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Science & technology: supporting Australia's national security

a summary by the editor of an address to the Institute on 30 July 2013 by

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Australia's Defence Science and Technology Organisation provides science and technology for safeguarding Australia. Dr Zelinsky outlines the organisation's current strategy and describes its seven, client-focused programmes. A particular focus is cyber and electronic warfare.

Key words: Defence Science and Technology Organisation; Australia; cyber and electronic warfare.

As Chief Defence Scientist, it is my privilege to lead Australia's Defence Science and Technology Organisation (DSTO). DSTO is a national leader in safeguarding Australia by delivering valued scientific advice and innovative technology solutions for defence and national security. In this paper, I shall outline DSTO's current strategy and structure, share my perspective on cyber with you and then outline the support that we are giving to the maritime, aerospace, land, joint, intelligence and national security elements of Australia's defence and security community.

DSTO's 2013 Strategy

Our 2013 strategic plan is shown diagrammatically at Figure 1. Our highest priority is support for current Australian Defence Force (ADF) operations, so 'operations' is shown in the centre of the diagram. To this end we have been undertaking research and development on a range of issues to enhance both the operational effectiveness and safety of our personnel deployed to Afghanistan; and this has involved not only work in Australia on issues which have arisen in Afghanistan, but also deployment of DSTO scientists and technologists to Afghanistan to work alongside the troops.

We have three second-level priorities: sustainment, acquisitions and future proofing. Our sustainment programme involves keeping current ADF equipments in operation and, where desired, lengthening their operational life as we did so successfully with Australia's F111 strategic bomber and reconnaissance aircraft fleet. The acquisition programme involves research and analysis to underpin decisions on proposed major equipment acquisitions, such as the joint strike fighter. The future proofing programme looks ahead to equipments and weapons systems and the like that the ADF may need to acquire in the future to maintain its technological edge in our region.

These first two inner-ring orders of priority in Figure 1 are shown with a dark background indicating that these projects are sponsored and fully funded by clients from the public and/or private sector. The third order of priority is shown with a lighter background and is funded from the DSTO budget. It includes the provision of advice to government, work on national security and our own strategic research.

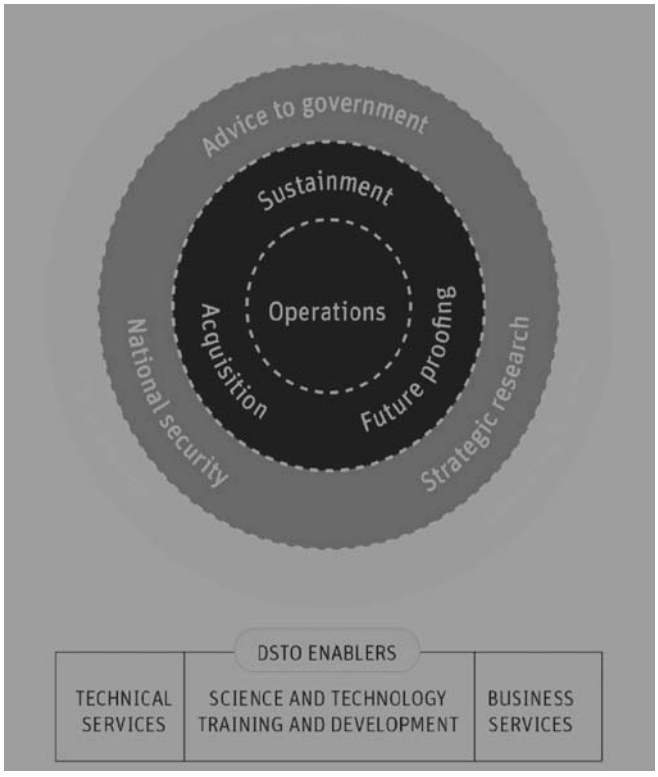

Figure 1: A diagrammatic representation of the DSTO 2013 strategic plan.

An example of the advice that we develop for government is an options analysis that we are undertaking on the nuclear submarines question. The national security programme includes all the science and technology that we are undertaking for the national security agencies. The strategic research programme involves all research and development that we initiate ourselves in-house on matters that we view as being of

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fundamental importance to Australia's defence and security. Perhaps the best-known outcome of this programme is the very successful Jindalee over-the-horizon radar and the resulting operational radar network which now provides continuous surveillance of Australia's northern approaches.

