



Australian Government
Department of Defence
Defence Science and
Technology Organisation

**THE DEFENCE SCIENCE AND TECHNOLOGY ORGANISATION SUBMISSION
TO THE HOUSE OF REPRESENTATIVES STANDING COMMITTEE ON
SCIENCE AND INNOVATION INQUIRY INTO PATHWAYS TO
TECHNOLOGICAL INNOVATION**

The Defence Science and Technology Organisation (DSTO), as part of the Australian Department of Defence, works closely with industry to enhance Australia's defence capabilities and to contribute to national wealth creation, including through the support of exports. DSTO achieves this through a multitude of interactions with industry, universities and other research agencies. These interactions aim to exploit the Australian scientific and technological capability for the benefit of Australia's security.

This submission illustrates, through a series of success stories, the breadth of DSTO's industry relationships and how DSTO's collaboration with Australia's civil science and technology community has led to technological innovation and commercialisation success. Collaborative arrangements include involvement in Cooperative Research Centres, the Defence Capability and Technology Demonstrator Program, collaborative research agreements and industry alliances.

The Department of Defence is a demanding customer with complex technological needs and this provides a powerful force for innovation and improvement. Defence's need for new technologically driven capability drives new science and innovative applications. DSTO meets these demands, partly through creating a global network of researchers and coalitions of companies to deliver new capability.

DSTO's interaction helps to build on Australia's science and technological innovations, capabilities, with consequent commercialisation of innovations for both defence and civilian applications.

Detailed below, with supporting examples, are the major mechanisms DSTO's uses to develop innovations and provide pathways to commercialisation.

Capability and Technology Demonstrator Program

A major program, which demonstrates technological innovation and in turn has led to successful commercialisation, is Defence's Capability and Technology Demonstrator (CTD) program. The CTD program, established in 1997, is managed by DSTO, and demonstrates how technology may be exploited to enhance a Defence capability in a previously unexplored manner. The emphasis of the CTD Program is on technological innovation. The program has proven so successful that it will be expanded in 2005/06 and effectively double in value, to \$26m per year.

Two examples of how DSTO is collaborating with Australian industry through the CTD program are given below.

(1) **ADVANCED LANDMINE DETECTION SYSTEM**

This innovation is a three-year project, which received \$3.45 million of funding under the Defence CTD Program, involves DSTO, Minelab Electronics, Tenix Defence Systems Pty Ltd and ADI Limited. The outcome of the CTD is a demonstrator that is a vehicular mounted, real-time multi sensor landmine detection system and will provide a safer, faster means of detecting anti-vehicle landmines on roads and tracks.

(2) **MAGSAFE**

DSTO is working with CSIRO on a new way of locating and identifying submarines from the air. A \$3 million CTD contract now forms part of CSIRO's \$7 million project to develop a novel magnetic anomaly detector system. The system employs three advanced detectors that provide a magnetic tensor, which should yield the submarine's range, depth and bearing.

Alliances

Industry Alliances are another mechanism that provides DSTO a means of collaboration with a company in complementary technological areas of mutual interest. Industry Alliances offer several benefits, which include assisting in the development of innovation and in providing possible pathways to commercialisation. The relationship between industry and DSTO develops a better understanding of customer needs and market capabilities in technological areas. Possible spin-offs include earlier and more effective development of innovative technologies that better meet Defence needs, and opportunities for both defence and export markets.

Examples of Industry Alliance engagement leading to strengthened and enhanced innovation and commercialisation follow:

(1) **THE AUSTRALIAN MINESWEEPING SYSTEM**

Modern sea mines employ advanced target detection devices. The sensors and microprocessors embedded in these mines are able to analyse some or all of the magnetic, acoustic, pressure and underwater-electric-potential signatures of ships to identify their targets.

In the 1970s, DSTO began to develop a new minesweeping technology, Dyads, which today can emulate the magnetic signatures of target vessels in intensity, structure and spatial shape, causing sea mines to detonate prematurely, safely out of range of target ships.

In 1992, DSTO and the Australian company, ADI Limited, signed a licence agreement to further develop the system technology. In 1993, the Australian Minesweeping System (AMAS), the world's first operational emulation sweep, was accepted into service by the Royal Australian Navy (RAN).

The development of an unpowered minesweeping system that can be adapted to a much wider range of craft than competing powered sweeps is estimated to have saved the ADF more than \$300 million.

