

Dr Todd Mansell
Chief Joint and Operations Analysis Division

Dr Tony Lindsay
Chief National Security and Intelligence, Surveillance and Reconnaissance Division

Dr Jackie Craig
Chief Cyber and Electronic Warfare Division

Dr John Riley
Chief Weapons and Combat Systems Division

VISION, PURPOSE, PEOPLE AND VALUES

VISION

DSTO aims to be a world leader in defence science and technology – indispensable in supporting and transforming Australia's defence and national security.

PURPOSE

DSTO is a national leader in safeguarding Australia by delivering valued scientific advice and innovative technology solutions for Defence and national security.

PEOPLE

DSTO has diverse, professional and specialised staff members who work in offices, complex laboratories, test facilities, weapons ranges and operational theatres. DSTO provides a work experience that is both challenging and career-developing and treats a safe, healthy and secure working environment as a key priority.

VALUES

DSTO values guide behaviour and decision-making and help to demonstrate the attitudes and actions for organisational success.

Excellence in science
We strive to lead, and be proud of, all our scientific undertakings.

People
We develop and support each other to achieve organisational deliverables in a safe environment.

Professionalism
We strive for excellence in everything we do.

Loyalty
We are committed to each other, our leaders and the organisation.

Integrity
We are trustworthy and honourable in all our interactions.

Courage
We act with strength of character, both in the courage of our convictions and in our intellectual courage.

Innovation
We actively and consistently look for better ways of doing business.

Teamwork
We work together with trust, respect and a sense of collective purpose.

FIRST PRINCIPLES REVIEW

David Peever, chair of the review team, and Chief of the Defence Force Air Chief Marshal Mark Binskin during the launch of the report of the First Principles Review of Defence.

While this Annual Review covers the period July 2014 to June 2015, it is relevant to include in this report highlights of the First Principles Review that impacted DSTO and the organisation's response.

Among its terms of reference, the First Principles Review of Defence was tasked to explore the feasibility of outsourcing DSTO as suggested in the National Commission of Audit in 2014.

The Review team, which submitted its report in April 2015, did not recommend outsourcing DSTO, pointing out that such a move would be detrimental to the interests of Defence.

The Review recognised that science and technology underpins Defence capability.

It recommended significant reforms across the Department of Defence, the most wide-ranging since the 1970s. Specifically, in relation to DSTO, the Review recommended the organisation:

• clearly articulate the value it contributes to Defence outcomes;

• review research priorities to ensure alignment with future force structure requirements;

- strengthen partnerships with industry and academia to leverage knowledge, promote innovation and create pathways in and out of academia and industry;
- rationalise its senior leadership structure; and
- abolish the DSTO Advisory Board.

During the year DSTO has worked to implement the recommendations. The Advisory Board was disestablished with effect from 1 July, and the senior leadership team was restructured.

DSTO continues to forge stronger links with industry through strategic alliances and with universities through its transformational Defence Science Partnerships framework. An out-placement program for staff to gain experience in industry and universities has made a successful start with seven participants. A new standing offer panel, established to procure R&D services from industry, has provided easier access to over 100 companies, mostly small and medium enterprises with specialist capabilities.

To align research to Defence requirements, DSTO has been implementing specific initiatives in its Strategic Plan aimed at closer engagement with Defence clients. This has ensured that the science and technology program is balanced against Defence needs following a consultative process. A revised process for prioritising the science program is in development and will bring together bottom-up client-driven requirements with top-down strategic guidance. A DSTO team has also been engaged in the development of the White Paper and the Force Structure Review.

The value of DSTO to Defence has been documented with specific examples of the capability advantage it delivers and the risks it reduces both at the strategic and operational level. By carrying out its mission to safeguard Australia through independent scientific advice and innovative technology solutions, DSTO is delivering critical value to Defence and national security.

The value proposition is backed by the economic benefits that result from the science and technology program. Defence commissioned ACIL Allen Consulting to conduct an independent analysis of the economic value. Their report evaluated 10 research projects and assessed that the science and technology program generated economic returns four to five times the budget allocated to DSTO, approximately $20 to $25 billion of value in the last 10 years. Defence has accepted the value proposition statement and the economic value report.

VALUE PROPOSITION

DSTO 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.

Strategic

DSTO reduces risk in Defence's core business – Defence operations, intelligence, capability development and integration. It does this by providing specialist advice and innovative technology solutions that are grounded in research and are independent of commercial or non-government research interests.

DSTO strengthens strategic capability by building unique, collaborative international partnerships that enable access to classified government and compartmented technologies not otherwise available.

By building partnerships with academia, industry and other government departments, DSTO explores the impact of emerging technologies that can potentially create and prevent strategic surprise. DSTO is uniquely placed to take a longer term perspective to mature and de-risk ground-breaking technologies prior to industry transition.

Operational

DSTO strengthens operational capability through the provision of scientific advice and technology solutions that enhance and adapt Defence capability to our unique circumstances. This includes providing benefits in terms of military efficiency, effectiveness, readiness, sustainability and reducing losses.

DSTO enhances operational capability through the research, development, testing, evaluation, and modification of new and existing warfighting systems for the Australian Defence Force.

DSTO reduces the cost of ownership and increases the availability of Defence capability through technical advice based on modelling, risk analysis, experimental testing and life extension work.

Source of value

DSTO's capacity to deliver value is built on its:

- Unique world-class sovereign capabilities, with research staff and infrastructure covering the spectrum of Defence science;
- Deep knowledge of and responsiveness to the Australian Defence environment and military capabilities;
- Proven record of linking research and innovation with applications, and researchers and innovators with end users;
- Active collaboration with Defence and national security communities of interest nationally and internationally;
- Ability to integrate diverse and privileged information from multiple sources into coherent expert advice relevant to Defence, national security and government decision-making, policy formulation and strategic planning;
- Ability to maintain commercially unviable technology capabilities that are critical to Defence; and
- Ability to work with academia and industry to foster a national science and technology base and transfer knowledge to support Defence capability development, acquisition and sustainment. This activity also generates economic value for the nation.

VALUE AND IMPACT FOR DEFENCE

	DSTO Role	Value and Impact for Defence	Examples
CORE ROLES	**Operations**	• Force protection • Effectiveness and efficiency • Fast tracking new capabilities • Lessons learnt	• Counter-IED technology • Survivability: Bushmaster, ASLAV vehicles • Staff in Special Ops, deployed in theatre • Cryptology, Intelligence and Logistics
	Sustainment	• Improved Defence capability • Preparedness • Cost savings	• Physical Employment Standards • Armidale Class Patrol Boats serviceability • Collins submarine remediation • F/A-18 structural refurbishment • Recovery of PC-9 airworthiness
	Acquisition	• New advanced capability • Manage technical risk • Drive interoperability • Cost savings	• Risk assessment and mitigation for major projects (e.g. LAND 121 Phase 4, F-35) • Co-development programs, such as AEW&C, AIR 7000, Growler, P8-A Poseidon aircraft • Diggerworks
	Future-Proofing	• Shape strategic capabilities • Access global innovation • Adopt critical technologies • Reduce technical risk	• Cyber technology • Intelligence analytics • Heavyweight torpedo • Future submarine design options
EXTENDED CORE	**Advice to Government**	• Technical advice that is expert and independent to inform decision makers • Inform strategic planning • Science diplomacy	• Air accident investigations - CH-47, MH-370 and MH-17 investigations • Defence White Paper • Convention on Prohibition of Chemical Weapons • Defence Export Controls
	National Security	• Leveraging dual-use technologies • Coordinating whole-of-government requirements and investment	• Chemical and biological hazards for first responders • Biometric identification and analytics for intelligence agencies and Immigration & Border Protection Force
	Strategic Research	• Create 'game changing' capability • New knowledge and understanding	• Over-the-horizon radar • Hypersonic technologies • Unmanned systems • Under Sea Warfare • Exploitation of space-based capabilities
SUPPORTING	**Emerging Futures**	• Anticipate change • Create and prevent strategic surprise	• *Forward 2035* foresighting study • Support quantum technologies, smart materials, replace GPS • Small satellite systems
	Partnerships	• Leverage alliances • Access to critical technology • Shape university capabilities • Transition to capability with commercial revenue	• The Five Eyes Technical Cooperation Program • University and industry collaboration • Defence Materials Technology Centre • Capability and Technology Demonstrator Program • Nulka, JDAM-ER, JORN
	Outreach	• Enhance reputation of Australian Defence • Fostering/recruiting future workforce	• National Science Week, *Catalyst* program • Support Science, Technology, Engineering and Mathematics education

IMPLEMENTATION OF THE STRATEGIC PLAN

Two years into the implementation of its 2013-2018 Strategic Plan, DSTO continues to make progress against each of its strategic initiatives.

TECHNICAL BENCHMARKING

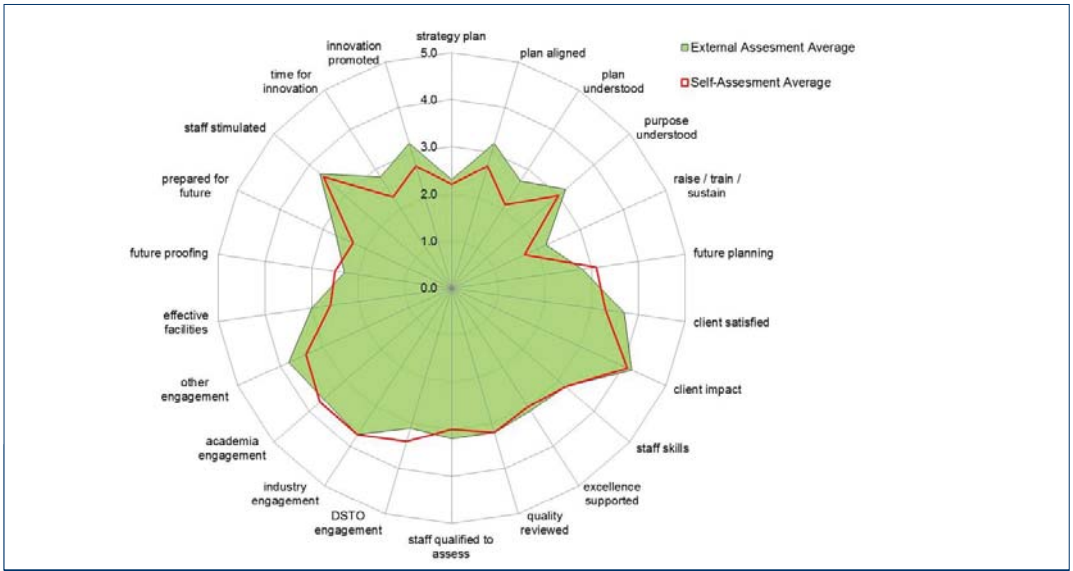
A key organisational achievement in 2014-15 was the benchmarking of DSTO's science and technology capabilities. All 39 of DSTO's major S&T capabilities were benchmarked internally for the quality and relevance of their science and technology.

The benchmarking exercise was validated by external national and international reviewers from government, academia and industry, who assessed nine major S&T capabilities. Of these, 12 research areas were ranked as world best practice.

WORLD BENCHMARK CAPABILITIES	COMMENTS IN THE REVIEW REPORT
Defence and National Security Counter Improvised Explosive Device	Capability is well respected within the Five Eyes community. Quality of deliverables well in excess of what could be reasonably expected. Australia's equipment is on par with US/UK.
Satellite Communication (SATCOM) Waveform Development	OASIS and SATCOM on the Move (SOTM) protected waveform work is world leading as evidenced by international collaboration, client feedback and knowledge of review panel subject matter expert. OASIS solution addresses an existing critical operation issue.
Defence Nutrition Capability	Great skill set that is valued internationally and should be maintained. Highly rated by stakeholders with many examples of exploitation and technology transfer to stakeholders.
Physical Employment Standards	World leading approach that other nations are seeking to copy.
Diggerworks	Innovative approach to engaging industry and Defence. Regularly cited including in Defence Estimates.
Aircraft Structural Integrity	Quantitative fractography, short-crack threshold modelling, thermal stress analysis and full-scale fatigue testing.
Submarine Power & Energy Research	World benchmark areas in lithium ion battery research and environmental stressing of lead acid battery cells. Very modern lab facility being built, improving on world leading capabilities in the US. Staff working with world leading US experts. Addressing areas where the US is not as strong, enabling enhanced mutual reliance. Young, motivated staff.
Surface Ship Naval Architecture	Hydrodynamics of high-speed slamming and multi-ship hydrodynamic interaction. Contribution to world leading expertise through collaborative Joint Industry Programs.
Corrosion Monitoring	This world leading capability includes the development of sensors and the computer models for understanding and predicting corrosion health monitoring for aircraft.
Maritime Materials Performance and Structural Integrity	This world leading capability includes the development of mechanistic theories of environmentally assisted cracking and the application of these atomic scale mechanisms in support of the structural integrity of the Collins class submarine and in the evaluation of hull steel for the future submarine.

WORLD BENCHMARK CAPABILITIES	COMMENTS IN THE REVIEW REPORT
Passive Radar	There is considerable world-wide interest in the development of passive coherent location systems that use radio frequency signals that are present in the environment to provide detection and geolocation. The DST Group system was recognised by the reviewers as the world benchmark for its real-time implementation of advanced signal processing techniques together with the associated signal processing research that have produced significant advances in target detection.
Sea Clutter Modelling	Estimating the performance of next generation radar systems depends upon an accurate understanding of the background (clutter) environment and then using this information to design optimal detectors. The extensively published DST Group research program into sea clutter was recognised by the reviewers as the world benchmark for its comprehensive coverage and close linkage between the development of an understanding of the environment and the design of optimal target detectors.
Inverse Synthetic Aperture Radar (ISAR)	Work is world leading.
Energetic Materials and Systems	World benchmark areas include the development and evaluation of pyrotechnic countermeasures, service life assessment of ADF munitions including missile rocket motors, and research into standoff explosives detection. The work undertaken is considered critical for Australia both in the Defence and National Security areas.

DSTO will use the outcomes of its benchmarking to make improvements to its S&T capability and infrastructure. In addition, DSTO appointed five Principal Scientists, recognised for their scientific expertise, to grow S&T excellence in priority areas.



Comparison of external assessment and self-assessment average. Red shows self-assessment average. Green shows external assessment average.

CLIENT PROGRAM

To deliver a strategically driven client program, DSTO introduced Domain Program Managers for each Defence domain; Maritime, Land, Aerospace, Joint, Intelligence and National Security. The Domain Program Managers work closely with DSTO's existing network of scientific advisers to ensure that the science and technology program reflects the needs and priorities of its clients.

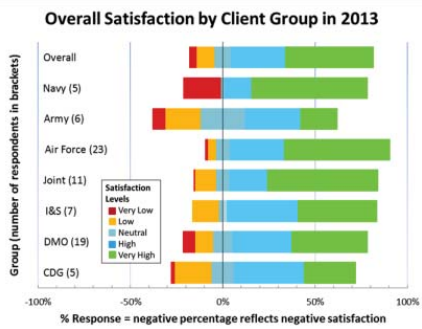
In developing its 2016 S&T Program, DSTO coordinated and facilitated workshops for each domain to discuss and develop Domain Program Guidance. This guidance was integral in shaping a science and technology program that closely aligned with the client's requirements and priorities.

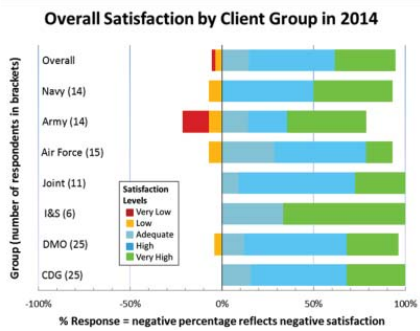
CLIENT REVIEW OF SCIENCE AND TECHNOLOGY (S&T) PROGRAM AND CLIENT SATISFACTION

DSTO improved the annual review of its S&T Program by senior Defence clients and continued its use of client satisfaction surveys to gather client feedback on the quality and timeliness of the organisation's S&T support.

The survey results clearly show that overall DSTO's science and technology support is meeting the needs of Defence. The annual desk officer survey, completed in November 2014 shows 94% of respondents were satisfied with DSTO performance, an improvement on 2013 results.

General themes from the feedback included the need for a balance between short and long term science and technology; the importance of responsiveness to high priority tasking; the requirement to align science and technology with client needs; the value of embedded staff and continuity of support; and the need for DSTO to broker national and international partnerships.





BIG PICTURE ANALYSIS

In 2015, DSTO and the University of New South Wales co-hosted the inaugural Emerging and Disruptive Technology Assessment Symposium focusing on future directions of research in Trusted Autonomous Systems. The symposium, which involved participants from government, industry and academia, was a major success in facilitating the sharing of knowledge and ideas that will shape future research and innovation in this area and its impact on Defence and national security.

SOLVE-IT CHALLENGES

As one of its initiatives to foster innovation within the organisation, DSTO introduced crowd-sourcing to tackle complex problems by using a multi-disciplinary, cross-divisional approach. The outcomes from the first Solve-It Day, a pilot to simplify international travel processes, resulted in automated planning tools, databases and a user-friendly web application. Another Solve-It challenge is looking at ways to counter the threat of improvised explosive devices.

LEADERSHIP TRAINING, PERFORMANCE MANAGEMENT, DIVERSITY AND CAREER DEVELOPMENT

Common performance indicators for senior managers were implemented across the organisation to ensure consistently high performance of research leaders. The organisation continues to roll out tailored coaching and leadership skilling programs for senior staff.

During the year DSTO's mentoring program attracted more participants with 60 mentors and 39 mentees now registered.

Career development prospects for staff were improved by offering 'additional responsibility' opportunities and rotational positions, broad banding of staff at the S&T 4 and 5 levels and recruiting for critical jobs.

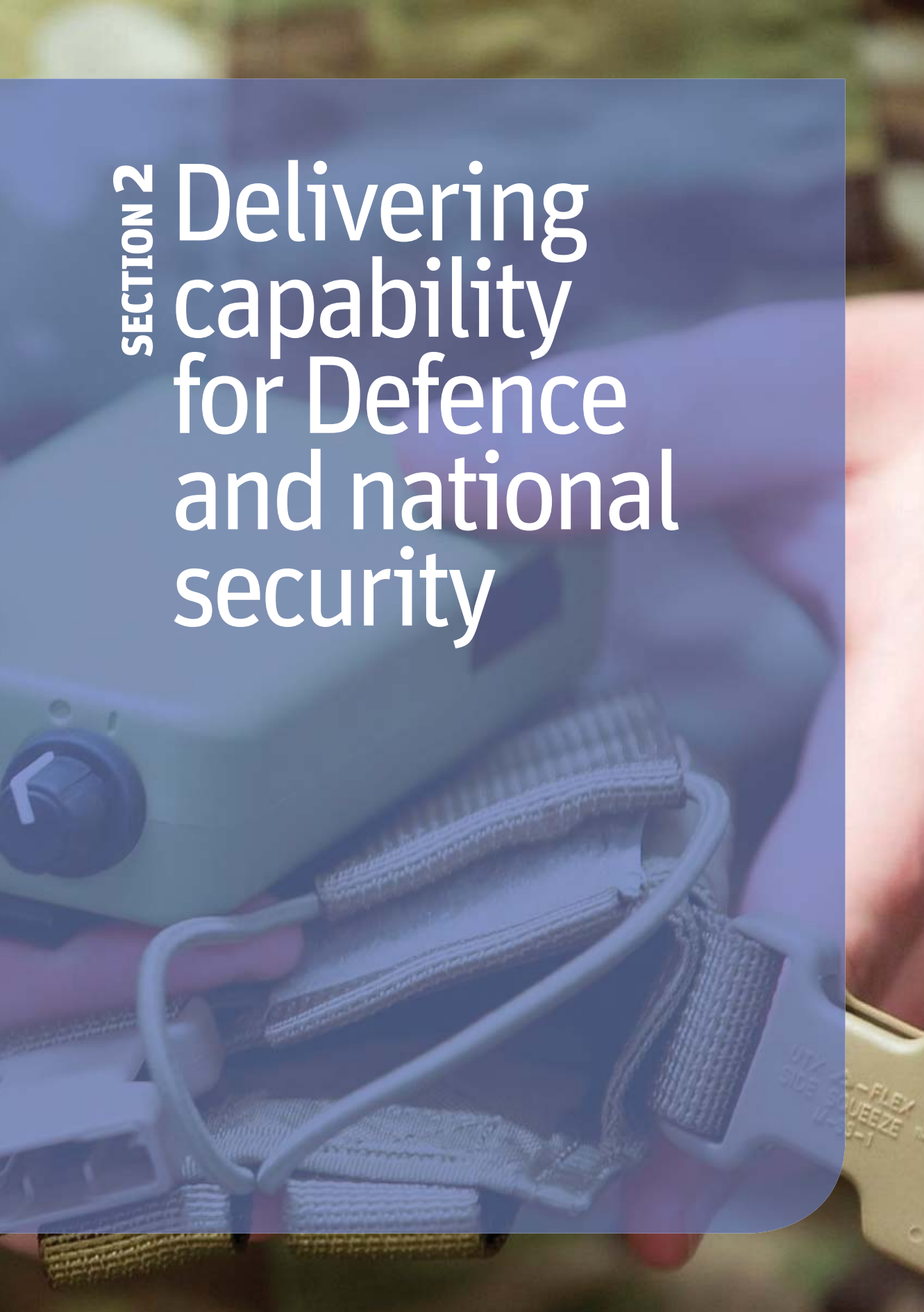
Initiatives to improve gender and indigenous diversity continued through scholarships, cadetships and apprenticeships.