The outermost ring of Figure 1 is our lowest priority work and includes our partnerships with other research and development providers; our outreach programme, which involves telling the community what we do and, most importantly, encouraging Australia's young people to enter science; and our emerging futures research, in which we scan developments in science and technology and examine matters we predict may impact on Australia's defence and security down the line. An example is work we have underway on hypersonics.

To drive this strategy, we have a five-year plan of strategic initiatives which includes a focus on big-picture issues such as the impacts of climate change on defence and national security. It also seeks to ensure that in the short term we deliver to Defence, in the medium term we shape the defence and national security environment, and in the longer term we create and anticipate 'tomorrow'. In the process we strive to be valued advisers, collaborative partners and innovative integrators.

DSTO's 2013 Structure

To deliver this strategy, DSTO has adopted a flatter and more client-facing structure and with fewer divisions that previously. I am now assisted by a 10-person management team. I have three deputy chief defence scientists who are responsible to me for strategy and programmes, partnerships and outreach, and corporate services, respectively. The major programmes are delivered through seven client-oriented divisions whose chiefs report directly to me. These seven divisions respectively run the following programmes: land; maritime; aerospace; joint and operations analysis; national security and intelligence, surveillance and reconnaissance; cyber and electronic warfare; and weapons and countermeasures.

Cyber and Electronic Warfare

I see interferences in the cyber realm and electronic warfare as major threats, not only to our national security and public sector, but also to our industry and commerce and to individual Australians. Electronic funds transfer has become the norm now and only 14 per cent of the economy runs on cash. So this area has become a high government policy priority and this priority is reflected in DSTO's strategic plan. This is a broad domain, covering: information assurance; threat estimation; intelligence; situational awareness; and planning and shaping. It calls for strategic national investment.

Maritime Programme

Our Maritime Division, which is led by Ms Janis Cocking, provides scientific and technological support to ADF activities in the maritime domain. The division's current priorities are:

- major acquisitions and their introduction into service such as the air-warfare destroyers, the future submarine and the future frigate; and
- platform life extensions for the Collins-class submarines and the Armidale-class patrol boats.

For example, the division is currently doing developmental work on a hull-mounted sonar innovation involving the integration of Panorama software into the Broadband Sonar Advanced Processing System used in the patrol boats; working collaboratively on other projects with Thales; supporting the heavily-utilised patrol boat fleet in northern Australian waters to ensure that the fleet remains operable; and is developing a new hull monitoring system.

Aerospace Programme

Our Aerospace Division is led by Dr Ken Anderson. Its two main foci are:

- maintaining the airworthiness of in-service aircraft, including their structures, engines, fuels, and other systems, and contributing scientifically to investigations of accidents and incidents; and
- advising on new acquisitions and their introduction into service, including the F-35 joint strike fighter, the EA-18G Growler (a variant of the F/A-18F Super Hornet that has the ability to disrupt or jam a range of military electronics systems, including radars and communications systems), the E-7A Wedgetail airborne early warning and control aircraft, maritime patrol aircraft, and related training systems.

The division is currently conducting research in the exciting field of hypersonic aerodynamics (a hypersonic speed is one of Mach 5 and above) in collaboration with the Centre for Hypersonics at the University of Queensland and the United States Air Force Research Laboratory. Of particular note is our work on air-breathing engines for flights of up to Mach 8. The scientific excellence of this work was acknowledged last year when it was awarded the 2012 Karman Award in Aeronautics. Another of the division's recent achievements is a system to warn air crew of hostile gunfire.

As an example of the operational support that we give to the Royal Australian Air Force (RAAF), we provided special training last year in the form of an exercise which we named Exercise Black Skies to prepare RAAF electronic systems operators for Exercise Pitch Black 2012, a major Air Force exercise in Australia involving seven nations. Among those trained were joint terminal attack controllers, air defence ground controllers and F/A-18 Hornet and E-7A Wedgetail crews. This included an evaluation of these 'synthetic' training capabilities, the benefits of which we demonstrated to the RAAF.

Land Programme

Our Land Division, which is led by Dr Simon Oldfield, has three foci: 'Diggerworks'; physical employment standards; and the Land 400 science and technology support project.

