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Defence Science and
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DCDS(Pol)/OUT/2006/

Mr Gary Banks
Chairman
Productivity Commission
PO Box 80
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Dear Mr Banks,

PUBLIC SUPPORT FOR SCIENCE AND INNOVATION – DRAFT RESEARCH REPORT

Thank you for providing the Defence Science and Technology Organisation (DSTO) with a copy of the draft research report on Public Support for Science and Innovation.

I would like to congratulate you and your team on the development of the draft report and the insight it provides into the economic and social impacts of public resources being expended on science and innovation in Australia.

I found the section on DSTO to be substantially agreeable; however, I should add the following information for your consideration:

- Some of the material that you have used is somewhat dated and I take this opportunity to provide a more recent overview of DSTO's activities (*attached*).
- DSTO ceased using a laboratory structure on 1 July 2006; the current structure has three Deputy Chief Defence Scientists, one for Platform and Health Sciences (based in Melbourne), one for Information and Weapon Systems (based in Adelaide), and the third for Policy and Programs (based in Canberra).
- The proportion of DSTO's research activity directed at the long-term needs of its clients would be considerably less than one half, contrary to the statement in paragraph 6 of Sect 10.5.
- Your finding that *the effectiveness of DSTO's research is heavily dependent on the effectiveness of the procurement practices and the research directions set by the Australian Defence Organisation* is valid but tends to overlook the fact that the research directions are set by a process of consultation between DSTO and its Defence clients. In addition, please note that a significant amount of DSTO work supports the sustainment and operation of the extant Australian Defence Force.
- In Section 10, the reports states: *an option to facilitate greater contestability might be to review the potential for providing a component of research funding directly to the users of DSTO research allowing them, if they wish, to allocate funds to external providers.* It is important to note that approximately 10% of the DSTO budget is paid at the discretion of the users, frequently using Defence project funds,

to support user-defined activities and timescales. In addition, some funds go to other providers (including CSIRO) sometimes directly and sometimes with DSTO participation. Consequently, it should be recognised that DSTO already operates a hybrid funding system with some of its budget coming direct from the portfolio and some from its clients.

Please advise if I can assist further.

Yours sincerely,

Dr Ken Anderson
Deputy Chief Defence Scientist (Policy)
18 December 2006

Attachment 1. Overview of DSTO, December 2006

Attachment 1

Overview of Defence Science and Technology Organisation
December 2006

DSTO is one of five Groups that make up the Department of Defence. DSTO provides specialist advice and support to the Government and Defence to ensure the efficient and effective operation of defence and the development of Australia's future defence capability.

DSTO is a multifaceted organisation with a basic role to apply the results of scientific research to Defence and National security problems. DSTO's applied research is supported by basic research endeavouring to extend the frontiers of scientific knowledge. While some of this is done within DSTO, primarily through the long range research program, DSTO also draws upon the wider scientific community through various outreach programs.

In 2004-05 DSTO employed some 2380 civilian and military personnel.

The organisation is currently undergoing significant reorganisation and renewal. This was initiated in 2005 by the DSTO senior leadership team to proactively reposition DSTO to drive its future development and growth. It will enable DSTO to apply and deliver our very best to meet customers' needs, and to drive the direction of S&T for Australia's defence and national security in a rapidly changing environment.

The centrepiece of DSTO Renewal is a focus on People and Culture. As an organisation, DSTO is rethinking and reflecting on the values the organisation holds, the behaviours exhibited, and enhancing the capabilities of our workforce.

The DSTO mission

DSTO is the Australian Government's lead agency charged with applying Science and Technology to protect and defend Australia and its national interests. It delivers expert, impartial advice and innovative solutions for Defence and other elements of national security.

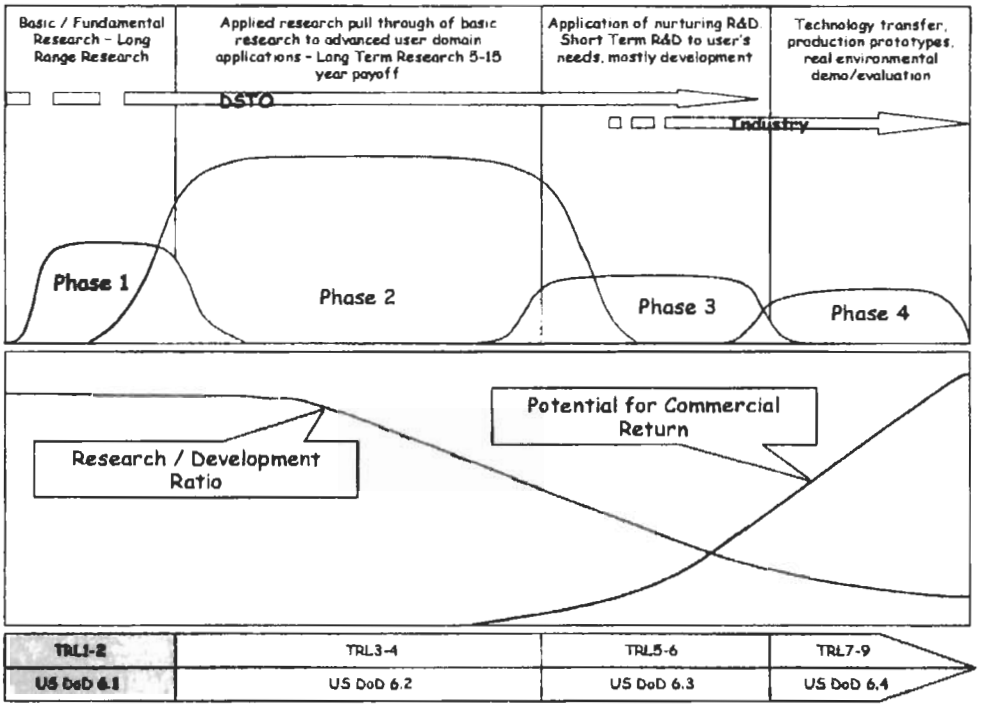
DSTO achieves this through:

- Influencing the framing and implementation of defence policy through the use of science and technology;
- Providing advice and support to ensure that Australia is an informed buyer of its defence equipment;
- Developing new niche capabilities, especially where there are special national demands such as those related to our unique circumstances;
- Providing smart user advice and support to existing capabilities in increasing their performance and reducing costs of ownership;
- Assisting industry to become better able to support the capabilities needed to defend Australia, and through industry contribute to national wealth creation; and
- Strengthening the national security technology base through collaboration nationally and internationally to support Government's broader national and international objectives.

DSTO is an integral part of Australia's science and innovation system. However, there are a number of characteristics that distinguish DSTO from other players in the public science and innovation community. These include DSTO's integration within the Department of Defence, its funding being tightly linked to Australia's defence; and DSTO's role, mandated by the Government in 2004, as Australia's lead science and technology agency on the S&T aspects for safeguarding Australia's national security.

DSTO does not operate across the whole of the science and technology spectrum. The following chart using the US Government Accountability Office Technology Readiness Level (TRL) analytical tool shows the areas of the science and technology spectrum that DSTO operates in.

TRLs are measured along a scale of one to nine with paper studies of the basic concept and ending with a technology that has proven itself in actual usage on the intended product.



DSTO generally works at the TRLs 1, 2, 3 and 4. These levels are at the conceptual end of the spectrum and in general are not serviced or provided for by industry. One of DSTO's principal outreach programs with Australian Industry is the Capability Demonstrator Program (CTD Program). This Program acts as a capability transition bridge with industry and operates at the TRL levels 5 and 6.

Funding of DSTO research

DSTO's budget in 2005-06 is approximately $384m, of which 89% is funded by the Defence portfolio. Revenue, mainly cost recoveries for the provision of services to private industry, comprises 3%, while about 8% is received from non-Defence Government agencies for work performed specifically for them.

R&D expenditure was distributed between projects that:

- support to Australian Defence Force operations;
- development of Defence capabilities for the next 10 years;

- research technologies for future Defence capabilities; and
- research associated with develop enabling science for long term capabilities, ie Long Range Research comprising approximately 10% of DSTO's internal research effort.

Approval and funding for DSTO R&D projects is based upon a project's priority within the wider Defence community. DSTO's research priorities are driven principally by the Department of Defence, using factors such as importance to national security, contribution to the operational effectiveness of the ADF and defence technology trends to determine the appropriate level of funding for each project.

During the course of 2006, DSTO's planning, reporting and management framework has been redesigned and is in the process of being implemented. The framework is based on 3 separate but linked plans:

- Strategy Plan – based on high level Government and Defence Planning and Policy and long term Technology futures;
- Program Plan – triennium plan for the delivery of client requirements with resource allocations
- Major Science and Technology Capability Plans which provides a five year linkage of resources to the development of core Science and technology underlying client requirements.

The new model will allow DSTO to:

- More easily match client requirements with deliverables;
- Assist in the generation of more accurate financial reports;
- Permit resource tracking of deliverables with the application of resources; and
- Enhance role clarity and at all times allow managers to ascertain quickly and definitively who is accountable for delivery.

Just as importantly this new framework will also enable DSTO capability to be more closely aligned to meet client requirements for S&T support.

The two drivers are obviously closely connected and the overarching challenge is to ensure that the investment to meet short term client requirements is not out of balance with the longer term development needs.

DSTO as a member of the science and innovation community

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.

Approximately 11% of DSTO's budget is spent on research and development with external organisations. This includes:

- Memoranda of Understanding, collaborative projects and liaison with other agencies and government departments;
- Participation in Cooperative Research Centres;
- Centres of Expertise and research agreements with universities; and

- Scholarships and fellowships to students and scientists.

Collaborations with other agencies

Memoranda of Understanding (MOU) and the underlying collaborative projects with other agencies and departments facilitate future relationships and allow both agencies to leverage complementary skills and knowledge.