IMPROVING ORGANISATIONAL ICT

The initiative to transform ICT and drive innovation and collaboration underpins corporate and research functions by facilitating activities under other initiatives in the Strategic Plan. Key ICT achievements in 2014-15 involved the roll out of the Objective records management system and Windows 7, and expansion of the video conference facilities to smaller sites.

ORGANISATIONAL EFFICIENCIES

DSTO continues to achieve organisational efficiencies and productivity through simplified processes. It has standardised agreements for processing university agreements, established a new Standing Offer panel to achieve important cost savings for research, science, engineering or technical services, introduced quicker electronic distribution of S&T reports and reviewed library services with a view to modernisation.



SECTION 2

Delivering capability for Defence and national security

SUPPORTING AUSTRALIAN DEFENCE FORCE OPERATIONS

DSTO plays an important role providing direct support to Defence personnel undertaking military operations around the world. DSTO's support and advice in this area are invaluable in helping to ensure that missions are conducted safely and successfully.

While the majority of support to operations can be provided from the safety of laboratories and facilities back in Australia, DSTO scientists are often deployed on military operations to provide immediate, on-the-ground advice and assistance.

DSTO delivers this support through 'Fly Away Teams' made up of scientists with particular skills to address particular needs. These teams can be put together at short notice in cases of urgent need. Should scientists on the ground face a problem they are unable to solve with available resources, they can call on scientists back in Australia for assistance through a support facility called 'Reachback'.

RAPID RESPONSE TO IED THREAT

In 2014-15, DSTO responded urgently to a new improvised explosive device threat emerging in ADF theatres 'Operation Highroad' in Afghanistan and 'Operation Okra' in Iraq. The ADF had no countermeasure capability with its existing land platform system, and the US supplier of this system could not develop or provide a solution. The ADF was faced with the prospect of having to rapidly acquire many millions of dollars of new equipment to address the threat. Instead, DSTO was able to quickly develop, successfully test and produce a new countermeasure technique and corresponding auxiliary unit which could be integrated into the existing system. In three weeks, DSTO was able to manufacture and deliver 20 units to theatre. Another 50 units were subsequently produced by industry over a three month period.

SPECIALISED IED PROTECTION SYSTEMS

Unique, low-cost, robust and lightweight protection systems developed by DSTO to counter improvised explosive devices are now being deployed by the National Defence and Security Forces in Afghanistan.

DSTO developed the force protection systems under Defence's Redwing program. The system has two variants, 'Greengum' for personal dismounted use, and 'Greygum' for installation on light vehicles. The equipment is designed for harsh operating environments and requires minimal operator training and limited logistical support. More than 100,000 units were supplied.

ENHANCED TARGETING ACCURACY IN MIDDLE EAST DEPLOYMENT

In 2014-15, DSTO helped improve the targeting accuracy of F/A-18 aircraft deployed to the Middle East for air support operations over Iraq. In the months prior to deployment, the RAAF undertook trials to collect the required data. DSTO conducted statistical studies to assist in the selection of

scenarios to maximise the accuracy of their weapons. DSTO's expertise also ensured that RAAF pilots now have simple tools to clarify the complex decision-making process during demanding missions.

GIVING SHIP SONAR TEAMS THE OPERATIONAL EDGE THROUGH MENTORING

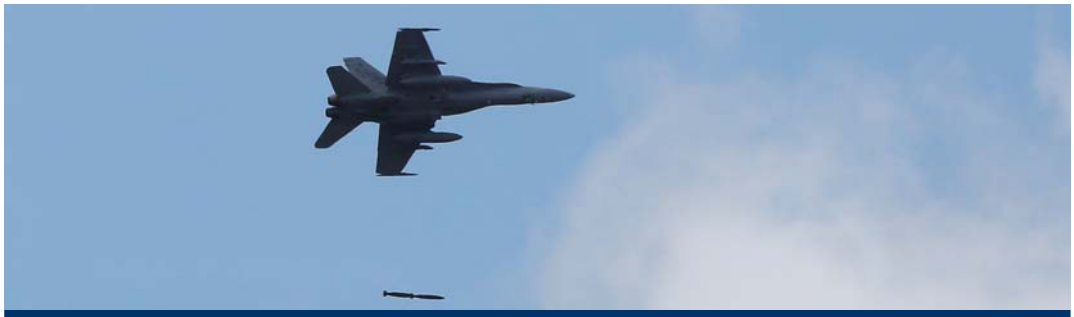
Navy is using DSTO subject matter experts as mentors to provide Anti-Submarine Warfare (ASW) teams with an operational advantage.

In November 2014, during Exercise Distant Shores, DSTO personnel helped HMAS Arunta's ASW team understand and exploit the variability in ocean characteristics that frequently affects sonar performance. Working with DSTO staff, the sonar team learned to optimise their sonar settings for submarine detection, achieving an impressive performance.

As the ship's Commanding Officer reported, the exercise was "...invaluable from a training perspective exposing many of the ship's crew to the challenges of anti-submarine warfare with a real submarine in an environment that makes detection difficult."

Afghan soldiers inspecting Greengum devices.

IED countermeasures and auxiliary units have been integrated into operational vehicle platforms.



F/A-18 releasing a weapon during Exercise Black Skies.

Ships during Exercise Distant Shores.

SUSTAINING AND ENHANCING EXISTING DEFENCE CAPABILITY

A large proportion of DSTO's work effort is directed at sustaining and enhancing current Defence capability. Specifically, this work is aimed at improving the ADF's operational effectiveness, enhancing the safety of troops, maximising the availability of Defence platforms and minimising the costs of owning and operating Defence assets.

ENHANCED PERFORMANCE OF THE F/A-18 MISSILE

DSTO led a joint project between Australia and the United Kingdom to upgrade the software of the advanced short-range air-to-air missile carried on RAAF and RAF F/A-18 aircraft. The software developments undertaken have delivered step-change improvements in performance.

DSTO was responsible for the concepts underlying the modifications and proving the performance gain through modelling and airborne trials. The final software load was thoroughly tested by DSTO using hardware-in-the-loop experiments and airborne trials using pods mounted on a Lear jet. The capability was proven through a set of highly successful live firings and the new software is now ready to be loaded onto RAAF and RAF assets.

VEHICLE SURVIVABILITY EVALUATION PROGRAM

DSTO completed the pre-acquisition phase of Australia's largest-ever vehicle survivability evaluation program. Over a period of four years, trials included landmine, side-blast, ballistic and fragmentation evaluation. These trials were leading-edge and included several scientific world firsts, including 3D high-speed visualisation, and the use of performance-based blast loading conditions which allow for a more accurate comparison of a vehicle's blast protection capabilities. The evaluation program provided new insights into vehicle occupant survival and achieved successful discrimination between the tested vehicles.

"These trials defined the standard for future trials and remain the largest, most innovative and complex live-fire test series ever conducted in Australia and an outstanding example of collaboration within Defence."

Letter of thanks from
MAJGEN Jeffery Sengelman
SOCAUST

ENHANCED SMART BOMB

In 2015, the RAAF took delivery of the first production set of Australian-designed and manufactured wing kits for the Joint Direct Attack Munition-Extended Range (JDAM-ER).

Developed by DSTO scientists, the wing kit technology consists of a set of deployable wings which convert a standard JDAM into a long-range glide bomb, capable of striking a target with pinpoint accuracy at up to three times the range of the original weapon.

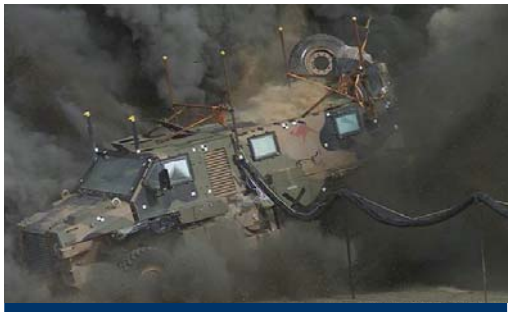
DSTO provided critical electromagnetic compatibility support to the JDAM-ER weapon project. Testing undertaken by DSTO with the US Air Force provided invaluable data to support the system verification and validation of computer models, completing the certification picture for the weapon's wing kit.

ANTHROPOMETRIC SURVEY OF NAVY PERSONNEL

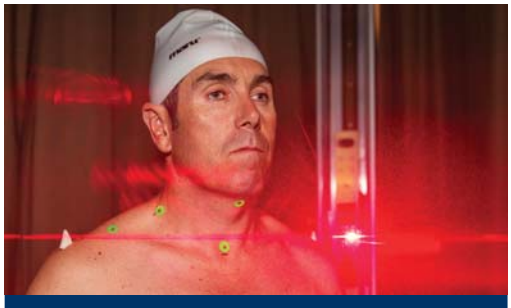
DSTO is undertaking the first detailed anthropometric measurement of Navy personnel in 38 years. DSTO scientists have conducted body scans and taken physical measurements on 1,343 Navy personnel at Fleet Base West and Fleet Base East. The data will provide a new benchmark for assessing the ergonomic performance of future naval platforms. It will also provide an objective basis for the design and cost effective supply of a wide range of escape and safety equipment, medical supplies, nutrition logistics, uniform, and fire-fighting apparatus.

ASRAAM missile on F/A-18 aircraft.

JDAM-ER weapon on F/A-18 aircraft.



Live-Fire Blast Test on a Bushmaster, using a performance-based landmine blast loading.



Navy personnel being scanned during anthropometric study.

HIGH DATA RATE SATELLITE COMMUNICATIONS FOR NAVY SHIPS

After a five-year research program DSTO succeeded in finding a technical solution to one of Navy's vexing problems – how to provide high data rate satellite communications for ships in high threat environments. DSTO scientists developed a novel method to prevent such communications interfering with the ship's self-protection sensors – the OASIS satellite communications waveform. Implementing the waveform in software defined modems, they conducted an exhaustive series of complex trials with Navy, involving interoperation with many different ship systems, and concluded that OASIS worked exactly as intended, causing no reduction in the sensor performance or consequential increase in ship vulnerability. The solution is now being transitioned to Navy for implementation.

ENHANCED ELECTRONIC SURVEILLANCE AND INTELLIGENCE CAPABILITIES

DSTO has demonstrated a world-class capability in the design and implementation of Electronic Intelligence signal processing algorithms. These include algorithms for specific emitter identification, Low Probability of Intercept detection, multi-channel signal detection and processing, mapping algorithms to parallel processing architectures, multi-sensor signal processing, and the development of Technical Signals Intelligence tools and decision aids. Some of these techniques have outperformed those of DSTO's international partners. The Australian developed tool suite has been assessed as sufficiently valuable to be transitioned to a Five Eyes operational state and maintained by the community.

LIVE is a DSTO-developed situational awareness tool that integrates off-board intelligence sources to provide Navy platforms with enhanced over-the-horizon maritime domain awareness. It has been successfully deployed on the HMAS Melbourne, HMAS Perth and HMAS Bundaberg and was rolled out as an embedded component of the Navy's STARDUST Electronic Support/Electronic Intelligence augmentation system. LIVE may become a software component or application within a future command support system such as the Maritime Tactical Command and Control system.

There has been an exchange of the LIVE situation awareness tool with a maritime tracking tool from a US government agency aiming to integrate them and jointly extend the capability to include platform vulnerability assessments.

RECOVERY OF THE F/A-18 CENTRELINE PYLON

The F/A-18 centreline pylon has a history of fatigue cracking at the forward attachment points in its structural support frame. In 2014, it was found that the current in-service non-destructive inspection methods could not detect sufficiently small cracks to ensure safe operations.

In addition, the standard approaches to restore the centreline pylon capability would increase the stress concentration at the critical location and potentially raise the risk of premature pylon failure.

DSTO recommended a method that would increase the sensitivity of inspections and apply an optimal re-profiling to reduce stress concentrations while removing any cracking. This approach enabled the prompt and effective recovery of pylons, negating the need to purchase replacements and allowed the deployment of aircraft to the Middle East to resume.

MAINTAINING THE STRUCTURAL HEALTH OF THE F/A-18

- **Rapid certification of aircraft structures** Using the outer wing of an F/A-18, DSTO and the RAAF are investigating the use of static testing to reduce the time and expense of the certification process. The principal phases of the F/A-18 Hornet Outer Wing Static Test were successfully completed in March 2015, enabling the RAAF to adopt a through-life fatigue management strategy which does not require costly wing skin removal and internal inspections.

- **Providing assurance on the durability of F/A-18 bulkhead holes** Indications of cracking in wing attachment bulkhead holes of the F/A-18 were cause for considerable concern to the RAAF. Fatigue cracking from this hole could eventually lead to bulkhead failure with catastrophic consequences. After extensive stress analyses and testing, DSTO was able to determine that the remaining durability of the hole was sufficient to allow the current configuration to remain in service without further inspection prior to retirement.

- **Improvements to fatigue life methodologies** DSTO scientists have developed a method of testing, measuring and analysing small cracks to improve their ability to predict short crack growth behaviour in the aluminium and titanium alloys used in Defence airframes. This new methodology, which has attracted the interest of the US Navy, has been incorporated into the updated F/A-18 Hornet fatigue monitoring program. Results indicate a welcome decrease in the estimated fatigue damage on average across the fleet, allowing greater flexibility of operations as the airframe approaches its planned withdrawal date.

EXPLORING DRAG REDUCTION TECHNOLOGIES FOR THE C-17

DSTO is involved in an international collaboration researching drag reduction technologies for the C-17 aircraft. The United States Air Force, the US Air Force Research Laboratories, the Royal Canadian Air Force, the National Research Council of Canada and DSTO are partnering with Boeing and Vortex Control Technologies to test the effectiveness of aerodynamic finlets that will be attached to the rear fuselage of the C-17 aircraft.

Wind tunnel testing of a C-17 aircraft model fitted with finlets has shown that the aircraft's drag could be reduced by 1% to 2% in cruise conditions, with the potential to provide fuel savings in excess of $15 million over the life of the fleet.

The outcomes from this project may significantly reduce the through-life operating costs of the RAAF's C-17 fleet through reduced fuel burn, with additional benefits on engine emissions and life.

Jaime Calero preparing centreline pylon for machining.

C-17 Globemaster taking off from a base in Afghanistan.

C-130J WING FATIGUE TEST

DSTO provided invaluable support to the C-130J-30 Wing Fatigue Test, a collaborative program between the RAAF and the Royal Air Force. The results of the test, performed in the United Kingdom, will enable the RAAF to safely and efficiently manage the airworthiness and operational capability of the C130J fleets until their planned withdrawal date.

While the program is nearing completion, it continues to benefit from the significant scientific oversight and technical leadership provided by rotating DSTO staff members attached to the program, who have been commended for their invaluable contributions.

ASSURING THE SAFE OPERATION OF THE PC-9 FLEET

In 2009, unexpected cracking in the aft fuselage of the RAAF PC-9/A trainer fleet initiated a series of structural integrity programs to ensure the operational safety of the fleet.

Work by DSTO and its Defence and industry partners successfully assured the safe operation of the world's oldest PC-9 fleet beyond 30 years of service, extending the planned withdrawal date to December 2019.

SYNTHETIC TRAINING EXERCISES

DSTO regularly assists with training exercises for military personnel. In 2014, DSTO hosted Exercise Black Skies, a synthetic, collective training research exercise conducted collaboratively with the RAAF. The annual exercise offers the RAAF an opportunity to conduct mission rehearsal for the live Exercise Pitch Black, as well as participate in DSTO's training research.

DSTO also hosted RAAF participants in Coalition Virtual Flag, the largest virtual coalition air force training exercise held each year. An air battle management team from 2SQN and pilots from 37SQN trained in simulators in DSTO's Air Operations Simulation Centre in Melbourne. The crews received valuable training experiences in mission planning, conduct, and debriefing in a large force employment environment – Exercise Red Flag.

SUPPORTING NAVY PLATFORMS AND PERSONNEL

- **Active radar absorbing materials** DSTO is designing active radar absorbers to reduce the radar cross-section of military platforms. These absorbers incorporate metamaterials that can be turned off in situations where a high radar cross section is desired, or turned on when in a threat environment. Samples of DSTO-developed active radar absorbing materials are undergoing environmental exposure trials to evaluate their durability. In the tests performed so far, there has been no significant change in performance after 24 months of outdoor exposure.

- **Improved tuned vibration absorbers for Collins submarines** DSTO developed tuned vibration absorbers for the Collins Class submarine, significantly reducing components of the acoustic signature, thereby minimising the likelihood of detection and classification.

- **Assessing the integrity of submarine hull valves** Research into the integrity of critical submarine hull valves by DSTO scientists has enabled their safe service life to be increased from the proposed four years to eight to 10 years, saving approximately $1.3 million per boat in material costs alone. In addition, a potential issue with fasteners that increased the valve's susceptibility to shock failure was identified, with a subsequent solution determined and shock-proof tested.

- **Enhanced submarine dynamics and control simulation** To enhance its ability to simulate submarine manoeuvring dynamics and control, DSTO updated the algorithms used in its simulations to be far more representative of the performance of the real boat. DSTO's use of simulation models is estimated to have saved Defence millions of dollars.
- **Ensuring a safe working environment** DSTO has developed a specialised atmospheric analysis strategy to monitor the air quality on board the Armidale Class patrol boats. DSTO's specialist knowledge of atmospheric habitability issues enabled a system to be deployed for measuring currently regulated air pollutants, as well as those likely to be regulated in the near future, thus future-proofing the results.
- **Crew endurance** In collaboration with the Navy, DSTO recently completed a study of the work and sleep patterns of ship personnel during an overseas operational deployment. Data from this trial highlighted the impact of fatigue on performance and the value of fatigue awareness and fatigue risk management processes.
- **Rapid pipe repair systems** The DSTO-designed lever clamp enables a single person to repair pipes of various diameters in less than 60 seconds, a significant improvement over current repair methods used by Navy. The innovative clamp has generated interest from both Defence and civilian organisations. Patents have been granted in Australia, New Zealand, the United States, Singapore, and are currently lodged with Canada and Europe.

Innovative lever clamp being installed.

DSTO team members Neil Tavener, Peter Formby, Mike Bell, Stuart Anstee, Tony White and David Battle with the REMUS 600 autonomous underwater vehicle.

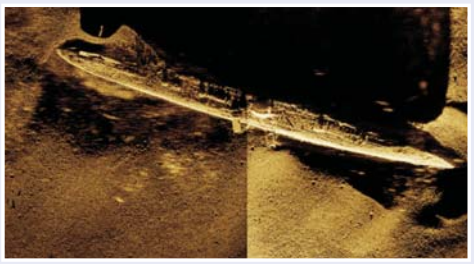
SUCCESSFUL TRIAL OF ADVANCED SONAR TECHNOLOGY

In May 2015, a team of six DSTO scientists and technicians, equipped with two autonomous underwater vehicles and cutting edge sonar technology, sailed from Darwin to Cairns. Among the several scientific and engineering objectives of the cruise was to deploy the autonomous underwater vehicles at various locations to observe how they and their sonar payloads coped with the high water temperatures and strong currents for which the North is famous.