Diggerworks is a user-centred, adaptive acquisition project designed to equip the individual soldier for the

battlefield. It is a stakeholder partnership involving embedded team members from the Army, the Defence Materiel Organisation, the DSTO, the Defence Capability Development Group and others. The project is threat-directed, evidence-based and enabled by research.

Physical employment standards are quantifiable physical demands personnel must be able to satisfy if they are to operate safely and effectively in a given job. They are determined through rigorous scientific means with input from Army, Navy, and Air Force subject-matter experts. The standards are based on job tasks, without age or gender bias; and they address four key human performance capacities: aerobic power, anaerobic power, muscular strength, and muscular endurance.

The ***LAND 400 S&T Support*** project is an equipment selection, research and development project for the Army. It has several components currently. These include:

- the Land Command-and-Control Systems Integration project, involving the development and integration of a range of battle management systems (BMS), including a headquarters BMS, a dismounted BMS, and a vehicle-mounted BMS;
- the Land Motion Platform, which analyses human and team performance when moving;
- the Human-Vehicle Integration project, involving the integration of human systems into vehicles including command-and-control, team performance, situational awareness, and workload; and
- the Vehicle Electronics and Architecture project, which involves integration of command-and control systems, sensors, weapons and vehicle systems, plus vehicle power.

Joint Programme

The chief of the Joint and Operations Analysis Division is Dr Todd Mansell. His priorities are to provide support to:

- current ADF operations (no. 1 priority), especially force protection (including countering improvised explosive devices) and operational analysis; and
- joint capability development, especially electronic warfare, intelligence, surveillance, reconnaissance, and the amphibious capability.

One of the division's current projects involves a series of multi-national 'joint fires' experiments as part of the Coalition Attack Guidance Experiment, a multi-national initiative designed to analyse and assess both the systems and the technical protocols anticipated for use to control the air space in future operational environments. Another project involves the development of logistic support software tools.

Intelligence Programme

The chief of the National Security and Intelligence, Surveillance and Reconnaissance Division is Dr Tony Lindsay. The Intelligence Programme provides support to four organisations: the Defence Intelligence Organisation, which it assists with current and future technical intelligence; the Australian (formerly Defence) Signals Directorate and the Australian Cyber Security Centre, which it assists with cyber science and deployed cyber technology; and the Australian Geospatial-Intelligence Organisation, with which it is working on the next-generation over-the-horizon radar.

National Security Programme

The national security programme seeks to coordinate and develop science and technology to enhance whole-of-government national security through the national security science and technology policy, the national security research programme, international research collaboration, analysis of whole-of-government national security systems, and dual-use counter-terrorism technologies.

Our national security science and technology programme includes a number of capabilities that are both critical for national security and, within Australia, are unique to the DSTO. These include: chemical, radiological, biological and nuclear defence (detection, forensics, mitigation and training); intelligence exploitation and decision support tools; information operations (cyber security and computer forensics); explosives detection and evaluation; man-portable air-defence systems; and blast protection for VIP vehicles.

The DSTO is also a leading provider of biometric systems, such as face recognition systems, especially their evaluation and analysis; multi-agency exercise analysis and support for emergency response; operational support to first-responder agencies; strategic risk analysis for whole-of-government national security; socio-cultural modelling, particularly understanding group identities; and surveillance technologies, such as image exploitation.

Conclusion

Through the DSTO, the Australian national security and defence community has access to world-class scientific and technological advice to underpin evidence-based decision-making; and to research, development and related scientific and technological services which are essential to national security in the 21st century.

The Author: Dr Alexander ("Alex") Zelinski, Chief Defence Scientist of Australia, has led Australia's Defence Science and Technology Organisation since March 2012. A computer scientist, systems engineer and roboticist, his career spans innovation, science and technology research and development, commercial start-ups and education. He holds the degrees of Bachelor of Mathematical Sciences, Doctor of Philosophy, and Doctor of Science, all from the University of Wollongong; and is a member of the University of Wollongong Council. Named since 2008 as one of Australia's 100 most influential engineers, the World Economic Forum selected Dr Zelinski as a Technology Pioneer in 2003, 2004 and 2005 in recognition of his commercialisation of technology with seeing machines; and in 2005, he received the Clunies-Ross Award of the Australian Academy of Technological Sciences and Engineering "for successful innovation involving the application of science and technology for the benefit of all Australians". [Photo of Dr Zelinski: DSTO]