DSTO and ADI cooperation is underpinned by a 1996 Mine Warfare **Industry Alliance** agreement. ADI commits substantial research and development and DSTO reinvests significant royalty revenues to further develop the system.

Working together, DSTO and ADI have expanded the system to include a number of other elements.

By the end of 2002, ADI had earned approximately \$58 million in sales, including exports to the value of approximately \$47 million. The system is in service with the navies of Australia, Denmark, Indonesia, Japan, Poland, Thailand and the USA.

The Australian Minesweeping System exemplifies best practice in DSTO-industry interaction because it contributes to Australia's defence capability, engages industry as a partner and mutually shares risk, is genuinely collaborative, and generates commercial income and exports.

In an address to the 2001 Defence Intellectual Property Conference, ADI's General Manager Mine Countermeasures, Mr Jack Byrnes, explained why the system is a commercialisation success story.

"Both parties bring complementary domain skills to the table, both parties are prepared to continue to invest in product improvement and upgrade, and we have generated the cash flow necessary to maintain our momentum".

(2) ADVANCED SONAR SYSTEMS

DSTO has collaborated with Australian industry for over three decades to develop an in-country capability in advanced sonar systems that meets ADF requirements in a broad range of operational environments. This is exemplified by the Barra sonobuoy and Kariwara solid filled towed sonar array.

Working with industry, particularly Thales Underwater Systems Pty Limited (TUS) and Acoustic Technologies Pty Ltd, DSTO has undertaken modelling, sea trials and development of the sonar array.

In 1997, DSTO and the ADF entered into an **alliance agreement** with TUS to exchange information on sonar systems technology and trends. This alliance has greatly benefited the Collins class submarine, allowing many new sonar functions supplied by other companies, including SMEs, to be implemented onboard the Collins.

Similar efforts under the alliance have improved the functionality of the TUS Spherion B anti-submarine sonar aboard the ADF's ANZAC frigates.

Today, the ADF, DSTO and TUS are cooperating to develop advanced sonars.

The Kariwara towed array is a sonar device that can be used passively or as a receiver for low-frequency signals in an active system.

TUS has further developed DSTO's Kariwara technology under licence to produce new-generation solid towed arrays (SENTRY) for the world commercial seismic survey market. SENTRY generates export sales worth approximately \$40 million per year. TUS has exported over 500 kilometres of towed arrays since 1996, making it the world's largest manufacturer of towed arrays.

Centres of Expertise (COEs) with Universities

DSTO uses COEs for contract research in specific areas of technological innovation, which establish formal long-term links with external research agencies, particularly universities, to enhance the technology base needed to meet future Defence customer requirements. COEs provide a mechanism for universities to potentially act as a focal point for technology transfer to industry, where appropriate.

A significant benefit that has flowed from COEs has been the ability of universities to leverage off the DSTO COE contribution to gain additional funding for research grants, commercial contracts, and specialist equipment and facilities.

The COE in Helicopter Structures and Diagnostics Research has managed to secure research grants from the ARC and other sources. A bearing diagnostic technique developed within this COE has facilitated the placement of a contract by a German company to adapt it to their diagnostic instruments. This contract will also see the COE be given access to bearing test machines and field data to help develop diagnostic and prognostic routines.

DSTO funding into the COE in Structural Mechanics has successfully been leveraged to allow Monash University with funding from the ARC, a CRC and private company, to acquire specialised equipment. This COE is proving a highly efficient way to establish world-class facilities for the benefit of both Defence and Australian Industry.

Collaborative Arrangements

Collaboration is an effective means for DSTO in leveraging innovative research and development (R&D) and sharing risks and benefits. This has proved to be particularly successful through the following projects:

(1) COMPOSITE BONDED REPAIR

DSTO invented and now leads the world in the use of adhesively bonded fibre composites to repair or reinforce aircraft components.

In 1990, an Australian-owned private company, Helitech Industries Pty Ltd, was licensed to market and develop DSTO's composite bonded repair technology.

In 1995, Helitech, in collaboration with DSTO, developed a composite bonded repair for the US Air Force C-141 Starlifter heavy transport aircraft. Helitech's wholly owned US subsidiary, Composite Technologies Inc, was awarded a contract for the repair of the US Air Force Starlifter fleet wings. The contract was worth over US\$10 million.