The team launched their REMUS 600 autonomous underwater vehicle equipped with a state-of-the-art Kraken AquaPix Interferometric Synthetic Aperture Sonar on a mission to survey the wreck of the Imperial Japanese Navy's submarine I-124. Also known as "Darwin's Submarine", the I-124 was sunk by the HMAS Deloraine in the Beagle Gulf in 1942 following a failed attack in which its torpedo ran astern of the Deloraine by only 10 feet.

Prior to the DSTO mission, there were plenty of questions as to how the sensitive mine-hunting sonar would handle such a large distributed target. It was not even known if the strong currents in the vicinity of the wreck would allow the focusing algorithms to work at all on account of the stability they require to form sharp images.

After diving to a depth of approximately 40 metres, the REMUS 600 approached the 85-metre wreck from the north, capturing a clear image at a range of approximately 80 metres. Despite crabbing against 1.5 to 2 knot cross-currents at angles exceeding 11°, the sonar managed to resolve features as small as 3 centimetres in size.



Sonar image of the 1942 Japanese submarine wreck.

ENSURING DEFENCE IS A SMART BUYER

DSTO provides critical scientific and technical advice to the Government on Defence acquisitions. It provides input to all stages of the acquisition process from the initial capability definition through to the selection process and introduction into service.

In providing its advice, DSTO considers the whole-of-life costs of the purchase, including sustainment and operating costs. It determines whether the acquisition and its support systems can be delivered and integrated into the Defence Force within the designated time frame, and if the acquisition will provide the capability that was originally specified.

TECHNICAL RISK ASSESSMENTS

Technical Risk Assessments are DSTO's primary method of providing acquisition advice. Technical risks arise from the uncertainty that key technologies or integration methods and practices might not mature in time for the project and thus threaten the feasibility of the capability objectives.

DSTO's Technical Risk Assessments ensure that decision-makers in Defence and government are fully aware of the risks associated with a project, and help inform risk management strategies.

In providing its assessment of technical risk, DSTO applies the AS/NZ ISO 31000 Risk Management Framework standard.

In 2014-15, DSTO provided Technical Risk Assessments on 25 acquisition projects and Technical Risk Certification for another 30.

RAPID ASSESSMENT OF TECHNICAL RISK

DSTO's ability to respond quickly to Defence requirements was put to the test in the lead up to the Government's decision to procure two additional C-17A Globemaster aircraft and two additional KC-30A multi-role tanker transport aircraft.

The acquisition proposals for these projects were developed rapidly within Defence to take advantage of market opportunities. DSTO appointed project science and technology advisers to expedite the development of technical risk assessments for these projects. These assessments provided the Chief Defence Scientist with the necessary S&T advice to support his technical risk certification for the Cabinet submissions.

ASSESSMENT OF PROTECTED MOBILITY VEHICLES

Defence is in the process of procuring Protected Mobility Vehicles (Light) to replace part of the Army's Land Rover fleet. These vehicles require a balance between protection, mobility, survivability, and networked command and control integrated systems. A developmental 'made and supported in Australia' option is being considered for this project.

Since the early days of the project, DSTO, in collaboration with Army and the then Defence Materiel Organisation, has conducted survivability testing, and assessed various technical risks associated with the project. Specific risks prompted Defence to conduct a viability assessment in early 2014, which showed that the design was not yet proven. Further design development occurred, and in August 2014, DSTO and the Land Engineering Agency conducted testing that demonstrated the design viability. By DSTO identifying critical technical risks, the project was able to treat the risks, resulting in a better design for the Army.

DSTO TECHNIQUE ADOPTED FOR JOINT STRIKE FIGHTER TESTING

An innovative technique developed by DSTO to facilitate the analysis of crack growth in aircraft structures has been adopted by Lockheed Martin for use in airframe durability tests of the F-35 Joint Strike Fighter.

DSTO's Marker Band technique provides a substantially more efficient and simpler means of measuring crack growth than current methods. The inclusion of Marker Bands on the F-35 full-scale durability test will facilitate better management of the structural integrity of the worldwide F-35 fleet. Accurately knowing the location and growth rate of cracks allows reinforcements and repairs to be designed in an orderly fashion and installed during scheduled maintenance. In contrast, unanticipated discovery of these same cracks in the operational fleet can result in groundings, fleet-wide inspections, rapid design of modifications and unscheduled modifications, all of which reduce aircraft availability and increase costs.

So successful is the technique, DSTO has been approached by the F-35 Joint Program Office to provide Marker Bands for other related smaller scale fatigue tests.

ENSURING ELECTROMAGNETIC AND STORES COMPATIBILITY OF THE JOINT STRIKE FIGHTER

DSTO has a well-established team investigating the electromagnetic compatibility of the F-35 aircraft. The team is assessing and monitoring the aircraft's ability to withstand electromagnetic exposure from both natural and man-made sources in order to minimise any impact on its systems and performance. In the last financial year, two DSTO subject matter experts participated in a full suite of testing in the United States. The result was a high-level of insight into a key Australian military capability, and an ongoing seat within the US F-35 team.

DSTO is also collaborating with the US Air Force to develop leading-edge computational modelling techniques to support F-35 stores clearance requirements over the life of the aircraft. DSTO has a well-established computational radio frequency modelling capability that complements the stores compatibility knowledge of the US Air Force. The working relationship is already proving to generate deep insight into the F-35 stores compatibility challenges.

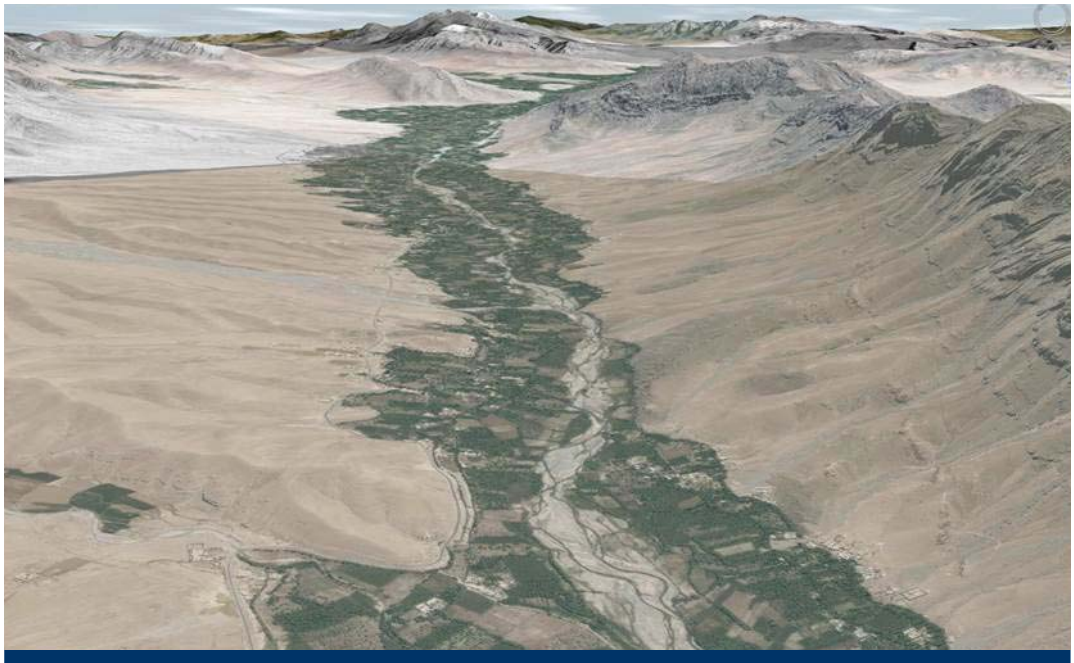
JOINT AIR WARFARE BATTLE LABORATORY

With its extensive experience and expertise in simulation and synthetic training, DSTO was tasked with managing the acquisition and sustainment of a synthetic collective training capability to be installed at RAAF Williamtown. The Joint Air Warfare Battle Laboratory will be used to define and prepare the future Air Force elements of Defence's distributed mission simulation capability. It will also provide an environment in which to explore the capabilities of the "new Air Force" and to study both current and future requirements for synthetic collective training. DSTO will manage the training and research activities in the facility over the next five years.

READY ACCESS TO SATELLITE IMAGERY

DSTO has worked with the Australian Geospatial-Intelligence Organisation to develop Serval, a system that provides Defence users with ready-access to commercially available high-resolution satellite imagery. When a user makes a request through the Serval system, Serval checks whether the data has been previously downloaded by a Defence user. If it has, the user can have it again free of cost. This once-off payment for a geospatial tile is saving Defence considerable amounts of money.

Satellite imagery from the Chora Valley in Afghanistan overlaid on a 3D terrain model.



Geospatial imagery of another terrain in Afghanistan.

ACHIEVING FULL OPERATING CAPABILITY OF THE WEDGETAIL

Over 20 years of DSTO support was rewarded in May 2015 with the declaration that Australia's new Early Airborne Warning and Control aircraft, the E-7A Wedgetail had achieved full operating capability.

DSTO has had a pivotal role in addressing technical challenges during the development of this capability, and is highly regarded by RAAF Surveillance and Response Group and Australian and US industry for its contributions to mission system and sensor performance.

Over the past year DSTO has continued to provide valued S&T support to progress the capability from initial operational capability to full operational capability in areas including radar and tracking performance, mission computing, training, and self-protection.

DSTO has also commenced the technical risk reduction program for the first of the Wedgetail's block updates, comprising several interoperability upgrades to ensure the capability can continue to operate with new ADF and coalition assets such as Super Hornet, Growler and JSF.

Wedgetail aircraft.

Exploring Airbourne Early Warning and Control concepts in the Wedgetail Integration and Research Environment.

DSTO SUPPORT FOR WEDGETAIL

Australia's Wedgetail Airborne Early Warning and Control (AEW&C) asset was acquired in response to concerns in the mid-1980s about the limited surveillance attainable then over Australia's northern approaches.

DSTO began work in this area in 1994 at the ADF's request with a Project Definition Study, drawing on subject matter experts in operational analysis, weapons, platform performance, radar, communications and self-protection.

The initial studies sought to establish the best way of filling the surveillance capability gap. Through operations analysis assessments of the types of radar systems available, the optimal option was found to be AEW&C technology. A more refined and detailed view of the desired Australian AEW&C capability was then obtained via computer simulation operations analysis and in-depth studies of state-of-the-art technologies. That information and other specifications were used to draw up a Request for Proposal, which was issued to Defence suppliers in 1996.

During evaluation of the responses, DSTO applied a newly developed technique whereby the three shortlisted AEW&C options were exposed to enemy fighters in computer-simulated scenarios. This analysis showed Boeing's proposal to be optimal. DSTO staff numbers working on Wedgetail at the time peaked at more than 100 experts who applied in excess of 30-person years of work over a one-year period, much of this work being done on risk analysis.

DSTO support from here on focused on problem-solving advice as well as research on crewing and tactics and procedures to inform the asset development process. A large part of this support was offered through resident project teams stationed in the United States with expertise in the areas of radar, human factors, tactical data links and integration. From January 2000 until December 2013, a total of 20 DSTO staff worked in Seattle and Baltimore, up to six of them being resident at any one time.

When initially delivered, Wedgetail's radar target detection and tracking capabilities were found to perform below required levels. DSTO analysis and advice proved crucial for remediating these problems. The support it provided in the areas of mission-system computing, data links, tactics and procedures, crewing and self-protection similarly led to significantly enhanced capability performance.

DSTO's support overall for Wedgetail ensured the delivery of a cutting edge AEW&C for Australia. According to Air Vice Marshal Chris Deeble, "The RAAF today operates the best AEW&C capability in the world, with more capability yet to be realised. The innovation, professionalism and dedication that DSTO bought to bear in achieving this outcome were exemplary."

DSTO continues to support the evolution of Wedgetail with research and advice to deliver improvements in current system performance and proof-of-concepts for future capability development.

MITIGATING HUMAN-RELATED RISK FOR THE FUTURE FRIGATE

DSTO is working closely with Defence to ensure that the needs and requirements of Defence personnel are integrated into the design of the future frigate. DSTO has undertaken a comprehensive series of workshops and interviews with Defence experts to identify the potential human-related risks and opportunities of the future frigates and enable a comprehensive and integrated approach to risk mitigation.

IDENTIFYING USER NEEDS TO IMPROVE NAVY WARFIGHTING EFFECTIVENESS

DSTO analysts have been leading a series of workshops with Navy participants to identify the warfighter needs of the Nulka system. The outcomes of the workshop have been used to identify user requirements which will aid in the redesign of the new user interface and develop requirements for future versions of the system.

DSTO will work with BAE Systems to develop several interface design options. Following the development of working prototypes, DSTO will lead evaluations with representative users and scenarios, and work together with BAE Systems to assist in the evolution of the design to meet user needs.

UNDERSTANDING THE ACOUSTIC SIGNATURE OF THE FUTURE SUBMARINE

As part of its extensive support to the future submarine project, DSTO is assessing the acoustic signature of the submarine; a challenging task at this point in the design process when detailed information about the submarine is not available.

DSTO is working with Frazer-Nash Consultancy Ltd to develop a software framework for modelling the mechanisms that contribute to the acoustic signature of a submarine. Models will be used to identify aspects of the proposed design that are at risk of not meeting the signature requirements, and the models can be progressively updated as the submarine specification is finalised and the submarine design progresses.

The software framework being developed will integrate modelling tools developed by Frazer-Nash as well as DSTO's own signature prediction models. This new capability establishes an independent means of testing the claims of the submarine designer and has already been used to study the behaviour of machinery sub-systems on the Collins class submarines. In 2014, the UK Ministry of Defence expressed an interest in using the new modelling tool and negotiations on UK involvement in the software development are ongoing.

In addition, DSTO continues to simulate flow structures using its high performance computer. An understanding of the origin and control of these flow structures is important in reducing the acoustic signature of any submarine. An important aspect of future work will be to simulate modified appendage, sail and casing shapes to minimise turbulence and hence acoustic signatures.

SUPPORTING FUTURE MARITIME SURVEILLANCE WITH STATE-OF-THE-ART SIMULATION

DSTO's Synthetic Human-in-the-loop AIR 7000 Research Program (SHARP) is being used to explore the concepts of operations, tactics and the critical decision-making process associated with operating a P8-A Multi-static Acoustic buoy field.

Outcomes from the trial will be used to inform follow-on constructive simulation efforts in support of the joint P8-A collaborative development program between the United States and Australia.

SHARP was also used to support studies for Defence's Multi-Role Helicopter.

Personnel from 92WG operate SHARP during a trial supporting Project AIR7000.

SHARP replicates the tactical layout of maritime surveillance platforms such as the P8-A Poseidon.

FUTURE-PROOFING DEFENCE

DSTO plays an important role ensuring that Australia is prepared for the Defence and national security challenges of the future. The organisation's expert scientists actively monitor evolving technologies to assess their potential as either an emerging threat or critical capability.

To better position Defence and Australia's national security agencies, DSTO undertakes strategic research in technology areas that it considers may provide game-changing capabilities for Defence in the future: autonomous systems; cyber warfare; future undersea warfare; intelligence, surveillance and reconnaissance; signature management; bioterrorism preparedness; future electronic warfare; hypersonics; materials and energy; and space systems.

DSTO has also identified a number of 'grand challenges' for safeguarding Australia. These large-scale, cross-disciplinary initiatives will be high-impact and scientifically complex, involving integrated and productive collaborations with industry, universities and government. A framework for Grand Challenges was completed and the concept was highlighted in the White Paper development process as a collaborative mechanism to deal with complex capability problems.

IMPROVING BIODETECTION CAPABILITIES

DSTO is involved in the establishment of a program for the evaluation of biodetection and diagnostic platforms to ensure the ADF and national security agencies will be able to use the best possible detection and diagnostic platforms into the future. This, and the development of in-field assays, will enhance the capacity of Defence and national security agencies to operate in harsh environments, including those containing chemical, biological or radiological threats.

EXPLORING THE POTENTIAL OF METAMATERIALS

Metamaterials are arrays of materials that have been engineered to behave in ways that do not occur in nature. For example, simple electronic elements such as resistors, capacitors and inductors, can be arranged so that when radiofrequency waves pass through them, the waves are bent in a direction opposite to that which occurs when they pass through normal materials.

Applications include enhanced radiofrequency sensors and transmitters, and signature management. The tremendous military potential of these applications means that metamaterials are known as a disruptive technology and are the subject of intense research.

DSTO has developed the capability to design metamaterials and incorporate them into composite structures as the composite is being manufactured. Work to date has focused on creating lightweight aircraft skins that contain electrically-small antennas. Other applications are also possible.

MULTI-MISSION AUTONOMOUS SYSTEMS FOR URBAN OPERATIONS

DSTO is developing airborne and ground-based autonomous systems specifically designed for urban operations including emergency response, humanitarian assistance and disaster relief. With their typically cluttered environments, urban operations pose specific challenges to researchers. Current research is focused on navigation inside buildings; contaminant-source localisation and intelligence; and surveillance and reconnaissance capabilities using sensors that operate in smoke and darkness.

UNPOWERED EXOSKELETON REDUCES BURDEN

DSTO researchers are exploring the use of an unpowered, lightweight, fully-passive exoskeleton to reduce the fatigue and injury caused by soldiers carrying excessive loads.

While powered exoskeletons show real promise in enabling the wearer to lift and move about with very heavy loads, the design and natural movement of the human body tends to battle with the exoskeleton movement, causing a dramatic increase in the user's energy cost when walking with a load. In addition, powered systems tend to be heavy, very expensive and power hungry.

DSTO's unpowered exoskeleton is considerably simpler in design, requires no heavy batteries, is low cost and easier to integrate with the user and their equipment. In addition, when no longer required, the system can be easily removed and added to the pack.

The development is currently at a proof-of-concept stage with early testing showing encouraging results. However, the biomechanics of the system require extensive refinement to ensure it is integrated optimally with the soldier and truly fit for purpose.

While the technology is being developed around military use it may be applicable to many civilian scenarios such as firefighting, trekking and personal load carriage roles that require assistive technology.

Tom Chapman models the exoskeleton.

ADVANCING HYPERSONIC TECHNOLOGIES

Hypersonic technologies are maturing rapidly in many nations around the world and DSTO is well positioned as a leader in this field. DSTO is a partner in the Hypersonic International Flight Research Experimentation (HIFiRE) program, an international collaboration with the United States Air Force Research Laboratory. To date, the HIFiRE collaboration has flight-tested seven hypersonic vehicles, producing high fidelity data on advanced scramjet engines, boundary layer transition physics and hypersonic flight systems.

The HIFiRE program has developed a number of technologies and processes that are allowing hypersonic systems to be elevated up the Technology Readiness Level scale. One of the key processes that the HIFiRE program has delivered is affordable flight testing. The program allows a “turn-key” approach to the hypersonic research community where scientific experimental objectives can be translated into a flight data package through a single group, DSTO. The scientific data produced and recorded via telemetry during a flight test is considered the final frontier on the path to gaining knowledge on hypersonic flight systems.

In March 2015, DSTO launched the HIFiRE 7 vehicle from the Andoya Test Range in Norway. HIFiRE 7 was a free-flying, back-to-back scramjet experiment designed to measure the thrust produced by the hypersonic engines. Many of the mission objectives were achieved but the prime combustion data was not recovered due to data transmission failure at that key time. DSTO has plans to repeat this experiment. However, the data recorded during the flight test was of exceptional quality and is currently being analysed by government and university scientists. The analysis of the flight data will result in the advancement of a number of key hypersonic technologies.

Further test flights are planned for 2016 at the Woomera Test Range.

Hypersonics flight trial in Norway.

ADVANCED NANOSTRUCTURED FABRICS FOR PERSONAL PROTECTION

The Defence Materials Technology Centre and DSTO are participating in a collaborative project looking at advanced nanostructured fabrics for use in low-burden personal protection. This project, funded through the Defence Innovation Realisation Fund, will further develop a technology that could provide a lower weight Individual Protection Equipment capability against chemical and biological threats, including aerosols.

ENHANCED CAPABILITIES FOR PROCESSING, EXPLOITING AND DISSEMINATING INTELLIGENCE AND SURVEILLANCE DATA

In 2014-15, DSTO's exemplar integrated ISR architecture (ELIIXAR) was used extensively to demonstrate enhanced capabilities for processing, exploiting and disseminating intelligence and surveillance data from multiple sources in operational environments.

Using ELIIXAR, DSTO provided critical support to several Defence projects, including the RAAF Distributed Ground System Australia project, several Defence acquisitions, the RAAF's Plan Jericho to develop an adaptive and agile Air Force in the information age, and Army's modernisation plans.

To facilitate field demonstrations of integrated ISR, DSTO has developed a Deployable ISR Container Environment (DICE). This is accommodated within a standard shipping container, and provides a deployable data processing, exploitation and dissemination capability allowing local analysis and reach-back of ISR data within a secure environment. Most recently, the DICE has been exercised during Talisman Sabre 2015, providing reachback of high-resolution motion imagery from airborne platforms.

RAAF officers in the Deployable Intelligence Surveillance and Reconnaissance Container Environment used for field demonstrations.

SUPPORT TO SATELLITE PROGRAMS

DSTO is experimenting with very small satellites (10 cm x 10 cm x 34 cm) called Cubesats to determine how these systems might be used to meet defence and national security needs. Currently two collaborative Cubesat programs (Buccaneer and Biarri) are underway with national and international partners. Each program has nominated dates for mission launches in 2016 and 2017. DSTO's support to these programs ranges from modelling and simulation to payload development, as well as creation of a ground station to support the missions, part of an international network of ground stations.

INTERNATIONAL SPACE SITUATIONAL AWARENESS

Research in space relates to broad area and battlespace surveillance and intelligence collection. This involves integrating the operation of sensors and assets and fusing the processing, exploitation and dissemination of systems to support current and future Defence needs. In conjunction with the Defence Science and Technology Laboratory in the UK and Defence Technology Agency in New Zealand, DSTO conducted an international space situational awareness experiment. A small set of objects in earth orbit were selected and observed by radar in the UK, telescope in New Zealand and DSTO's space situational awareness telescope in Australia.

The objects were at a variety of altitudes, from low-earth orbit (hundreds of kilometres) through to geosynchronous orbit (around 36,000 km). The aim of the experiment was to explore the orbital accuracy provided by geographically dispersed sensors and to explore data and communications requirements for near-real-time cueing of space situational awareness sensors.

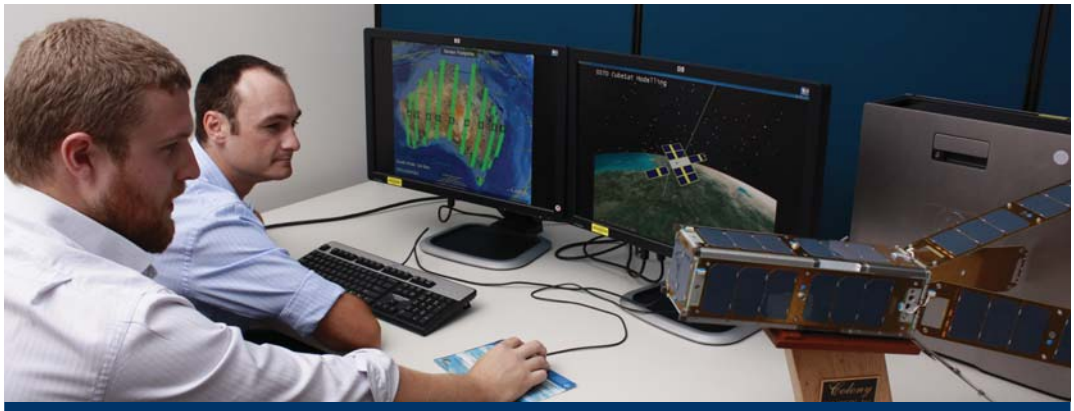
In the experiment, orbital cues were generated by the radar in the UK and successfully handed off to the sensors in Australia and New Zealand, which were then able to simultaneously acquire and track the objects.

FUTURE ROCKET MOTOR TECHNOLOGY

The Advanced Tactical Booster Technologies program achieved significant milestones during the 2014-15 year. The collaborative program with the US Air Force Research Laboratory aims to advance rocket motor technologies for future boost applications.

Areas of particular interest include advanced rocket motor modelling and simulation; high performance propellant designed to withstand the rigours of service in demanding thermal and vibrational environments; high strength but light-weight rocket motor case and insulation materials; and innovative nozzle design and construction.

DSTO conducted a successful and reliable firing of a new ballistic test motor capability. This test motor capability will be used for the assessment of propellant formulations, case and liner materials, nozzle construction and motor grain designs. Successful candidates will progress to larger scale motor tests and ultimately to representative motors comprising all of the newly developed technologies.



Leon Stepan and Iain Cartwright developing software simulations and hardware circuitry for small satellites.

Ballistic test motor firing.

HIGH ALTITUDE ANTI-SUBMARINE WARFARE

DSTO is collaborating with the US Office of Naval Research to conduct enabling research in future high altitude anti-submarine warfare.

It involves investigating the use of unmanned aircraft carrying a Magnetic Anomaly Detection system designed to detect minute disturbances in terrestrial magnetic fields caused by large ferrous objects such as submerged submarines. It is intended that the unmanned aircraft will be launched, managed and controlled by P8-A aircraft crew, introducing a range of engineering and operational challenges.

The work represents a large body of cross-discipline research in the fields of *aeronautics* to understand the properties of the marine atmospheric boundary layer just above the ocean surface and the host vehicle's aerodynamic design; *operations research* to explore concepts of operations; *human sciences* to explore the crewing and interface issues associated with the management and control of flying unmanned aerial vehicles from a P8-A platform; *magnetic sensing* to research the sensors' ability to perform in what will be a potentially physically turbulent and magnetically harsh environment; and *sonar signal processing* to investigate the science of multi-static acoustic technologies.

This work has drawn together experts from across DSTO and is staged in the form of graded, risk-mitigating strategies to explore the solution space of viable systems intended to enhance Australia's arsenal in anti-submarine warfare.

DEVELOPING ANECHOIC TILES FOR THE FUTURE SUBMARINE

Rubber anechoic tiles covering the outside of the submarine hull are critical for reducing the reflection of sound from a submarine, thereby decreasing its likelihood of being detected by a threat's active sonar system. DSTO developed the anechoic tiles currently used on the Collins class submarine and is now developing anechoic tile technology for Australia's future submarine.

DSTO has developed models to assess the acoustic properties of new anechoic tile designs and is researching tile geometry and metamaterials to optimise acoustic performance. In addition, detailed submarine models have been developed to study the effect of submarine hull form and anechoic tile coverage on the acoustic reflection.

DSTO's rubber lab has been expanded to facilitate the manufacture of novel materials and tile designs, which will ultimately be transitioned to industry for full scale production.

UNDERSTANDING ADVANCED COMPOSITE STRUCTURES FOR MARITIME APPLICATIONS

Advanced composite materials for structural use offer many benefits due to their corrosion resistance and high stiffness-to-weight and strength-to-weight ratios. In the maritime domain, such composite structures are significantly larger and thicker than for aerospace applications.

To develop a better understanding of the materials science and structural integrity issues associated with such thick maritime structures, DSTO successfully designed and manufactured a large composite hydrofoil and conducted a series of full-scale structural tests to characterise the mechanical behaviour and failure mechanisms.

The knowledge and capabilities established through these tests will allow DSTO to provide independent and expert advice to Navy on the applications and potential benefits of advanced composite structures in the maritime domain.

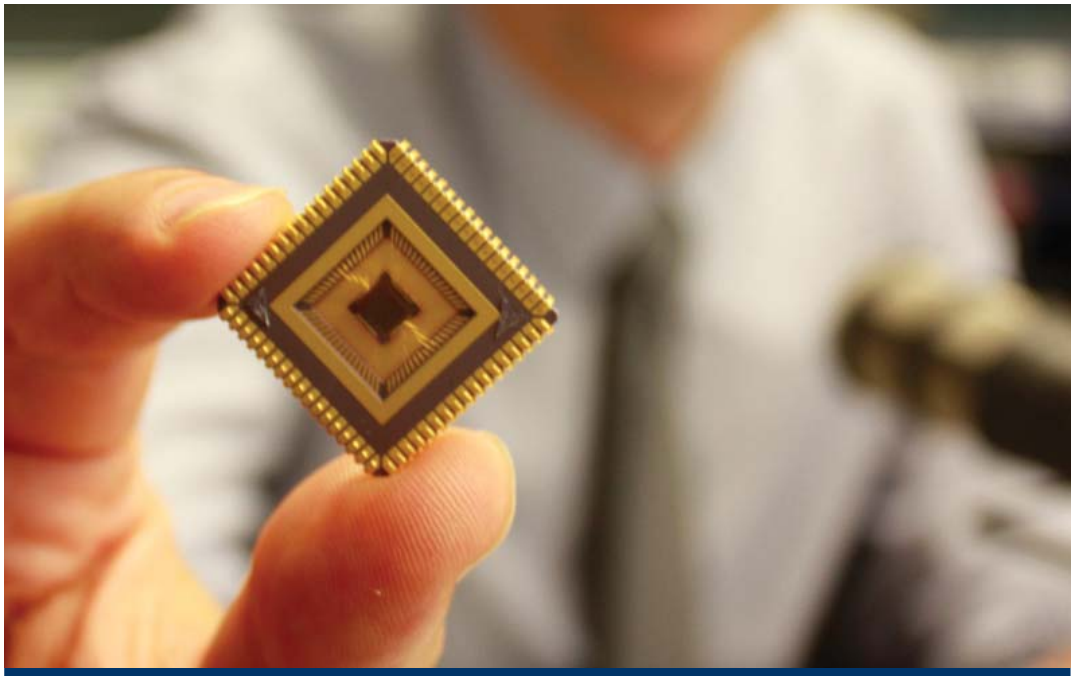
ADVANCED ELECTRONIC SURVEILLANCE SYSTEMS FOR THREAT WARNING AND SITUATIONAL AWARENESS

DSTO has developed a world leading capability in the design and implementation of electronic surveillance systems based on commercial off-the-shelf technology. Specific examples of this work include the development of a 6 GHz instantaneous bandwidth digital receiver designed to improve the ability to detect, localise and identify emerging electromagnetic threats in both the radar and communications domains. Another example is the development of a 500 MHz multichannel receiver to spatially detect, separate, direction-find and determine the characteristics of these emitters in a cluttered RF environment. These developments offer the potential to integrate a number of almost disparate technologies to provide state-of-the-art performance for future electronic surveillance systems. There is a clear transition path of this technology to the P8-A maritime patrol aircraft, Triton unmanned aerial vehicle, and other Navy platforms.

CREATING IMAGES IN LOW LIGHT USING A NOVEL PHOTON SENSING MICROCHIP

In conjunction with the University of New South Wales, DSTO is designing a microchip that can sense individual photons. Researchers are looking to establish a design capability that will facilitate the development of microchips to detect and digitally time individual photons of light. Such sensor nanotechnology has many applications including in weapon systems development.

Pev Hall connecting RF cables to an experimental wideband multi-channel direction-finding array used with the advanced multi-channel receiver system.



Microchip that senses individual photons.

BLACK CANARY SNIFFING OUT INVISIBLE DANGERS

DSTO scientists have developed a new technology to immediately warn people of lethal harm from the presence of toxic vapours.

A large range of toxic chemicals are used in everyday processes, which in the right hands are safe and effective. However, nefarious use or accident can expose military personnel, first responders and civilians to potentially lethal harm. Being invisible to the eye and having no smell, many toxic chemical vapours are undetectable by humans until it's too late.

In the past, birds such as canaries were used to detect poison gas in coal mines and were even used in the trenches in WW1. A bird's sensitive respiratory system acted as an early warning device for miners and soldiers.

Coal miners took canaries in small wooden or metal cages down the mine to alert them to the presence of poisonous gases such as methane, carbon monoxide and hydrogen sulfide. If any of these gases were present in the mine, the canary would die, warning the miners to escape the tunnels before levels of the gas became dangerous for them.

Smart detection device

The 'Black Canary' is a device developed by DSTO to detect and warn people of toxic vapours in the immediate vicinity. It does this by constantly sampling the air into a series of detection cartridges.

If toxic vapours are present, the cartridges change colour and communicate with the user through automated tactile and optical alarms, including wireless transmission to a range of other devices.

Multiple cartridges can be used in the device to detect several different types of toxic vapours, such as hydrogen cyanide, nitrogen dioxide, ammonia, chlorine gas, sulphur dioxide, hydrogen sulphide, hydrogen chloride and phosphine.

Continuously monitoring cartridge responses, Black Canary will warn the user of an impending threat within seconds of recognising an optical change.

Currently the time to positively identify is 60 seconds for target vapours at permissible exposure levels.

With the same architecture and mass as a smartphone, Black Canary may be stowed in a pocket, attached to a helmet or webbing, or affixed to a stationary or moving platform.

The technology has been patented.

ENHANCING NATIONAL SECURITY

DSTO leads the coordination of science and technology research to enhance Australia's whole-of-government program for national security.

It works with other government agencies to:

- Implement national security science and technology policy and coordination processes;
- Manage the DSTO National Security Program;
- Foster international national security research collaborations;
- Provide strategic analysis of national security priorities and resourcing; and
- Integrate counter-terrorism technologies to benefit Defence and civilian agencies.

THE ABILITY TO TRACE RICIN TO ITS SOURCE

Ricin is an extremely potent toxin extracted from the caster bean. A lethal dose in humans is estimated to be about the size of a grain of salt.

It can be difficult to link use of a chemical or biological agent back to the perpetrator. One potential agent is ricin. DSTO has identified a set of DNA markers that will potentially allow a crude ricin sample to be traced to a specific plant and potentially a geographic origin.

Simon Ovenden preparing a sample for the castor bean metabolomics research, for analysis by the nuclear magnetic resonance spectrometer.

PREPARING FORENSIC TEAMS FOR CHEMICAL WARFARE INCIDENTS

DSTO continues to provide leadership, scientific and technical support and training to Australia's Chemical Warfare Agent Laboratory Network. This involves providing specialist training to state laboratories to better prepare forensic teams when responding and managing incidents suspected of involving chemical warfare agents and related materials.

BIODETECTION CAPABILITIES FOR FIRST RESPONDERS

DSTO's expertise in the strategic use of biodetection and diagnostic platforms, and its development of in-field assays for the detection of microbial pathogens is not limited to Defence, but is also of enormous value to Australia's national security agencies. First responders require the same biodetection capabilities as ADF personnel and benefit from DSTO advice on effective biodetection and diagnostic platforms.

COASTAL SURVEILLANCE

DSTO assisted the Australian Customs and Border Protection Service in the development and deployment of a coastal surveillance radar system for the Cocos Keeling Islands. The radar system is based on a commercial navigation radar with DSTO-developed signal and data processing and control system. The radar system is an evolution of the DSTO-developed solution that is deployed on Christmas Island.

ENSURING THE SECRECY OF WIRELESS COMMUNICATIONS

Multiple-Input Multiple-Output (MIMO) wireless communications form an important part of modern wireless communication standards such as Wi-Fi, LTE and WiMAX.

MIMO communication links employ multiple antennae in the transmit and/or receive systems coupled with advanced coding techniques that increase channel throughput and robustness. The strategy effectively adapts the communication method to take advantage of the available wireless multipath channel.

The use of antenna arrays and advanced coding techniques in MIMO wireless links has led to the development of sophisticated signal processing capabilities that enable high data rate communications. As a consequence, MIMO wireless techniques present a challenge to an eavesdropper who, in addition to dealing with the demodulation and decoding of complicated waveforms, sees a different RF channel to the legitimate communicators. This channel difference can be exploited by the legitimate communicators in a manner unknown to an eavesdropper and thus increase the security of the link.

DSTO has quantified such challenges, including the effects of channel independence and signal statistics. It is also investigating techniques that provide enhanced security to MIMO communications by explicitly taking advantage of the physical properties of the channel.

Project *Wasabi*

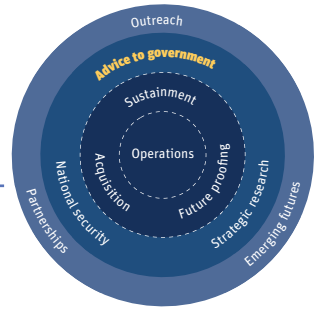
DSTO is collaborating with a number of international partners on Project *Wasabi* to study patterns of flow of everyday activities in an urban setting by using wide area airborne surveillance. The aim is to gather information that will assist authorities in responding to public emergencies, disaster relief efforts and security for major events.

Flight trials are conducted using an aircraft called the DSTO Experimentation Airborne Platform equipped with cameras and sensors. During 2014-15 the aircraft imaged areas in Port Adelaide.

Urban images taken from the air for the *Wasabi* project.

Safely collecting samples of hazardous materials for transport and analysis.

SUPPORTING THE CIVILIAN SECTOR



The work of DSTO researchers often has applications beyond Defence. DSTO is frequently called upon by civilian agencies to lend its unique expertise to assist in crisis situations or to contribute to activities of national significance.

In 2014-15, DSTO provided support to the Australian Federal Police, the Australian Transport Safety Bureau (ATSB), and the South Australian Country Fire Service.

ASSISTING THE AUSTRALIAN FEDERAL POLICE IN INVESTIGATING THE MH17 DISASTER

DSTO contributed to a whole-of-government response supporting the investigation and recovery operations following the destruction of Malaysian Airlines aircraft flight MH17 in a conflict zone over Ukraine on 17 July 2014.

The passenger list released by Malaysian Airlines on 20 July identified 38 Australian citizens and residents on board the plane. It is suspected that the plane was brought down by a surface-to-air missile.

The Australian Government dispatched a team of AFP investigators and forensics experts to help identify and repatriate the remains of the passengers and to conduct an investigation into what was responsible for bringing down the aircraft. DSTO scientists were included in the team that remained in Australia to assist the AFP in its accident investigation.

In support of the resulting international investigation, led by the Netherlands authorities, the AFP sought further input from DSTO. A work program was subsequently developed and forms a component of Australia's contribution to the investigation. This ongoing effort includes the support of additional Defence scientists.

The AFP has commended the efforts of DSTO staff for demonstrating outstanding dedication and drive in the development of forensic and technical reports, and for their proactive and innovative contribution to the specialist reporting and mapping which ensured search and recovery opportunities were maximised and team members' safety maintained.

ASSISTING IN THE SEARCH FOR MALAYSIA AIRLINES FLIGHT MH370

DSTO continues to assist in the international effort to solve the mystery of missing Malaysia Airlines aircraft MH370 which disappeared while flying from Kuala Lumpur to Beijing in March 2014.

DSTO's recommendation to use unanswered phone call data provided evidence that MH370 turned south earlier than originally assumed. The scientists had to develop and calibrate new statistical data processing techniques to make sense of the limited satellite information. By using these new mathematical models they were able to get a much better fix on a narrower search area in the Indian Ocean, about 2400 km west of Perth.

In April 2015, the governments of Malaysia, China and Australia agreed that up to 120,000 square km will be searched if required.

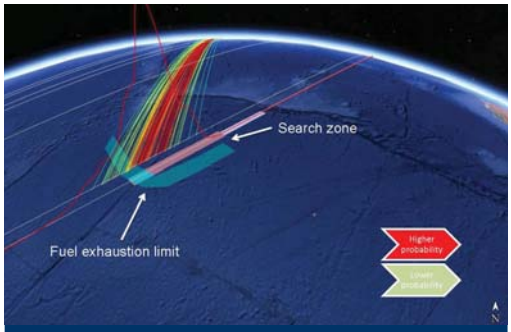
In July 2015, a small part of the wreckage from the Boeing 777 aircraft was found on a beach on Reunion Island in the Indian Ocean and is consistent with the current search according to CSIRO ocean drift modelling. It does not, however, provide enough information to reduce the size of the current search zone.

DSTO has continued to apply advanced modelling and analysis techniques to the limited available detection data and its contributions have led to improvements of Inmarsat models. The work has contributed to the Australian Transport Safety Bureau's public reports released in June and October 2014. An updated report was released in December 2015 accompanied by a DSTO book describing the full statistical methodology applied to the search zone calculations.