In 1996, Helitech teamed with DynCorp, a major US defence contractor, to form the joint venture, Advanced Repair Technologies Inc (ARTI), to further exploit the commercial and defence markets for composite bonded repairs. In close collaboration with DSTO, ARTI has developed and applied major structural repairs for Belgium's F-16 Falcon and has offered the repairs to the US Air Force.

Helitech has also used the licensed technology to develop rotor blade repairs, and has conducted major repairs on the US Army's AH-64 Apache attack helicopter fleet. This contract is ongoing.

Both DSTO and Helitech have benefited through this transfer of technology. Helitech has gained substantial export opportunities and experience in supporting ADF aircraft. At the same time, DSTO has enhanced its technology base through the evaluation of the technology on a wide range of aircraft and in externally funded trials, mainly in the USA. Mutual benefit is a key to this and many other success stories.

(2) STARLIGHT

Starlight is a unique system developed by DSTO to allow users of secure computers to access insecure networks, such as the Internet, without compromising their own security.

Under a joint DSTO/Tenix product development program the first Starlight-based devices, comprising the Interactive Link Data Diode and Multiple Computer Switch, emerged as the most secure products of their type and won a prestigious IT security competition as part of the combined World Congress on IT in 2002.

DSTO has signed a ten year licence agreement with Tenix Industries Pty Ltd to take the Starlight technology product range to a global market.

The transition of Starlight technology into product has resulted in very tangible benefits for the Defence and industry, demonstrating that the development of DSTO technology contributes to both capability and national wealth.

Starlight technology development are an example of how Defence innovations can be successfully transferred into products and services that have potential to meet the needs of both government and commercial sectors.

(3) INTELLIGENT AGENTS

DSTO has signed several agreements with Agent Oriented Software Pty. Ltd. (AOS) to develop intelligent agent tools. AOS has incorporated these tools into its core product, 'JACK Intelligent Agents™', to form an enhanced graphical development environment suitable for military analysts. AOS has commercialised the capability with teaming technologies developed collaboratively with DSTO.

This agreement with AOS gives DSTO, as a leading edge customer in the intelligent agent market, a direct influence in shaping developments and provides DSTO with access to the tools as commercially supported products.

AOS believe their close collaboration with DSTO has been instrumental in the development of JACK and their success as a company. Dr Andrew Lucas, Managing Director of AOS states that, "An opinion from DSTO carries a lot of weight, particularly in international defence markets".

Commercialisation

DSTO regards successful commercialisation as where '*Australian Defence Industry*':

- is created and, or sustained in technology areas of importance to the Australian Defence Force due to DSTO activities;
- grows through technology-transfer and knowledge exchange with DSTO Intellectual Property; or
- provides DSTO with a royalty stream.

Success of any commercialisation initiative is largely dependent on the relationship between the researchers and the technology recipient, and hence the quality of the ongoing technology transfer and development.

DSTO's primary goals for industry interaction are (i) enhancing industry capability to serve Defence, and (ii) national wealth creation, not royalty income for DSTO.

In order to assist in achieving these goals, and following on from recommendations emanating from the Review into "DSTO's External Engagement and Contribution to Australia's Wealth"¹, DSTO has established the Technology Transfer Advisory Group (TTAG) to assist in providing (i) independent commercial viability assessments, (ii) Business Plans, (iii) Market Research, (iv) technology bundling opportunities, and (v) suggestions for future development on selected DSTO intellectual property and technology with commercial potential in the civilian market.

DSTO experience with commercialisation suggests that maximising royalty income is often counter-productive to creating industry capability, including through incubation. This approach has led to some success in commercialisation as already indicated above and in the following examples.

(1) LASER AIRBORNE DEPTH SOUNDER

The Laser Airborne Depth Sounder (LADS) is a self-contained, transportable bathymetric survey system that uses a pulsed laser mounted in a fixed-wing aircraft.

In 1989, in partnership with BHP Engineering, Vision Systems Ltd won a \$52 million Defence contract for the further development, manufacture and commissioning of LADS.

In June 2000, Tenix Defence Systems Pty Ltd acquired Vision Systems' defence business, including LADS Corporation and renamed the company Tenix LADS Corporation Pty Ltd.

¹ This review was commissioned by Defence Minister Robert Hill and undertaken by Mr Robert Trenberth in 2003. A copy of the report may be provided on request.

The LADS technology has generated over \$100 million in revenue for its Australian owners over a 10-year period.