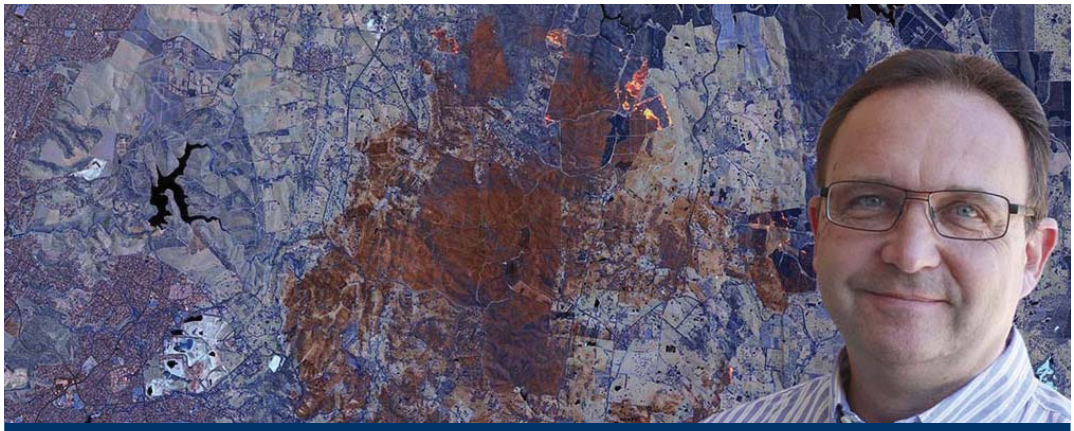
SUPPORT TO FIREFIGHTERS

During the 2015 South Australian bushfires, DSTO facilitated the timely provision of high-resolution satellite imagery to firefighting services, providing them with information unavailable by other means and potentially saving lives and property.

Mapping the wreckage for reconstruction to analyse how MH17 was destroyed.



Analysis of the search zone for MH370.



Researcher Chris Ekins assisted the Country Fire Service with smoke-penetrating geospatial imagery during the 2015 South Australian bushfires.

SECTION 3

Partnerships and Outreach

ENHANCING OUTCOMES THROUGH COLLABORATION AND ENGAGEMENT

DSTO recognises that collaboration and engagement significantly enhance its ability to provide world-class scientific advice and innovative solutions for Australia's defence and national security.

Through its partnerships and alliances with industry, academia and other research organisations, both in Australia and around the world, DSTO is able to leverage knowledge, expertise and capability, ensuring that it continues to provide world-class outcomes for Defence.

PARTNERING WITH INDUSTRY

During 2014-15, DSTO's strategic alliances with industry partners continued to deliver capability benefits to Defence and industry.

In December 2014, a new strategic alliance was signed with Airbus Group Australia Pacific with an initial focus on collaboration involving helicopter operations and helicopter airframe support. With this agreement there are now nine strategic alliances with Defence primes. The companies include Airbus Group Australia Pacific, ASC, BAE Systems Australia, Boeing Research & Technology, IBM, Lockheed Martin, Northrop Grumman, Saab and Thales Australia.

At the time of writing, 37 joint research and development projects were in train with 11 organisations (including ANSTO and CSIRO), nine had already commenced and 14 were due to commence before the end of 2015.

During the year, DSTO also worked closely with a number of small and medium enterprises to expedite the production of counter-IED equipment under the Redwing program. These firms included Associated Electronic Services, Diemould-Axiom Precision, Lintek, Micreo Ltd, and Ultra Electronics-Avalon Systems.

PARTNERSHIPS WEEK

In May 2015, DSTO held its inaugural Partnerships Week at its Edinburgh site as part of an outreach campaign to establish closer ties with industry, universities and other research organisations.

The week attracted more than 250 visitors who were keen to explore opportunities for collaboration in a number of areas, including telecommunications, wearable electronics, wireless security, signals intelligence, trusted autonomous systems, software defined networking, telepresence, geolocation technology, fuel cell technology, acoustic communications and human injury and resilience.

The event included presentations, briefings, demonstrations, meetings and an exhibition of DSTO technologies.

DSTO and Airbus Group signed a strategic industry alliance during the year.

Jeff Ackers and Mark Fitzgerald discuss grenade launcher technology with a visitor during Partnerships Week.

DSTO and the Bureau of Meteorology held a workshop under their strategic alliance for joint research.

TECHNOLOGY PITCHES

In 2014-15, DSTO experimented with a new way to promote its collaboration opportunities - using a series of Technology Pitches.

DSTO Technology Pitches were held at a number of relevant conferences and events and involved DSTO researchers delivering 1-minute and 3-minute pitches to industry executives about commercialisation opportunities.

The pitches have proven to be extremely successful, creating significant interest and resulting in a number of commercialisation outcomes. The award-winning cyber security device, Digital Video Guard, was licensed to Northrop Grumman for further development. BAE Systems is marketing DSTO's electronic warfare laser technology overseas as well as the deployable 20kW high frequency transmitter for over-the-horizon-radar applications. The maritime software for Broadband Sonar Advanced Processing System was licensed to Thales Australia for on-sale to the New Zealand Navy which has also adopted the environment-friendly paint developed by DSTO for the Australian Navy fleet.

New Zealand ship being painted with Haze Grey paint originally developed by DSTO for the Royal Australian Navy.

Phil Jackson pitching realignment tool technology at the Air Show.

PARTNERING WITH UNIVERSITIES

Since its inception in 2013-14, DSTO's Defence Science Partnerships arrangement has expanded to include 30 Australian universities. The arrangement takes a novel approach to university engagement by creating a single framework with a set of standardised agreements and a common method for costing research inputs. The award-winning framework, recognised by Knowledge Commercialisation Australasia for creative engagement, provides a much stronger and expanded network of research capability to meet Defence priorities.

More than 150 agreements have been signed under the program. Due to the innovative framework provided by the program, the mean processing time for those agreements has more than halved.

During the first year of the Defence Science Partnerships, the funding for contracts with universities increased from $12 to $16 million.

The Universities that are part of the program are:

- Charles Darwin University
- Curtin University
- Deakin University
- Edith Cowan University
- Federation University
- Flinders University
- Griffith University
- LaTrobe University
- Macquarie University
- Monash University
- Queensland University of Technology
- RMIT University
- Swinburne University
- The Australian National University
- The University of Adelaide
- The University of Melbourne
- The University of New South Wales
- The University of Queensland
- The University of Sydney
- The University of Western Australia
- University of Canberra
- University of Newcastle
- University of South Australia
- University of Southern Queensland
- University of the Sunshine Coast
- University of Tasmania
- University of Technology Sydney
- University of Wollongong
- Victoria University
- Western Sydney University

Robert Peile, Victoria Pit and Troy Thomas after receiving the Knowledge Commercialisation Australasia trophy for the most creative engagement awarded to DSTO for Defence Science Partnerships.

CLOSER ENGAGEMENT WITH GOVERNMENT AGENCIES

DSTO seeks to enhance its science and technology outcomes by collaborating with other government agencies, both domestically and internationally.

During the past year DSTO has strengthened its strategic alliances with three publicly funded research agencies - CSIRO, the Bureau of Meteorology and the Australian Nuclear Science and Technology Organisation. It also continued its support to the Department of Immigration and Border Protection.

INTERNATIONAL ENGAGEMENT

DSTO's cooperation with its allies and regional partners is an important element of the Australia's defence science and technology capability. By undertaking collaborative research with allied countries, Australia, through DSTO, is able to:

- Access overseas capabilities that would not otherwise be available to the Australian Defence Force;
- Reduce duplication of effort;
- Draw on best practice; and
- Gain access to the leading edge technologies of partners.

In 2014-2015, DSTO maintained its strong working relationships with its traditional partners: Canada, New Zealand, the United Kingdom and the United States of America; and continued to strengthen and develop its partnerships in the Indo-Pacific region, particularly with Japan, Singapore and South Korea. This included working towards the first collaborative project with Japan in the area of marine hydrodynamics, negotiating the broadening of an existing Memorandum of Understanding with Singapore; and continuing negotiations for a Memorandum of Understanding with South Korea.

DSTO was also actively engaged across various multinational forums within the S&T and intelligence communities including:

- The Technical Cooperation Program (TTCP);
- The Chemical, Biological and Radiological Memorandum of Understanding;
- Responsive Space Capabilities Memorandum of Understanding; and
- The NATO Science and Technology Organisation in which Australia is an invited participant, with the second largest participation rate amongst non-NATO countries behind Sweden.

Under The Technical Cooperation Program, Australia's traditional Five Eyes partners (Canada, New Zealand, UK, USA) continued to provide benefits in support of DSTO's Strategic Plan. DSTO's participation in TTCP provides Australia with direct access to laboratories, expertise and research being conducted by over 1200 scientists and engineers across 170 agencies and organisations.

As part of contributions to the ANZAC centenary, DSTO participated in the commemoration events in Turkey marking the preservation of the wreck of the WWI submarine *AE2* which was sunk during the Gallipoli campaign in 1915.

CYBER COLLABORATION WITH THE UNITED STATES

DSTO has established an enduring strategic partnership with the United States in cyber science and technology. The goal of the collaboration is to identify, conduct and provide science and technology to assure that key cyber terrain is available to support critical missions.

In particular, researchers are looking at the science and technology that will underpin future capabilities that provide commanders with:

- An assessment of cyber mission risk;
- An understanding of the mission impact from cyber events; and
- Support in generating and selecting courses of action to maintain mission continuity and effective operations within a contested cyber environment.

Specific areas of research include exploring the challenges in the application of Artificial Intelligence and Machine Learning to enhance decision-making for military commanders operating in and through cyber-physical space.

In this mission-assured research collaboration, DSTO's science and technology partners in the US are the Navy Research Laboratory and the Massachussetts Institute of Technology while the US operational partners include the US Pacific Command.

Overseas members of TTCP Technical Panel 4 of the Joint Systems Analysis Group met with their Australian counterparts during the year.

Chief Defence Scientist Dr Zelinsky and his Singapore counterpart Professor Quek Tong Boon signed a new 10-year MOU on defence science cooperation.

FUNDING DEFENCE INNOVATION

DSTO is continuing to improve linkages between the Defence Innovation Realisation Fund; the Capability and Technology Demonstrator program; the Defence Capability Plan and Capability Acquisition and Sustainment Group to enhance the potential to realise innovations.

DEFENCE INNOVATION REALISATION FUND PROJECTS

The Defence Innovation Realisation Fund (DIRF) supports the development of innovative technologies from initial research or technology demonstration to a mature capability ready for Defence acquisition.

The first projects to received funding under the Defence Innovation Realisation Fund were approved by the Minister in July 2014 and consisted of five projects with a combined value of $15.2m.

Advanced nano-structured fabrics for low-burden personnel protection

Proposer – Defence Materials Technology Centre : This proposal aims to address a key capability gap in current in-service chemical, biological and radiological air-permeable Individual Protective Equipment.

Pegasus aircraft buoyancy system

Proposer – One Atmosphere (WA) : The Pegasus Aircraft Buoyancy System Project aims to demonstrate a light-weight, removable emergency flotation device, designed to suit Army's fleet of helicopters that currently do not have flotation devices fitted.

Broadband spherion advanced processing system (BSAPS)

Proposer - Thales Australia Ltd : Developed under the CTD Program, BASAPS is an upgrade of the existing ANZAC Class Frigate Spherion B hull-mounted sonar.

Fibre optic towed array (FOTA)

Proposer - Thales Australia Ltd : Based on Fibre Laser Sensor Technology, the FOTA array is less than 20 mm in diameter, more flexible, lighter and subject to less drag. As an underwater surveillance array using micro-sized lasers, it can detect sounds with extreme sensitivity.

Standoff handheld person-borne improvised explosive device detection system

Proposer - Rapid Prototyping, Development and Evaluation Program : This system combines optical and electronic detection technologies to provide a standoff CIED detection capability not currently available. It improves the individual safety of soldiers involved in IED detection on operations.

CAPABILITY AND TECHNOLOGY DEMONSTRATOR (CTD) PROJECTS

The purpose of the Capability and Technology Demonstrator program is to enable Australian and New Zealand industry to demonstrate how a particular technology might be used to enhance or replace a Defence capability.

Throughout its history the CTD program has proven to be highly successful in its goal of bringing together Defence, research organisations and industry to work on developing new technologies to the demonstrator level.

Round 19 of the CTD Program was approved by the Minister in late June 2015 and consisted of seven projects with a total program cost of $13.84m. The projects will be implemented early in the 2015-16 financial year.

Low profile body armour

Proposer – Armor Composite Engineering Pty Ltd (NSW) : This proposal aims to develop new bonding, coating and laminating systems that can be combined with various substrates, such as ultra-high hardness steel, advanced ceramics and advanced fibre materials, to create shaped laminates that will provide significant ballistic protection performance improvements for body armour applications.

New concept, miniature, wideband low-noise RF receiver

Proposer – CSIRO (NSW) : This proposal aims to develop a single, stealthy antenna with a significant size reduction, increased sensitivity and increased usable bandwidth in the HF-UHF frequency range when compared to existing antenna technologies.

Lightweight mobile x-ray

Proposer – Micro-X Ltd (VIC) : This proposal aims to develop the potential imaging performance achievable in two applications of a novel type of x-ray tube using Carbon Nano-Tube (CNT) electron emitter technology.

Anti-submarine warfare unmanned surface vessel

Proposer – Ocius Technology Ltd (NSW) : This proposal aims to demonstrate an Ocius Unmanned Surface Vessel coupled with a Thales thin-line towed array. This system promises to be suited for Anti-Submarine Warfare surveillance, being acoustically covert and able to operate autonomously on station for long periods.

Tactile cueing system for degraded visual and threat environments

Proposer – University of Canberra (ACT) : This proposal aims to increase the survivability of ADF helicopters, aircraft and soldiers in degraded visual and also threat environments. It will develop and demonstrate a flight information display that uses the sense of touch to provide threat awareness information and awareness of hover drift in degraded visual environments.

Data deconstruction for low bandwidth transmission of large volume geophysical spatial data

Proposer – Australian Bureau of Meteorology (VIC) : This proposal aims to develop a novel technique that will reduce transmission file sizes to kilobytes and be intrinsically secure.

Low-cost high-G centrifuge for pilot training

Proposer – Deakin University (VIC) : This proposal aims to develop a functioning, low-cost, short-radius centrifuge with sustained High-G Force for pilot training.

Samples of some products proposed as part of Round 19 of the CTD Program.

COLLABORATION TO ENHANCE INNOVATION

Following the inaugural Defence Innovation Forum in July 2014, DSTO has held two follow-on workshops. The first was with industry representatives to help identify what an innovation strategy might look like. The second was with representatives from universities to understand how universities could better participate in Defence's innovation programs. Both workshops identified some useful ideas on improving innovation.

DSTO is exploring how these ideas can be incorporated into Defence's innovation program to develop a more flexible and agile system that also provides greater opportunity to collaborate more broadly across industry and universities.

THE FULBRIGHT DISTINGUISHED CHAIR IN ADVANCED SCIENCE AND TECHNOLOGY

DSTO sponsors the Fulbright Distinguished Chair in Advanced Science and Technology, which brings senior United States researchers to Australia on a four to five month appointment at DSTO or another research institution in Australia linked to DSTO.

The purpose of the Chair is for a distinguished researcher to undertake research into priority research areas for Defence, engage with DSTO staff through seminars and workshops and explore long-term collaborations and linkages. This also assists to advance mutual understanding between Australia and the US through research and cultural exchange.

The 2015 Distinguished Chair was Professor Richard W. Ziolkowski from the University of Arizona, who brought to DSTO an in-depth knowledge of metamaterials and metamaterial-inspired structures. While at DSTO, he extended his work on electrically small antennas to specific designs and applications, including energy harvesting and thermal applications – areas of particular interest to DSTO.

Fulbright scholar Professor Ziolkowski.

PROMOTING SCIENCE, TECHNOLOGY, ENGINEERING AND MATHEMATICS

In order to address critical skills gaps, DSTO is involved in a number of activities and initiatives to increase the number of students studying and aspiring to careers in science, technology, engineering and maths (STEM).

In 2014-15, some 60 DSTO employees participated in the Government's "Scientists and Mathematicians in Schools" program under which working scientists volunteer their time to schools across Australia to inspire and engage students, encouraging them to study STEM subjects.

In the tertiary sector, under the newly established Defence Science Partnerships framework, DSTO is working with universities to introduce a range of scholarships, paid work placements and cadetships to encourage students to pursue STEM qualifications. In the last financial year, DSTO granted 13 cadetships, 25 summer vacation scholarships, and 13 industry experience placements to students from 11 Australian universities.

DSTO also supported a number of community-based STEM events as part of National Science Week 2015 and held a 'STEM' day at DSTO Edinburgh, showcasing DSTO capabilities to the local high school community and promoting STEM as a future career path.

DSTO's Giuseppina Dall'Armi-Stoks working with Flinders University students on robots.

REACHING OUT TO THE WIDER COMMUNITY

As partnerships and external engagement have become priorities for DSTO, so too has the communication effort to promote the value and achievements of the organisation.

During the year, positive coverage increased steadily in the print media with prominent features in *The Australian* newspaper and niche publications like *ADM* and *CEO* magazine. The ABC science program *Catalyst* broadcast an episode on the Iron Bird model of the Joint Strike Fighter, built to study electromagnetic environmental effects on the aircraft, while another episode focused on the underwater exploration of the WWI submarine *AE2*. ABC *Landline* produced and broadcast a program on defence nutrition research at Scottsdale.

DSTO maintained its participation in high-profile science and defence industry events like the Future Land Force Conference 2014, the Australian International Air Show Downunder, Science Meets Parliament, the Australian Academy of Science Forum Science Pathways 2015, and the Australian Museum Eureka Prizes. A highlight of the events program was DSTO's participation in the Defence exhibition at the MAST Asia maritime expo in Yokohama to strengthen the science and technology relationship with Japan in view of the collaboration in hydrodynamics research.

The Chief Defence Scientist continued to be a drawcard speaker at numerous industry and university events, further raising the profile of the organisation.

SCIENCE AND TECHNOLOGY PUBLICATIONS

The DSTO report series capture the results of the organisation's research for clients and stakeholders. DSTO authors also publish in peer-reviewed journals and conference proceedings.

Printing of hard copies was phased out during the year and replaced with digital versions. Electronic distribution was introduced in July 2015, achieving significant savings in time to access reports.

During 2014-15, DSTO authors published or delivered 80 public release reports (Appendix A) and 204 papers externally (Appendix B).

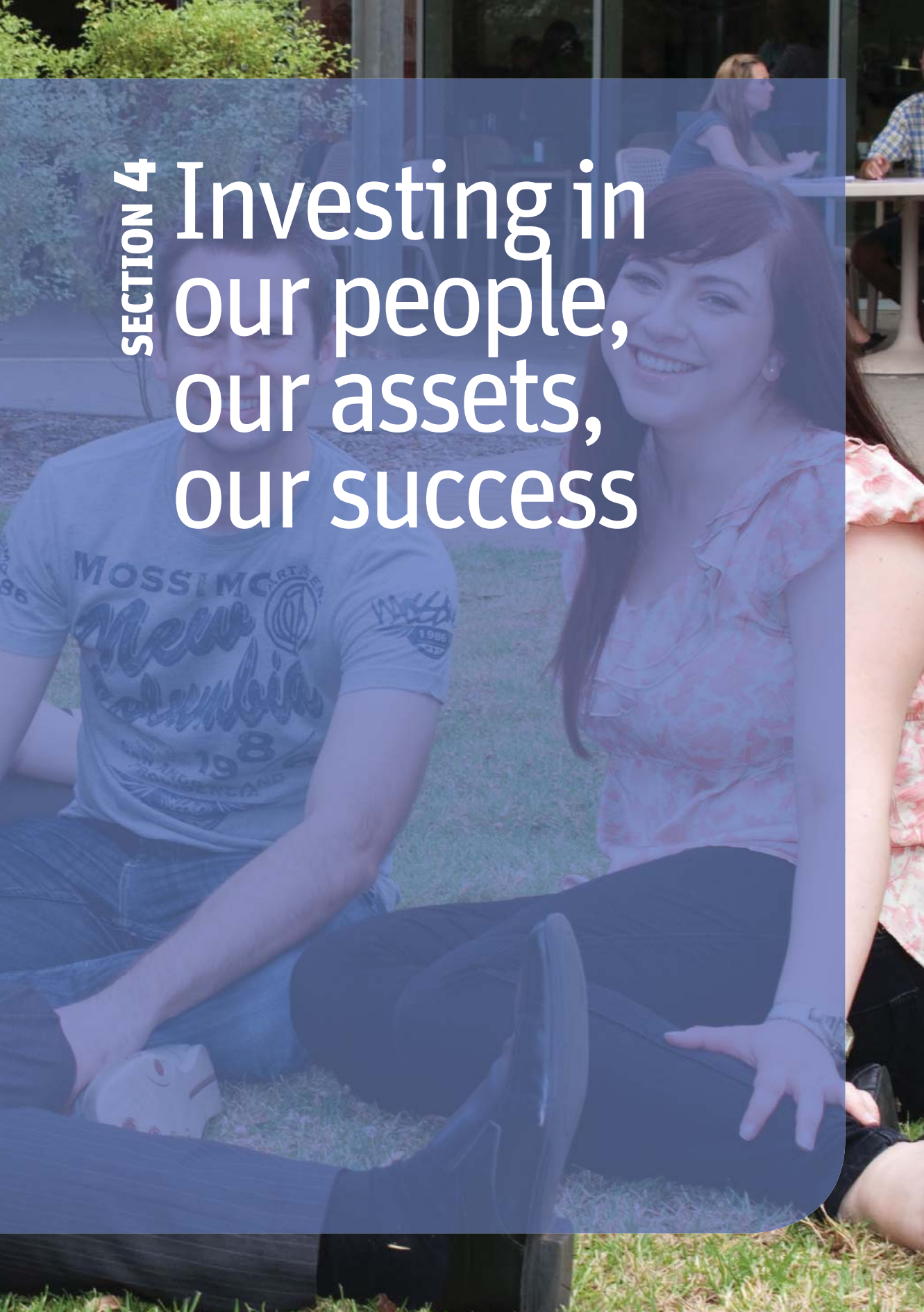
Andrew Walters being interviewed for the *Catalyst* program.

DSTO exhibition stand at the 2015 Australian International Air Show.

Camera-happy visitors at the DSTO display during MAST Asia in Yokohama.

SECTION 4

Investing in our people, our assets, our success



VALUING OUR PEOPLE

DSTO prides itself on employing some of the brightest minds and most innovative thinkers in Australia. To ensure that its people remain engaged and continue to deliver outstanding science and technology, the organisation strives to provide an inclusive workplace that values safety and wellbeing and supports career aspirations.

DEVELOPING OUTSTANDING LEADERS

Throughout 2014-15, DSTO has focused on enhancing the performance and accountability of its leaders.

The ability of the organisation's leaders to manage change was strengthened through a tailored leadership skilling and coaching program, *Leading Teams Through Change*, attended by the top two science leadership levels.

DSTO has developed a mentoring program that supports aspiring talent and offers outstanding leadership development opportunities through a targeted suite of programs. In addition, DSTO continues to run tailored programs to build leadership and change capability.

A highlight of the year was DSTO's annual Strategic Context Seminar in May 2015. An impressive line-up of leaders spoke, including the Chief Scientist of Australia, the CEOs of CSIRO and ANSTO, the Vice Chief of the Defence Force and the Vice-Chancellor of the Australian National University. This event was streamed live across DSTO so that as many people as possible could benefit from the insights of these key strategic and science leaders.

DSTO also hosted a visit by Professor David Ulrich, Human Resources thought-leader, academic and author of many books. Professor Ulrich met with senior leaders, as well as science leaders from a number of other science agencies to share his thoughts on building organisational people strategy, culture and leadership.

ATTRACTING AND RETAINING AUSTRALIA'S BRIGHTEST

DSTO has implemented a talent management strategy designed to nurture potential recruits and attract and retain Australia's brightest early career researchers.

In 2014-15, DSTO recruited 13 cadets and provided a significant number of STEM work placements through a suite of student programs. Following a rigorous and innovative selection process, DSTO also recruited 8 Post-Doctorates to increase its research capability in critical science and technology areas.

To support the career aspirations of staff, DSTO implemented an exciting range of opportunities, including PhD studies, secondments to industry and universities and internal mobility options.

At the latter stage of careers, DSTO's 'Transition to Retirement' program enables the most highly-skilled and experienced staff members to transfer specialist knowledge before they retire. Over 20 research staff have taken advantage of this program in the last year.

The feedback from staff is crucial as the organisation moves forward and strives to meet strategic goals. In July 2014, DSTO's Insight Survey showed significant improvements in staff perceptions of the organisation's strategy, leadership and change management. Feedback from the workforce has, and will continue, to help the organisation to refine new strategic initiatives.

A CULTURE OF INCLUSION

Enhancing diversity is a key element of DSTO's strategic plan to improve the organisation's gender and indigenous diversity. Of the 13 cadetships granted, six were awarded to women and seven to men from diverse cultural backgrounds.

DSTO continued to contribute to the Government's goal to have indigenous employment more representative of the population through school engagement activities and the expansion of cadetship, traineeship and employment programs. Under these programs, two cadets, two apprentices and two trainees were engaged across three sites. DSTO also contributed strongly to local cultural-awareness engagement activities and events, including NAIDOC Week, and seconded a number of staff to work in remote indigenous communities under the Jawun Program.

Chief Scientist Professor Ian Chubb speaks at the Strategic Context Seminar.

Artist Anthony Walker, Dr Alex Zelinsky, Secretary of Defence Dennis Richardson and Ngunnawal Elder Aunty Agnes Shea unveil the indigenous artwork commissioned by DSTO.

Supervisor Jim Walker with indigenous apprentices Joshua O'Brien and Anthony Russell in the engineering workshop.

HIGH ACHIEVERS

ORGANISATION FOR THE PROHIBITION OF CHEMICAL WEAPONS (OPCW) THE HAGUE PRIZE

Dr Bob Mathews was awarded the inaugural Organisation for the Prohibition of Chemical Weapons (OPCW) The Hague Prize in recognition of his sustained contribution, over the last 30 years, to the elimination of chemical weapons.

ACOUSTICAL SOCIETY OF AMERICA AWARD

Brian Ferguson received the 2015 Silver Medal in Signal Processing in Acoustics from the Acoustical Society of America for contributions to in-air and in-water tracking and localisation.

NATO SCIENCE AND TECHNOLOGY ORGANIZATION 2014 SCIENTIFIC ACHIEVEMENT AWARD

Rodney Borg, Robert Rossiter, Leo de Yong, Scott Walker and Ian Kermonde for their work on mitigating ship electro-optical susceptibility to conventional and asymmetric threats.

PUBLIC SERVICE MEDAL 2015

Simon Barter for his outstanding public service to aircraft accident investigation and safety, in particular his work in the area of metal fatigue in military aircraft, and the development of differentially corrected GPS-based debris mapping.

US NAVAL AIR WARFARE CENTER AIRCRAFT DIVISION COMMANDER'S AWARD

Rita Lim was part of a US Navy Investigation team of eleven critical technical personnel that was awarded the US Naval Air Warfare Center Aircraft Division (NAWCAD) Commander's Award for their outstanding work. Rita was supported at DSTO by Claudio Cessato, Bruce Grigson, Simon Ovenden, Michael Leist and Nick Athiniotis.

2014 MINISTER'S AWARD FOR ACHIEVEMENT IN DEFENCE SCIENCE

Dr Stephen Burke for developing new solutions and inspection techniques that have contributed significantly to the safe and cost-effective operation of Defence platforms.

2014 ROYAL AERONAUTICAL SOCIETY'S ADF AVIATION SAFETY AWARD

Rhys Lehmann for his outstanding contribution to helicopter flight dynamic modelling.

SIMTECT 2014, BEST PAPER AWARD

Flight Display Systems, Jessica Parker and Ronan McInerney, *A Comparison of Visual Display Systems for a Low-Cost Mission Training Flight Simulator*

16TH AIAC AEROSPACE CONFERENCE AWARDS, BEST WRITTEN PAPERS

Aerospace Design, Jonathan Dansie, *An environment model for simulating small aircraft flight in the marine atmospheric boundary layer.*

Propulsion, Jianfu Hou, *Assessment of allowable blade damage size for a blisk*.

Structures & Materials, Alex Shekhter, *Effect of anodising treatment on equivalent crack size of the 7xxx aluminium alloy.*

Aircraft Systems (On-Board and Off-Board), Samuel Dudley, *Antenna systems optimisation of UAS data links*.

DOCTOR OF ENGINEERING *HONORIS CAUSA*, UNIVERSITY OF TASMANIA

Janis Cocking for outstanding contributions to the field of maritime engineering.

VICE CHANCELLOR'S AWARD, UNIVERSITY OF TASMANIA

Stuart Cannon for outstanding service through leadership in the teaching and research programs of the Australian Maritime College.

FELLOW OF THE INSTITUTE OF ELECTRICAL AND ELECTRONIC ENGINEERS

Gordon Frazer elected Fellow for contributions to the advancement of Over the Horizon Radar.

M A SARGENT MEDAL 2015, AUSTRALIAN INSTITUTE OF ENGINEERS

Chief Defence Scientist Dr Alex Zelinsky for his significant contributions to engineering, including technical innovation and leadership.

INVESTING IN ORGANISATIONAL ENABLERS

In 2014-15, DSTO continued to invest in its infrastructure and organisational resources to enhance its research capabilities and organisational effectiveness.

REDEVELOPED FACILITIES

A highlight of the year was the $19 million refurbishment of the nutrition research facility in Scottsdale. Then Assistant Minister for Defence Stuart Robert opened the redeveloped facility on 5 November 2014.

The 60 year old facility has been replaced with a state-of-the-art food science laboratory designed to deliver the best nutritional outcomes for Defence personnel while improving the quality of combat ration packs. The redevelopment resulted in new chemistry, microbiology and food technology laboratories and a pilot plant for new product development. The Minister also announced a study to investigate the use of a new processing technology (Microwave Assisted Thermal Sterilisation) that is able to produce high-quality, long-life, shelf-stable foods for Defence ration packs.

Other refurbishment works included a major redevelopment of DSTO's laser laboratories to enable further advancements in its world-leading laser research program as well as the modernisation of the Fishermans Bend experimental Fuel Farm facility which can hold up to 75,000 litres of fuel of seven different types to enable researchers to test them for appropriate use by the ADF's air, land and maritime fleet.

RESEARCH LIBRARY DEVELOPMENTS

A review of the DSTO Research Library services was completed and recommended a new model of service delivery focused on desktop electronic delivery of information resources with a centralised print repository, extra research librarians to assist scientists, establishment of collaboration suites in the vacated library spaces, and a revised library management structure. Staff consultations continued during the year in an effort to achieve the end-state vision.

STANDING OFFER PANEL

A new Standing Offer Panel was established to streamline the process for engaging research, scientific, engineering and other technical services. Covering 22 skill sets and comprising 109 mainly small-to-medium enterprises, the panel offers both flexibility and timeliness in employing contracted services.

ENHANCED VIDEO CONFERENCING

DSTO upgraded and expanded its video conferencing facilities, significantly enhancing the organisation's ability to work collaboratively across locations.

IMPROVEMENTS IN ICT SERVICES

DSTO continued to modernise and secure its research ICT in 2014-15. The ICT reforms are aimed at supporting the demands of a modern and innovative research organisation. A strategy has been developed to implement the future ICT research architecture, research information services and high performance computing.

To that end collaborations with other federal government science organisations, particularly CSIRO and the Bureau of Meteorology, were commenced to leverage their experience in high-end scientific computing capabilities and sharing of resources in the future.

Meanwhile, further improvements were implemented, such as platform and network enhancements including physical and virtual server system upgrades, operating system hardening and security, data centre backup and storage remediation, and introduction of new unified communications gateways to facilitate easier collaboration between DSTO and Defence.

Andrew Nikolic, Member for Bass, then Assistant Minister for Defence Stuart Robert and Major General Paul McLachlan during the opening of the redeveloped facilities at DSTO Scottsdale.

SECTION 5

Emerging Futures

EMERGING FUTURES

DSTO conducts horizon scanning to gain knowledge and understanding of emerging science and technology areas across a broad spectrum over a 10 to 20 year horizon. It also undertakes analysis to determine how advancement of these technologies could result in emerging threats or the realisation of critical defence and national security capabilities. The outcomes of emerging science programs inform longer-term investment in the DSTO strategic research program.

Investing in the study of emerging science and technology areas enables Defence and national security agencies to exploit future opportunities and prevent strategic surprises. Through its combination of extensive multidisciplinary technology and systems and domain expertise, DSTO is positioned to credibly integrate knowledge gained from horizon scanning.

DSTO has been streamlining its processes to enable a more systematic horizon scanning of technology. This has involved strong engagement across the organisation for a broad science and technology consensus to be established. The result has been an assessment of science and technology trends that may have an impact on Defence through possible game-changing, military critical or pervasive trends. This assessment has been influential across Defence in shaping considerations for strategic policy and force structure.

US COLLABORATION

The long standing bilateral research program between DSTO and the US Department of Defense Research and Engineering on Emerging Technologies concluded during the year. The program aimed to identify, assess, contextualise and report on emerging disruptive technologies, their strategic effects and implications for Defence and national security.

Emerging technologies of interest to both Australia and the United States were examined. These technologies are broadly grouped into the fields of biotechnology and cognition; information and communications; manufacturing and materials; quantum and particle sciences; and platform and system studies. The assessments of these technologies provided both nations with a comprehensive understanding of the topics and future directions. For Australia, these assessments have been valuable in informing strategic policy development, including the Defence White Paper and the Force Structure Review.

Although the bilateral program has come to an end, work on emerging disruptive technologies will continue under the auspices of The Technical Cooperation Program.

EMERGING TECHNOLOGIES PANEL

As a follow-on, an Emerging Technologies panel was established by the Technical Cooperation Program to leverage shared capabilities amongst the participating nations and report on emerging technologies. This panel facilitates the exchange of information on emerging and potentially disruptive technologies, harmonises outcomes across the partner nations and champions good practice in technology foresight.

A case in point is DSTO's research in quantum technologies for more than a decade. This has provided an overview of the implications of quantum technology. Given the likely highly significant impacts of quantum technology in Defence, national security and a wide range of other areas, DSTO shaped discussion amongst the community to develop a Defence strategy which is cognisant of the whole-of-government perspective. At the same time DSTO has continued to do research in a variety of quantum technology areas. In the area of quantum computing, DSTO has a research agreement with the Centre for Quantum and Computation and Communication, focusing on the "demonstration of precision two qubit gate in silicon". In the area of quantum sensing, another research agreement was negotiated with the ANU Department of Quantum Science aimed at demonstrating high precision acceleration measurements using atom interferometry techniques.

Operation of the scanning probe microscope used to position single phosphorus atom qubits in silicon.

SECTION 6

Appendices

APPENDIX A : PUBLIC RELEASE SCIENCE AND TECHNOLOGY REPORTS

TITLE	AUTHOR/S	REPORT NO.
Mesh Generation via Local Bisection Refinement of Triangulated Grids	Jason R. Looker	DSTO-TR-3095
F-111 Adhesive Bonded Repairs Assessment Program - Progress Report 2: Analysis of FM300-2K Repairs	Eudora S. Y. Yeo	DSTO-TR-3088
Biotechnology on the Battlefield:: An Application of Agent-based Modelling for Emerging Technology Assessment	Scott Wheeler and BRIG (ret.) Justin Kelly	DSTO-TR-3087
Localisation of a Biochemical Source	Branko Ristic, Ajith Gunatilaka, Ralph Gailis and Alex Skvortsov	DSTO-TR-3084
Inter-Batch Variation and the Effect of Casting Vacuum on Ballistic and Mechanical Properties of a High Performing Cast Composite Ricket Propellant	Paul C. Smith	DSTO-TR-3069
Intelligent Multi-Media Presentation Using Rhetorical Structure Theory	Steven Wark and Marcin Nowina-Krowicki	DSTO-TR-3067
Personal Equipment and Clothing Correction Factors for the Australian Army: A Pilot Survey	Sheena Davis and Alistair Furnell	DSTO-TR-3044
A Review of Enterprise Architecture Use in Defence	Meredith Hue	DSTO-TR-3040
An Analysis of SE and MBSE Concepts to Support Defence Capability Acquisition	Meredith Hue	DSTO-TR-3039
Principles and Application of Magnetic Rubber Testing for Crack Detection in High-strength Steel Componenets: II Residual-field Inspection	S K. Burke, M.E. Ibrahim and G.R. Hugo	DSTO-TR-3033
Principles and Application of Magnetic Rubber Testing for Crack Detection in High-strength Steel Componenets: I Active Field Inspection	S K. Burke, M.E. Ibrahim and G.R. Hugo	DSTO-TR-3032
Change Detection in Rough Time Series	Lewis Warren	DSTO-TR-3023
Implementation of Geometric Algebra in MATLAB with Applications	Leonid K. Antanovskii	DSTO-TR-3021
The Effect of Weld Penetration on Blast Performance of Welded Panels	Emily Frain and Len Davidson	DSTO-TR-3017
Analysis of Urinary Metabolites of Nerve and Blister Chemical Warfare Agents	Stuart Thomson	DSTO-TR-3016
A Rule-based Track Anomaly Detection Algorithm for Maritime Force Protection	S.Boinepalli and A.J.Knight	DSTO-TR-3012

TITLE	AUTHOR/S	REPORT NO.
A Preliminary Anthropometry Standard for Australian Army Equipment Evaluation	Mark Edwards, Alistair Furnell, Jemma Coleman and Sheena Davis	DSTO-TR-3006
Effects of Dynamic Impact Loading on Microstructure of FCC (TWIP) Steel	C.H. Choi, C.T. Peng and B.F. Dixon	DSTO-TR-3004
Use of Simulation to Improve the Effectiveness of Army Welding Training	Susannah J. Whitney and Ashley K. W. Stephens	DSTO-TR-2997
Condition Based Maintenance Technology Impact Study: Assessment Methods, Study Design and Interim Results	Guy Edward Gallasch, Ksenia Ivanova, Sreeja Rajesh and Christopher Manning	DSTO-TR-2992
Optimising the Parallelisation of OpenFOAM Simulations	Shannon Keough	DSTO-TR-2987
Investigation of using Radio Frequency Identification (RFID) System for Gear Tooth Crack Detection	Eric Lee	DSTO-TR-2983
Detection of Fast Moving and Accelerating Targets Compensating Range and Doppler Migration	Sandun Kodituwakku and H.T. Tran	DSTO-TR-2978
Anomaly Detection and Attribution Using Bayesian Networks.	Andrew Kirk, Jonathan Legg and Edwin El-Mahassni	DSTO-TR-2975
Analysis of Multilayered Printed Circuit Boards using Computed Tomography	Samuel Fox and Greg Perry	DSTO-TR-2973
Modelling of Buoyant Thermals	Martin Kocan, Milan Jamriska, Alex Skvortsov and Timothy Dubois	DSTO-TR-2972
Formation Design Systems' Maxsurf Stability Tank Table Generator: Verification and Validation Study	Edward Dawson	DSTO-TR-2968
Modification of the Gurney Equation for Explosive Bonding by Slanted Elevation Angle	C. Choi, M. Callaghan, P. van der Schaaf, H. Li and B. Dixon	DSTO-TR-2960
The Application of Work Domain Analysis to Defining Australia's Air Combat Capability	Alanna Treadwell and Neelam Naikar	DSTO-TR-2958
An Evaluation of the Rapid Direct Advanced Translator Analyzer (RDATA)	Maurizio Gencarelli	DSTO-TR-2957
Imagery Transmission Over a Tactical Data Link	Maurizio Gencarelli	DSTO-TR-2956
Development and Evaluation of a Novel Method for Basic Marksmanship Training on an Australian Army Course	Philip Temby and Ashley Stephens	DSTO-TR-2951
Evaluation of the Effectiveness of Simulation for M4 Marksmanship Training	Ashley Stephens and Philip Temby	DSTO-TR-2950
Gamma Imaging using Ratational Modulation Collimation	M. Roberts, M. Kocan, A. Eleftherakis, D. Marinaro and A. Meehan	DSTO-TR-2946