(2) UV STIMULATOR MISSILE APPROACH WARNER

In 1997, DSTO developed a Long Range Ultraviolet (UV) Stimulator for electronic warfare testing and training by the ADF. The technology was based on DSTO's Flight Line Test Set (FLTS), which performed pre-flight testing of an aircraft's missile approach warner by simulating the UV signature of an approaching missile. The Long Range UV Stimulator took this technology and extended the range to over three kilometres, allowing it to be useful for electronic warfare ranges for equipment testing, training and tactics development.

DSTO licensed the new technology to UK electronic warfare specialist, ESL Defence Ltd, which was already licensed to market FLTS, and Australian company, Vision Abell (now part of Tenix Defence Systems Pty Ltd). This followed a collaborative agreement between the two companies to share marketing and production responsibilities.

Tenix Defence Systems and ESL Defence Ltd have since extended the DSTO technology and developed the long-range Mallina UV Stimulator, which can operate at ranges of up to six kilometres. The companies are jointly developing further Mallina products for laser and infrared warning, and directed infrared countermeasure systems stimulation. Long Range UV Stimulator units have been sold to Germany, the Netherlands, South Africa, the UK and the USA. Tenix Defence Systems is also well positioned to market the product within the Asia-Pacific region.

These are unique products with no other competitive product on the world market. Consequently, Tenix Defence Systems is able to supply and support UV stimulation devices for the ADF.

(3) HELICOPTER GEARBOX DIAGNOSIS

Technology developed by DSTO to monitor the health of helicopter gearboxes won international recognition in 1999 when the licence for the technology was bought by US company Chadwick-Helmuth Company Inc (now part of the Honeywell group), the world's largest producer of aviation vibration analysis equipment. The licence allows Chadwick-Helmuth to commercialise the DSTO technology and market the product worldwide.

In general, DSTO prefers to license its technology to Australian-owned companies or companies with a proven commitment to Australia. However, on occasions the only way to successfully commercialise a technology has been to licence the innovation to an overseas-based organisation, which enables access to an enhanced research base and opening up of new market opportunities. Consequently benefits flow back to Australia through royalty returns and enhanced Australian defence capability.

Intellectual Property (IP) and Patents

In 2003 Defence developed a new Intellectual Property policy, which promotes continuous improvement of IP management practices within Defence. This assists in the commercialisation process by:

- providing clear guidance to Defence and Industry on how Defence will secure and manage IP;
- emphasises the importance of IP in the development and sustainment of national defence capability; and
- recognising IP as an asset that must be appropriately managed.

Defence, predominantly through DSTO, uses Patents to protect its IP to assist in the facilitation of commercialisation, licensing to industry partners, and giving it freedom to operate in further developing the invention.

Capital and Risk Investment

The establishment of the Pre-seed Fund Program was a Federal Government initiative to increase the rate of commercialisation; encourage investors in the Pre-seed area; and entice experienced managers.

Whilst very supportive of the Pre-seed fund initiative, DSTO has not been able to engage successfully with the pre-seed fund managers due to a number of factors which include:

- the fund managers have stated that investments need to be in the \$300k - \$1m range, deals below this value are too resource intensive on the fund managers;
- the majority of DSTO's opportunities are low technology readiness levels and therefore high-risk; and
- exit strategies for latter stage (VC) investors strongly favour the technology provider taking an equity position in a spin-off company, something that is extremely difficult for DSTO (the Commonwealth) to commit to within a realistic commercial timeframe.

Summary

DSTO has been undertaking technology transfer and commercialisation for many years; however, it has been essentially an activity which has been consequential to its Defence mission, and not a primary driver for the organisation.

Currently, DSTO manages 71 licenses, with a licensing revenue stream of approximately \$4.5M over 10 years. Only a small number of the 71 licenses provide any significant financial returns, but with over \$85M of exports created through just 2 DSTO-based technologies (AMAS, and Advanced Sonar Systems). This highlights DSTO's philosophy of providing its intellectual property to industry in order to enhance Defence capability, rather than create revenue. This philosophy is well aligned with DSTO's Defence mandate.

This philosophy is evident in the following quotation from the Trenberth review:

“... the six case studies we considered stand to generate sufficient value to cover, effectively, all DSTO's budgets since 1990. We are therefore confident that DSTO investment over the time period considered has almost certainly delivered to Defence benefits well in excess of the costs while providing substantial wider benefits through its industry engagement processes and through interaction with other defence forces.”