TITLE	AUTHOR/S	REPORT NO.
Linear separability in categorisation and inference: A test of the Johnson-Laird falsity model	Susannah J. Whitney, George Galanis, and Armando Vozzo	DSTO-TR-2935
Learning Organisations: A literature review and critique	Steven Talbot, Christina Stothard, Maya Drobnjak and Denise McDowall	DSTO-TR-2928
Evaluating De-centralised and Distributional Options for the Distributed Electronic Warfare Situation Awareness and Response Test Bed	Kuba Kabacinski, Catherine Howard and Damian Hall	DSTO-TR-2918
Shallow Water Bathymetry using the REMUS 100 Autonomous Underwater Vehicle	Michael Bell	DSTO-TR-2916
Automated Cyber Red Teaming	Joseph Yuen	DSTO-TN-1420
Thematic Synthesis of Post Activity Reviews: Lessons Relating to Management of the Simulation Environment Supporting Activity Vital Fire in May 2014	Glen Pearce	DSTO-TN-1408
Refinement of Propellant Strand Burning Method to Suit Aluminised Composite Rocket Propellant	Paul C. Smith, Garry Hale and Raoul A. Pietrobon	DSTO-TN-1396
A New Interpretation of the Shannon Entropy Measure	Lewis Warren	DSTO-TN-1395
Computing with Epistemic Uncertainity	Lewis Warren	DSTO-TN-1394
Secure Ad Hoc Networking on an Android Platform	Angus Morton, David Adie and Paul Montague	DSTO-TN-1390
How to Create and Manipulate Radar Range–Doppler Plots	Don Koks	DSTO-TN-1386
Victualling for Future RAN Platforms - Alternative Technologies	Theresa K C Hay and Karl Slater	DSTO-TN-1379
Development of Physical Employment Standards for the Royal Australian Navy: Validation of Identified Whole of Ship Tasks	Kane Middleton, Greg Carstairs, Daniel Billing, Amelia Carr, Ben Lee-Bates, Peter Caputi and Denise Linnane	DSTO-TN-1376
Potential Performance Criteria for Combat Ration Packs – Texture Profile Analysis	Lan Bui and Duanne Hibbert	DSTO-TN-1373
Review of Fuel Cell Technologies for Military Land Vehicles	Benjamin Campbell, Simon Crase and Brendan Sims	DSTO-TN-1360
Compliance of 2012/13 Combat Ration Packs to the Recommended Nutritional Criteria	Lan Bui, Tracey McLaughlin and Ross Coad	DSTO-TN-1340
Data Reduction Algorithms for Store Separation Grid Testing	Jonathan Dansie and Adam Blandford	DSTO-TN-1339
Ageing of DNAN Based Melt-Cast Explosives	Arthur Provatas and Craig Wall	DSTO-TN-1332

TITLE	AUTHOR/S	REPORT NO.
The Army Learning Organisation Questionnaire: Developing a valid and reliable measure of Learning Organisation characteristics	Christina Stothard	DSTO-TN-1325
Atmospheric Corrosivity at Some Australian and Oversea Airbases and Airports	J.C. Bitcon	DSTO-TN-1320
CAGE IIIA Distributed Simulation Design Methodology	Dave Bowen, Michael Galister, Michael Slade and John O'Neill	DSTO-TN-1300
A Short Guide to Experimental Design and Analysis for Engineers	Edward H. S. Lo, T. Andrew Au and Peter J. Hoek	DSTO-TN-1291
Searcher Speed for a Stationary Tight Crossover Barrier	M.P.Fewell	DSTO-TN-1269
Effect of Explosion Bulge Test Parameters on the Measurement of Deformation Resistance for Steel	C. H. Choi, M. Callaghan and B. Dixon	DSTO-TN-1263
A Critique of Three Decision Support Techniques	Lewis Warren	DSTO-TN-1254
Armidale Class Patrol Boat Torsionmeter Removal and Reinstallation Procedure	Michael Brincat, Peter Vincent and Mark Ciacic	DSTO-TN-1238
Factors Controlling the Quality of Freeze Dried Rice	Gus Rowan McFarlane, Lan Bui and Jeanine De Diana	DSTO-TN-1235
Statistics of Radial Ship Extent as Seen by a Seeker	Don Koks	DSTO-TN-1220
Post-Activity Report: DHSS Organisational Culture and Performance Workshop	Christina Stothard, Mirela Stjelja, Tiffany Fischer, Maya Drobnjak and Steven Talbot	DSTO-TN-1212
Condition Based Maintenance Technology Impacts Study for the Military Land Environment	Ksenia Ivanova, Guy Edward Gallasch, Sreeja Rajesh, Christopher Manning	DSTO-RR-0404
Detection of Accelerating Targets in Clutter using a De-chirping Technique	H.T. Tran, R. Melono and S. Kodituwakku	DSTO-RR-0399
Rapid Technology Assessment Framework for Land Logistics	Ksenia Ivanova and Guy Edward Gallasch	DSTO-GD-0870
Australian Combat Ration Packs	Lan Bui and Terry Moon	DSTO-GD-0866
The Possible Effects of Potential Key Technological Developments on the Force Structure of the Australian Army 2040	B. Pincombe and P.Dexter	DSTO-GD-0862
Project Scheduling Tool for Maintaining Capability Interdependencies and Defence Program Investment: A User's Guide	M.T. Nguyen	DSTO-GD-0843
A Review of Software Tools to Support Analysis of Army Readiness and Sustainability	Dermot Blumson and Matthew Richmond	DSTO-GD-0832

TITLE	AUTHOR/S	REPORT NO.
Roll Damping Characterisation Program: User Guide	Edward Dawson and Murray Riding	DSTO-GD-0830
A Framework for the Statistical Analysis of Probability of Mission Success Based on Bayesian Theory	Vanessa Glenny	DSTO-GD-0828
Network Emulation Testbeds: A Technique for Virtual Network Topology Research and Experimentation	David Evans	DSTO-GD-0827
Operational Handbook: Working Amongst Different Cultures	David Matthews	DSTO-GD-0816
Pre-Deployment Handbook: Solomon Islands	Paul Bennett, Kathy Radoslovich and Rebecca Karlsson	DSTO-GD-0814
Pre-Deployment Handbook: Timor-Leste	Alison Hickman, Rebecca Karlsson and Kathy Radoslovich	DSTO-GD-0813
Pre-Deployment Handbook Afghanistan (Post 2014)	David Matthews and Raspal Khosa	DSTO-GD-0809
Pre-Deployment Handbook Papua New Guinea	Margaret Egudo and Paul Bennett	DSTO-GD-0808
Aggregation and Security: A Literature Review	David Adie and Tamas Abraham	DSTO-GD-0777
Archiving a Software Development Project	Peter Fisher	DSTO-GD-0739

APPENDIX B : PAPERS DELIVERED OR PUBLISHED EXTERNALLY

TITLE	AUTHOR/S	PUBLICATION
An Approach for Maintaining Capability Interdependencies and Budgeting Program Investment	Nguyen, M.T.	Australian Society for Operations Research (ASOR) Bulletin, Volume 33, Issue 1
Extruded single ring hollow core optical fibers for Raman sensing	Spooner, N.A.; Tsiminis, G.; Rowland, K.J., et al	23rd International Conference on Optical Fibre Sensors, Proc. of SPIE Vol. 9157
Explosives sensing based on suspended core fiber coated with conjugated polymer	Spooner, N.A.; Chu, F.; Tsiminis, G., et al	23rd International Conference on Optical Fibre Sensors, Proc. of SPIE Vol. 9157
A comparison between 1- and 2-degree of freedom electromagnetic energy harvester for heavy haul railcar application	Ung, C.; Moss, S.; Chiu, W.K.	8th Australasian Congress on Applied Mechanics (ACAM 8), Melbourne, Victoria: 24 - 26 November 2014, Engineers Australia
Laser Shock Ignition of Porous Silicon Based Nano-Energetic Films	Plummer, A.; Kuznetsov, V.; Gazcooke, J., et al	Journal of Applied Physics. doi:10.1063/1.4892444
The Situation Awareness Weighted Network (SAWN) Model	Ali, I.; Kalloniatis, A.; Kohn, E., et al	19th ICCRTS, Alexandria, Virginia, USA “C2 Agility: Lessons Learned from Research and Operations”
The J-Staff System, Network Synchronisation and Noise	Kalloniatis, A.; Zuparic, M.	19th ICCRTS in Alexandria, Virginia, USA “C2 Agility: Lessons Learned from Research and Operations”
Numerical modelling and experimental determination of the dynamic behaviour of composite structures	Cohen, B.; Dylejko, P.; Moore, S., et al	Internoise 2014 : 43rd International Congress on Noise Control Engineering, Melbourne, Vic.: 16 - 19 November 2014, Australian Acoustical Society
Rare-Event Simulation for Radar Threshold Estimation in Heavy-Tailed Sea Clutter	Zuk, J.; Rosenberg, L.	IEEE Statistical Signal Processing Workshop 2014, pp. 468-471.
Performance Prediction Modelling for High Resolution Radar with Scan-to-Scan Processing	Rosenberg, L.; Zuk, J.	IEEE Radar Conference 2014.
Numerical simulation of the ballistic protection performance of a laminated armor system with pre-existing debonding/delamination	Tan, P.	Composites Part B: Engineering 59 March 2014 50-59
Elastomer optimisation for high endurance vibration energy harvesting	Hart, G.; Moss, S.; Nagle, D.	Proceedings of Materials Innovation and Surface Engineering 2013, Materials Forum

TITLE	AUTHOR/S	PUBLICATION
Vibration energy harvesting using a spherical permanent-magnet	Moss, S.; Hart, G.; Burke, S.K., et al	Proceedings of SPIE Vol. 9057 9057-27 (2014)
Scaling of electromagnetic vibration energy harvesting devices	Moss, S.; Payne, O.; Hart, G.	Proceedings of SPIE Vol. 9057 9057-28 (2014)
Fractional-order formulation of power-law and exponential distributions	Alexopoulos, A.; Weinberg, G.V.	Physics Letters A, 378 (34) pp. 2478-2481, (2014)
Histogram-PMHT for extended targets and target groups in images	Wieneke, M.; Davey, S.	IEEE Transactions on Aerospace and Electronic Systems 50 (3) July 2014 2199-2217
Interior point solution of fractional Bethe permanent	Williams, J.L.	IEEE Workshop on Statistical Signal Processing, SSP 2014, Gold Coast, QLD: 29 June - 2 July 2014, IEEE Computer Society
The best fitting multi-Bernoulli filter	Williams, J.L.	IEEE Workshop on Statistical Signal Processing, SSP 2014, Gold Coast, QLD: 29 June - 2 July 2014, IEEE Computer Society
Invariance of the distributions of normalized Gram matrices	Howard, S.D.; Sirianunpiboon, S.; Cochran, D.	IEEE Workshop on Statistical Signal Processing, SSP 2014, Gold Coast, QLD: 29 June - 2 July 2014, IEEE Computer Society
Aircraft bearing estimation using underwater acoustic sensors	Lo, K.W.; Ferguson, B.G.	IEEE Workshop on Statistical Signal Processing, SSP 2014, Gold Coast, QLD: 29 June - 2 July 2014, IEEE Computer Society
Rare-event simulation for radar threshold estimation in heavy-tailed sea clutter	Zuk, J.; Rosenberg, L.	IEEE Workshop on Statistical Signal Processing, SSP 2014, Gold Coast, QLD: 29 June - 2 July 2014, IEEE Computer Society
Autonomous information driven search for a diffusive source in an unknown structured environment	Ristic, B.; Skvortsov, A.; Walker, A.	IEEE Workshop on Statistical Signal Processing, SSP 2014, Gold Coast, QLD: 29 June - 2 July 2014, IEEE Computer Society
Achievable accuracy in parameter estimation of a Gaussian plume dispersion model	Ristic, B.; Gunatilaka, A.; Gailis, R.	IEEE Workshop on Statistical Signal Processing, SSP 2014, Gold Coast, QLD: 29 June - 2 July 2014, IEEE Computer Society
Evidence of a Lombard response in migrating humpback whales (Megaptera novaeangliae)	Dunlop, R.A.; Cato, D.H.; Noad, M. J.	Journal of the Acoustical Society of America 136 (1) July 2014 430-437
Riveted patch repairs for helicopter tail drive shafts with battle damage	Wang, J.; Baker, A.A.; Bitton, D.	The Aeronautical Journal 118 (1205) July 2014 811-827
Rotational Energy Harvesting from a Drive Shaft for Structural Health Monitoring	Payne, O.; Moss, S.	Engineers Australia 8th Australasian Congress on Applied Mechanics (ACAM 8) ACAM8-ABS-1204

TITLE	AUTHOR/S	PUBLICATION
Evolution of magnetic and structural properties during iron plating of carbon nanotubes	Brack, N.; Kappen, P.; Herries, A.I.R., et al	Journal of Physical Chemistry C 118 (24) July 2014 13218-13227
Wide-area land-sea mapping using high frequency sky-wave radar	Holdsworth, D.; Turley, M.; Heitmann, A., et al	14th Australian Space Research Conference ASRC, Adelaide, 29 September- 1 October 2014
Effects of body-borne equipment on occupant forces during a simulated helicopter crash	Aggromito, D.; Chen, B.; Thomson, R., et al	International Journal of Industrial Ergonomics 44 (4) July 2014 561-569
Aris-Taylor dispersion in tubes with dead ends	Dagdug, L.; Berezhkovskii, A.M.; Skvortsov, A.	The Journal of Chemical Physics 141 (2) July 2014 024705
Photonic Technique for Phase Control of Microwave to Terahertz Signals	Attygalle, M.; Stepanov, D.	IEEE Transactions on Microwave Theory and Techniques, VOL. 62, NO. 6, June 2014
Full-Scale Manoeuvring Trials for the Wayamba Unmanned Underwater Vehicle	Sgarioto, D.; Madden, C.	Underwater Technology, Vol. 32, No. 2, July 2014, pp. 67-79
Big Data in a Defence Environment	Beck, J.	2014 Big Data Workshop, UNSW Kensington Campus, 1 July 2014
Fabricating fiber Bragg gratings with wide range and precise wavelength control	Stepanov, D.; Corena, L.	Advanced Photonics, (Optical Society of America, 2014), doi:10.1364/BGPP.2014.BM2D.2
Development and validation of an ELISA kit for the detection of ricin toxins from biological specimens and environmental samples	Chen, H.Y.; Tran, H.; Foo, L.Y., et al	Analytical and Bioanalytical Chemistry 406 (21) August 2014 5157-5169
Bayesian likelihood-free localisation of a biochemical source using multiple dispersion models	Ristic, B.; Gunatilaka, A.; Gailis, R., et al	Signal Processing 108 March 2015 13-24
The effect of target thickness on the ballistic performance of ultra high molecular weight polyethylene composite	Nguyen, L.H.; Ryan, S.; Cimpoeru, S.J., et al	International Journal of Impact Engineering 75 January 2015 174-183
A Generalized Machine Fault Detection Method Using Unified Change Detection	Wang, W.; Forrester, D.; Frith, P.	Annual Conference of the Prognostics and Health Management Society, 2014
Laser shock ignition of porous silicon based nano-energetic films	Plummer, A.; Kuznetsov, V.A.; Gascooke, J., et al	Journal of Applied Physics 116 (5) August 2014 054912
Trapping of diffusive particles by rough absorbing surfaces: Boundary smoothing approach	Skvortsov, A.; Walker, A.	Physical Review E - Statistical, Nonlinear, and Soft Matter Physics 90 (2) August 2014 023202

TITLE	AUTHOR/S	PUBLICATION
Development of assurance techniques for information quality on technical advice	Mead, R.F.; Kennett, S.R.	International Journal of Information Quality 3 (3) August 2014 228-250
Altitude and airspeed effects on the optimum synchrophase angles for a four-engine propeller aircraft	Blunt, D.M.	Journal of Sound and Vibration 333 (16) August 2014 3732-3742
Quantitative Evaluation of the NVIDIA PhysX Physics Engine in Unity	Sgarioto, D.; Travers, A.; Madden, C.	Proceedings of the Asia Pacific Simulation Training Conference and Exhibition (SimTecT 2014), 25-28 Aug, Adelaide, pp. 1-8
Explosives detection by fluorescence quenching of conjugated polymers in suspended core optical fibers	Chu, F.; Tsiminis, G.; Spooner, N.A., et al	Sensors and Actuators B: Chemical 199 August 2014 22-26
A robust model predictive control framework for diesel generators	Broomhead, T.; Manzie, C.; Eriksson, L., et al	19th International Federation of Automatic Control (IFAC) World Congress, Cape Town, South Africa: 24 - 29 August 2014, IFAC
Integration of Radar Software and Simulator	Gregory, D.; Young, R.	Abstract prepared for Progress in Radar Research 2014
Re-addition of antioxidant to aged MEROX and hydroprocessed jet fuels	Rawson, P.M.; Stansfield, C; Webster, R.L., et al	Fuel 139 January 2015 652-658
Analysis of millimeter-wave polarization diverse MIMO capacity	Lawrence, N.P.; Ng, B.W.H.; Hansen, H.J., et al	39th International Conference on Infrared, Millimeter and Terahertz Waves, IRMMW-THz 2014: 14 - 19 September 2014, IEEE Computer Society
A review of cognitive decision-making within future mission systems	Tweedale, J.	Procedia Computer Science 35 September 2014 1043-1052
Enhancing the dgree of autonomy on a 'Tier 1' unmanned aerial vehicle using a visual landing framework	Tweedale, J.; Gonano, D.	Procedia Computer Science 35 September 2014 1033-1042
Deep surface rolling for fatigue life enhancement of laser clad aircraft aluminium alloy	Zhuang, W.; Liu, Q.; Djugum, R., et al	Applied Surface Science 320 November 2014 558-562
Genomic characterisation of Almpiwar virus, Harrison Dam virus and Walkabout Creek virus; three novel rhabdoviruses from northern Australia	McAllister, J.; Gauci, P.J.; Mitchell, I.R., et al	Virology Reports 3 Sept - Dec. 2014 1-17
A performance comparison between cooled and uncooled infrared detectors for thermoelastic stress analysis	Rajic, N.; Street, N.	Quantitative InfraRed Thermography Journal 11 (2) 207-221 DOI: http://dx.doi.org/10.1080/17686733.2014.962835
Designing physical security for complex infrastructures	Nunes-Vaz, R.; Lord, S.	International Journal of Critical Infrastructure Protection 7 (3) September 2014 178-192

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A target detection model predicting field observer performance in maritime scenes	Culpepper, J.B.; Wheaton, V.C.	Electro-Optical and Infrared Systems: Technology and Applications XI, Amsterdam, Netherlands: 22 September, 2014, SPIE
Initial Results from the DSTO Experimental Phased Array Radar	Young, R.	Progress in Radar Research (PIRR) 2014, September 2014
Integration of Radar Software and Simulator	Gregory, D.; Young, R.	Progress in Radar Research (PIRR) 2014, September 2014, Abstract, poster and single slide presentation
On the Certification of Bonded Repairs to Primary Composite Aircraft Components	Baker, A.; Gunnion, A.; Wang, J.	The Journal of Adhesion 91 (1-2) January 2015 4 - 38
Liquid chromatography-mass spectrometry and chemometric analysis of ricinus communis extracts for cultivar identification	Ovenden, S.P.B.; Pigott, E.J.; Rochfort, S., et al	Phytochemical Analysis 25 (5) September - October 2014 476-484
Non-linear dynamics of a vibration energy harvester by means of the homotopy analysis method	Vandewater, L.; Moss, S.	Journal of Intelligent Material Systems and Structures 25 (13) September 2014 1605-1613
Improved stress intensity factors for selected configurations in cracked plates	Evans, R.; Clarke, A.; Gravina, R., et al	Engineering Fracture Mechanics 127 September 2014 296-312
Laboratory validation of sensors for a corrosion prognostic health management system for use with military aircraft	Butler, A.; Hopf, J.; Jacob, J., et al	54th Annual Conference of the Australasian Corrosion Association 2014: Corrosion and Prevention 2014, Darwin, NT: 21 - 24 September 2014,
Electrochemical characteristics of aluminium aloys in the presence of praseodymium (III) ions	Sudholz, A.; Trueman, A.R.	54th Annual Conference of the Australasian Corrosion Association 2014: Corrosion and Prevention 2014, Darwin, NT: 21 - 24 September 2014
Field testing of a corrosion prediction health management system on military aircraft	Trueman, A.R.; Butler, A.; Hopf, J., et al	54th Annual Conference of the Australasian Corrosion Association 2014: Corrosion and Prevention 2014, Darwin, NT: 21 - 24 September 2014
The role of microstructural characteristics in the cavitation erosion behaviour of laser melted and laser processed Nickel-Aluminium Bronze	Cottam, R.; Luzin, V.; Moody, H., et al	Wear 317 (1-2) September 2014 56-63
Nondestructive evaluation of thick-section composites and sandwich structures: A review	Ibrahim, M.E.	Composites. Part A. Vol. 64, pp. 36-48 (2014)
Application of MBCD to Creativity and Innovation	Jakobsson, Å. K.	INOCSE Insight Volume 17 Issue 4 pp 33-34

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HF radar detection of internal waves in the ocean	Anderson, S.; Buchan, S.	International Radar Conference, Radar 2014, Lille, France: 13 - 17 October 2014, Institute of Electrical and Electronics Engineers Inc.
Determining inductive sensor wear debris limits for rolling contact fatigue of bearings	Becker, A.; Abanteriba, S.; Forrester, D.	Proceedings of the Institution of Mechanical Engineers, Part J: Journal of Engineering Tribology 229 (6) June 2015 698-711
Direct down-conversion 38 GHz GaAs and SiGe receivers	Clement, R. M.; Milner, L.E.; Convert, E.R., et al	6th IEEE Compound Semiconductor Integrated Circuit Symposium, CSICS 2014, La Jolla, CA, USA: 19 - 22 October 2014, Institute of Electrical and Electronics Engineers Inc.
The identification of disulfides in ricin D using proteolytic cleavage followed by negative-ion nano-electrospray ionization mass spectrometry of the peptide fragments	Tran, T.T.N.; Brinkworth, C.S.; Bowie, J.H.	Rapid Communications in Mass Spectrometry 29 (2) January 2015 182-190
Fatigue crack growth in 7249-T76511 aluminium alloy under constant-amplitude and spectrum loading	Newman, J. C.; Walker, K.F.; Liao, M.	Fatigue and Fracture of Engineering Materials and Structures 38 (5) A 528-539
Application of the K+Rayleigh distribution to high grazing angle sea-clutter	Rosenberg, L.; Watts, S.; Bocquet, S.	2014 International Radar Conference, Radar 2014, Lille, France: 13 - 17 October 2014, Institute of Electrical and Electronics Engineers Inc.
Simulation of coherent sea clutter with inverse gamma texture	Bocquet, S.; Rosenberg, L.; Watts, S.	2014 International Radar Conference, Radar 2014, Lille, France: 13 - 17 October 2014, Institute of Electrical and Electronics Engineers Inc.
A review of the effectiveness of gamebased training for dismounted soldiers	Whitney, S J.; Temby, P.; Stephens, A.	Journal of Defense Modeling and Simulation 11 (4) October 2014 319-328
The Computed Tomography of Ceramic Matrix Composites During Mechanical Loading	Thornton, J.; Arhatari, B.; Wood, C., et al	XRM2014 12th International Conference on X-ray Microscopy, Melbourne, Vic.: 26 - 31 October 2014
HIFiRE-1 ascent-phase boundary-layer transition	Kimmel, R.L.; Adamczak, D.; Paull, A., et al	Journal of Spacecraft and Rockets 52 (1) January - February 2015 217-230
Manoeuvring of Unmanned Underwater Vehicles	Sgarioto, D.; Madden, C.	Society for Underwater Technology's UT2 Magazine, Oct-Nov, 2014, p36, Feature article.

TITLE	AUTHOR/S	PUBLICATION
Experimental study of the steady fluid–structure interaction of flexible hydrofoils	Zarruk, G.A.; Brandner, P.A.; Pearce, B.W., et al	Journal of Fluids and Structures 51 November 2014 326-343
An efficient, variational approximation of the best fitting multi-Bernoulli filter	Williams, J.L.	IEEE Transactions on Signal Processing, vol 63, no 1, pp 258-273, January 2015
Approximate evaluation of marginal association probabilities with belief propagation	Williams, J.L.; Lau, R.A.	IEEE Transactions on Aerospace and Electronic Systems, vol 50, no 4, pp 2942-2959, October 2014
Pre-Blast Strengthening of Fe–18Mn–0.6C–1.5Al TWIP Steel	Choi, C-H.; Peng, C-T.; Dixon, B.F., et al	Steel Research International 85 DOI: http://dx.doi.org/10.1002/srin.201400198
Reduced length fibre Bragg gratings for high frequency acoustic sensing	Davis, C.; Robertson, D.; Brooks, C., et al	Measurement Science and Technology 25 (12) December 2014 Article number 125105
Flow past a transversely rotating sphere at Reynolds numbers above the laminar regime	Poon, E.K.W.; Ooi, A.S.H.; Giacobello, M., et al	Journal of Fluid Mechanics 759 (4) October 2014 751-781
Flight Parameter Estimation Using Instantaneous Frequency Measurements From a Wide Aperture Hydrophone Array	Lo, K.W.; Ferguson, B.G.	Oceanic Engineering, IEEE Journal of 39 (4) October 2014 607-619
Student Assignment - Radar Simulation Presentation 2	Gregory, D.	Student assignment for the University of South Australia School of Engineering Honours Program
The CACTuS multi-object visual tracking algorithm on a heterogeneous computing system	Milton, A., Wong, S., Kearney, D., Lemmo, S.	ACM International Conference Proceeding Series; 1 November 2014, p19-24
A Competitive Attentional Approach to Mitigating Model Drift in Adaptive Visual Tracking	Wong, S., Gatt, A., Kearney, D., Milton, A., & Stamatescu, V.	29th International Conference on Image and Vision Computing New Zealand, Proceedings , Hamilton New Zealand (pp. 1-6). ACM.
Development productivity in implementing a complex heterogeneous computing application	Milton, A., Kearney, D., Wong, S., Lemmo, S.	13th International Conference on Field-Programmable Technology, FPT 2014, Shanghai; China: 10 - 12 December 2014, IEEE
Interaction Challenges for the Dynamic Construction of Partially-Ordered Sets	Pattison, T.; Ceglar, A.	CLA 2014, Proceedings of the Eleventh International Conference on Concept Lattices and Their Applications, Košice, Slovakia, October 7-10, 2014, pp 23-34

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Environmental Sensing of Heavy Metals Through Whole Cell Microbial Biosensors: A Synthetic Biology Approach	Bereza-Malcom, L.; Mann, G.; Franks, A.E.	ACS Synthetic Biology 3 (10) 9 October 2014
Fast estimation of coil factor and orthogonality errors in tri-axial magnetic coil systems	Dinale, J.; Vrbancich, J.	Measurement Science and Technology 25 (10) October 2014 105901
A review of equivalent pre-crack sizes in aluminium alloy 7050-T7451	Molent, L.	Fatigue and Fracture of Engineering Materials and Structures 37 (10) October 2014 1055-1074
Bragg grating fabrication with wide range coarse and fine wavelength control	Stepanov, D.; Corena, L.	Optics Express, Vol. 22, No. 22, pp. 27309-27320, 2014
Increasing the capacity of ad-hoc networks	Hunjet, R.; Coyle, A.	Australasian Telecommunication Networks and Applications Conference, ATNAC 2014, Melbourne, Vic.: 26 - 28 November 2014, Institute of Electrical and Electronics Engineers Inc.
Improved stress intensity factors for a single corner crack at a loaded fastener hole	Evans, R.; Clarke, A.; Heller, M., et al	Engineering Fracture Mechanics 131 November 2014 570-586
Evaluating Impacts of System Integration on Joint Fires Operations	Lo, E. H. S.; Hoek, P. J.; Au, T. A.	Military Communications and Information Systems (MilCIS) Conference November 2014
Fractional order Pareto distributions with application to X-band maritime radar clutter	Alexopoulos, A.; Weinberg, G.V.	IET Radar Sonar & Navigation 9 (7), 817-826
Isolator Internal Resonance and Radiated Noise from Ships	Dylejko, P.G.; MacGillivray, I.; Skvortsov, A.	Internoise 2014 : 43rd International Congress on Noise Control Engineering, Melbourne, Vic.: 16 - 19 November 2014, Australian Acoustical Society
A slot spiral in carbon-fibre composite laminate as a conformal load-bearing antenna	Daliri, A.; Wang, C.H.; Galehdar, A., et al	Journal of Intelligent Material Systems and Structures 25 (11) November 2014 1295-1305
A simple model of effective elastic properties of materials with inclusions	Skvortsov, A.; MacGillivray, I.	Internoise 2014 : 43rd International Congress on Noise Control Engineering, Melbourne, Vic.: 16 - 19 November 2014, Australian Acoustical Society
The effect of flow on the natural frequencies of a flexible plate	Peters, H.; Chen, L.; Kessissoglou, N.	Internoise 2014 : 43rd International Congress on Noise Control Engineering, Melbourne, Vic.: 16 - 19 November 2014, Australian Acoustical Society

TITLE	AUTHOR/S	PUBLICATION
Sound radiation from a water-loaded cylinder due to machine noise	Pan, X.; Tso, Y.; Forrest, J., et al	Internoise 2014 : 43rd International Congress on Noise Control Engineering, Melbourne, Vic.: 16 - 19 November 2014, Australian Acoustical Society
Estimation of pressure fluctuations in a turbulent boundary layer based on vibro-elastic models	MacGillivray, I.; Skvortsov, A.	Internoise 2014 : 43rd International Congress on Noise Control Engineering, Melbourne, Vic.: 16 - 19 November 2014, Australian Acoustical Society
Self-noise prediction of a flat plate using a hybrid RANS-BEM technique	Croaker, P.; Kessissoglou, N.; Karimi, M., et al	Internoise 2014 : 43rd International Congress on Noise Control Engineering, Melbourne, Vic.: 16 - 19 November 2014, Australian Acoustical Society
Influence of structural elasticity on trailing edge noise	Chen, L.; Kessissoglou, N.	Internoise 2014 : 43rd International Congress on Noise Control Engineering, Melbourne, Vic.: 16 - 19 November 2014, Australian Acoustical Society
Adapting a propeller noise model for aircraft at cruising altitudes	Blunt, D.M.; Jones, A.; Mewett, D.	Internoise 2014 : 43rd International Congress on Noise Control Engineering, Melbourne, Vic.: 16 - 19 November 2014, Australian Acoustical Society
Experimental investigation of the role of the battery in the AeroStack hybrid, fuel-cell-based propulsion system for small unmanned aircraft systems	Verstraete, D.; Gong, A.; Lu, D.D.C., et al	International Journal of Hydrogen Energy 40 (3) January 2015 1598-1606
Additive manufacturing of strong and ductile Ti-6Al-4V by selective laser melting via in situ martensite decomposition	Xu, W.; Brandt, M.; Sun, S., et al	Acta Materialia 85 74-84 DOI: 10.1016/j.actamat.2014.11.028
Static and fatigue testing thin riveted, bonded and hybrid carbon fiber double lap joints used in aircraft structures	Chowdhury, N.; Chiu, W. K.; Wang, J., et al	Composite Structures 121 315-323 DOI: 10.1016/j.compstruct.2014.11.004
Isogeometric analysis and genetic algorithm for shape-adaptive composite marine propellers	Herath, M.T.; Natarajan, S.; Prusty, B.G., et al	Computer Methods in Applied Mechanics and Engineering 284 835-860 DOI: 10.1016/j.cma.2014.10.028
OCR and Automated Translation for the Navigation of non-English Handsets: A Feasibility Study with Arabic	Biggs, J.; Broughton, M.	ALTA 2014 Proceedings, The Australasian Language Technology Association Workshop 2014, November, 2014, Melbourne, Australia, pp 108 - 112
Ultrasonicated-ozone modification of exfoliated graphite for stable aqueous graphitic nanoplatelet dispersions	Rider, A.N.; An, Q.; Thostenson, E.T., et al	Nanotechnology 25 (49) December 2014 Article Number 495607

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Lower limb kinematics and physiological responses to prolonged load carriage in untrained individuals	Mullins, A.K.; Annett, L.E.; Drain, J., et al	Ergonomics DOI: http://www.tandfonline.com/doi/abs/10.1080/00140139.2014.984775
Towards a formal semantics of social influence	Saulwick, A.; Trentelman, K.	Knowledge-Based Systems 71 November 2014 52 - 60
Residual strengths of composite structures subjected to ballistic impact	Wang, J.; Callinan, R.	Composite Structures 117 (1) November 2014 423-432
Supersonic particle deposition as a means for enhancing the structural integrity of aircraft structures	Jones, R.; Molent, L.; Barter, S., et al	International Journal of Fatigue 68 November 2014 260-268
Influence of sol-gel derived ZrO2 and ZrC additions on microstructure and properties of ZrB2 composites	Ang, C.; Williams, T.; Vowles, D., et al	Journal of the European Ceramic Society 34 (13) November 2014 3139-3149
Maximal and sub-maximal functional lifting performance at different platform heights	Savage, R.J.; Jaffrey, M.A.; Billing, D.C., et al	Ergonomics 1-8 DOI: 10.1080/00140139.2014.983185
Data in context: Social scientific studies of natural disaster and the analysis of social media	Resnyansky, L.	ACSPRI Australian Consortium for Social and Political Research Incorporated Conference, The University of Sydney 7-10 December, 2014, http://conference.acspri.org.au/index.php/conf/conference2014/paper/view/738
Robust stable economic MPC with applications in engine control	Broomhead, T.; Manzie, C.; Shekhar, R., et al	53rd IEEE Annual Conference on Decision and Control, CDC 2014, Los Angeles, California: 15 - 17 December 2014, Institute of Electrical and Electronics Engineers Inc
Downlink LTE synchronization: A software defined radio approach	Donarski, A.; Lamahewa, T.; Sorensen, J.	8th International Conference on Signal Processing and Communication Systems, ICSPCS 2014, Gold Coast,Qld.: 15 - 17 December 2014, Institute of Electrical and Electronics Engineers Inc.
A new space time coding scheme for the multiple input single output wiretap channel	Perreau, S.	8th International Conference on Signal Processing and Communication Systems, ICSPCS 2014, Gold Coast, Qld.: 15 - 17 December 2014, Institute of Electrical and Electronics Engineers Inc.

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Using Accumulo for Graph Twiddling	Webb, D.	4th IEEE International Conference on Big Data and Cloud Computing, BD Cloud 2014, Sydney, NSW: 3 - 5 December 2014, Institute of Electrical and Electronics Engineers Inc.
Effect of vertex singularities on the displacement and strain fields near a crack front	He, Z.; Kotousov, A.; Rose, L.R.F.	Recent Advances in Structural Integrity Analysis APCF/SIF-2014, Sydney, NSW, Australia: 9 - 12 December 2014, Woodhead Publishing (Elsevier)
The effect of specimen thickness on fatigue crack growth under variable amplitude loading in 7075-T7351 aluminium	Wallbrink, C.	Recent Advances in Structural Integrity Analysis APCF/SIF-2014, Sydney, NSW, Australia: 9 - 12 December 2014, Woodhead Publishing (Elsevier)
Effects of Mistuning Patterns on Forced Response or an Integrally Bladed Disk	Chen, G.; Hou, J.	Recent Advances in Structural Integrity Analysis APCF/SIF-2014, Sydney, NSW, Australia: 9 - 12 December 2014, Woodhead Publishing (Elsevier)
Improvements to predicting fatigue crack growth rates in aluminium alloy (AA7050-T7451) loaded with a standard transport aircraft spectrum	Burchill, M.; Walker, K.; Barter, S., et al	Recent Advances in Structural Integrity Analysis APCF/SIF-2014, Sydney, NSW, Australia: 9 - 12 December 2014, Woodhead Publishing (Elsevier)
Thermoelastic monitoring of fatigue degradation in aluminium alloy supersonic particle deposition coatings	Choi, J.; Zhuang, W.; Rajic, N.	Recent Advances in Structural Integrity Analysis APCF/SIF-2014, Sydney, NSW, Australia: 9 - 12 December 2014, Woodhead Publishing (Elsevier)
Effect of models and derivation methods for initial flaw size distribution on probability of failure of airframes	Torregosa, R.F.; Hu, W.	Recent Advances in Structural Integrity Analysis APCF/SIF-2014, Sydney, NSW, Australia: 9 - 12 December 2014, Woodhead Publishing (Elsevier)
Optimal coupon design to achieve natural crack start in coupon fatigue tests	Yu, X.; Burchill, M.; Kaye, R., et al	Recent Advances in Structural Integrity Analysis APCF/SIF-2014, Sydney, NSW, Australia: 9 - 12 December 2014, Woodhead Publishing (Elsevier)

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An investigation into variations in roughness-induced crack closure in high strength aircraft alloys under fatigue loading	Walker, K.F.; Wang, C.H.; Newman, J.C.	Recent Advances in Structural Integrity Analysis APCF/SIF-2014, Sydney, NSW, Australia: 9 - 12 December 2014, Woodhead Publishing (Elsevier)
Vibration energy harvesting from heavy haul railcar vibrations using a two-degree-of-freedom couple oscillating system	Ung, C.; Moss, S.; Chiu, W.K.	Journal of Rail and Rapid Transit, Proceedings of the Institution of Mechanical Engineers Part F, article number 569861, 2015
Low cognitive load and reduced arousal impede practice effects on executive functioning, metacognitive confidence and decision making	Jackson, S.A.; Kleitman, S.; Aidman, E.	PLoS ONE 9 (12) December 2014 Article 115659
Alternative methods for derivation of safe life limits for a 7050-T7451 aluminium alloy structure	Molent, L.	International Journal of Fatigue 74 55-64 DOI: 10.1016/j.ijfatigue.2014.12.012
Toxin effect on protein biosynthesis in eukaryotic cells: A simple kinetic model	Skakauskas, V.; Katauskis, P.; Skvortsov, A., et al	Mathematical Biosciences 261 January 2015 83 - 90
Prediction of Trailing-Edge Noise Based on Reynolds-Averaged Navier–Stokes Solution	Chen, L.; MacGillivray, I.R.	AIAA Journal 52 (12) December 2014 2673-2682
Multidimensional Gas Chromatography of Alkyldihydrofuranones in Thermally Stressed Jet Fuels	Webster, R.; Evans, D.; Marriott, P.	The Royal Australian Chemical Institute National Congress 2014, Powerpoint presentation
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Using Scenario-Based Planning to Facilitate Strategic Decision Making on Future Infrastructure Requirements	Hobbs, Wayne SR ; Curtis, Neville J	Australian Defence Operations Research Review 2013, Pages 103-118

APPENDIX C : PATENTS GRANTED

Patent Title	Inventors	Country	App No	Filing Date	Priority Date	Grant No	Granted Date
Method of Manufacturing an Electrical Component	Wilson, A., Vincent, P., Muscat, R.	USA	10/581552	02-Jun-2006	05-Dec-2003	8879274	04-Nov-2014
Opto-Acoustic Pressure Sensor	Foster, S Van Velzen, J., Tikhomirov, A., Bedwell, I (Thales) Luc, F. (Thales)	Canada	2581866	28-Mar-2007	28-Sep-2004	2581866	23-Dec-2014
Method and Apparatus for Modifying Out of Band Reflection for a Laser Element	Foster, S., Tikhomirov, A.,	Canada	2589288	24-May-2007	26-Nov-2004	2589288	14-Oct-2014
Degradation Sensor	Wilson, A	Australia	2009212091	28-Jan-2009	05-Feb-2008	2009212091	20-Nov-2014
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Testing Mechanical Components for Wear and Tear	Gerrard, D.	Australia	2009326854	09-Jun-2011	09-Dec-08	2009326854	08-Jan-2015
Digital Video Guard	North, CJG., Beaumont, MRG., Yiu, KKH., Green, JD.	Australia	2009329836	24-Dec-2009	24-Dec-08	2009329836	07-May-2015
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