DSTO's external engagement activities also involve liaison with other agencies on whole-of-government science matters and, on occasion, the placement of DSTO staff within other agencies, eg the secondment of DSTO staff to the National Security Science and Technology (NSST) unit within the Department of Prime Minister and Cabinet. The Chief Defence Scientist is a member of the Prime Minister's Science Engineering and Innovation Council (PMSEIC) and has taken a leading role in driving the "Safeguarding Australia" component of the government's National Collaborative Research Infrastructure Strategy (NCRIS).

DSTO and CSIRO signed a MOU in 1989 to actively promote scientific collaboration between the two organisations where it was in the national interest to do so.

A number of joint research activities are being undertaken through this MOU. For example, DSTO and CSIRO Industrial Physics are developing MAGSAFE a magnetometer designed for the detection of submarines on a single fly-past, and without flying directly overhead the vessel. Data collected from MAGSAFE includes range, depth and bearing of a submarine from the aircraft platform, as well as its horizontal and vertical speeds and direction of travel. MAGSAFE links into other CSIRO Industrial Physics research projects with implications for DSTO and Defence, such as OCEANMAG which detects underwater hydrocarbons and ocean bed mineralisation, maps the ocean floor, detects currents and waves and provides a tsunami early warning platform.

DSTO and the Australian Federal Police (AFP) recently signed a MOU to facilitate future collaboration between these two agencies in the areas of defence, security, counter-terrorism, surveillance, forensic technology and allied disciplines.

DSTO and ANSTO have signed a MOU and a number of collaborative research projects in the area of national security that will see the two agencies collaborating on projects to develop coordinated chemical, biological and radiological training programs for emergency services and forensic scientists, and improved technologies for the detection of chemical, biological and radiological agents.

Another example of DSTO's engagement with the wider science and innovation community is "Braccetto" (meaning "arm-in-arm" in Italian), the first collaborative agreement to result from the Public ICT Research Roundtable, which draws on the considerable experience of the participants in human interface technology.

Three members of the Roundtable – DSTO, National ICT Australia (NICTA) and the CSIRO ICT Centre – are jointly funding the development of detailed business and project plans, alongside contributions from major Australian universities including the University of South Australia and the University of Sydney as well as ICT Cooperative Research Centres (CRCs). Building on existing work of DSTO, NICTA and the CSIRO ICT Centre,

Braccetto will focus its efforts on developing high level interactive collaboration technologies.

Cooperative Research Centre (CRC) engagement

DSTO has been an active participant in the CRC Programme since it was established in 1990, with the value of DSTO contributions to 19 CRCs totalling over $65 million in cash, staff involvement and access to facilities and equipment. Some of the CRC's with which DSTO has been associated include the CRC for Advanced Composite Systems, the CRC for Sensor Signal and Information Processing, CRC for Polymers and the Enterprise Distributed Systems Technology Centre.

The CRC for Advanced Composite Structures (CRC-ACS) has investigated and developed the use of composite aircraft skin panels to replace standard aluminium panels in an attempt to overcome disbonding and corrosion issues following moisture ingress. Two F-111 skin panels were chosen as initial demonstrators, and a low temperature structural composite material consisting of epoxy resin and carbon fibre was developed to replace the existing aluminium panels. This composite material not only reduces aircraft weights, but also allows the use of a low cost tooling process. CRC-ACS and the Boeing Aerospace Support Centre completed the first installation and testing in June 2004 at Boeing's RAAF Amberley facilities.

Engagement with Universities

DSTO uses Centres of Expertise (COE) for collaborative research in specific areas of technological innovation, establishing formal long-term links with universities to enhance the technology base needed to meet future Defence customer requirements. In addition, COEs provide a mechanism for universities to potentially act as a focal point for technology transfer to industry, where appropriate. In 2005-06 DSTO had seven COEs with universities, encompassing technologies areas of photonics, radar systems, systems integration, aerodynamics and structural mechanics.

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. For example, 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.

DSTO makes a significant contribution to the university sector through funding of research, for example over the 2005-06 financial year DSTO had 121 active research agreements, at a total contract value of over $5 million, with 21 universities.

Scholarships and Fellowships

DSTO contributes to the development of Australia's future science and innovation skills through the funding of a number of scholarships and fellowships. In 2006-07 this funding is expected to exceed $800,000 with over $500,000 being made available in scholarships to students to pursue science and technology studies at both undergraduate and post-graduate

levels, and over $300,000 funding post-doctoral fellows on collaborative projects at various universities.

DSTO is also examining its current policies and procedures associated with the awarding and value of scholarships to better address both the future needs of the organisation as an employer of science and technology skills and to maximise DSTO's contribution to the science and innovation community as a whole.

DSTO's interactions with industry

The net domestic effect of research and development conducted by DSTO is to increase Australia's defence and national security capabilities. In addition to these benefits, the DSTO R&D program also maintains a large volume of critical work within Australia, providing employment and learning opportunities as well as financial support to manufacturing and other industry sectors.

DSTO works in partnership with industry to deliver technology-based solutions to Defence. A variety of mechanisms are used to facilitate interaction and collaboration including the Capability & Technology Demonstrator Program, alliances and collaborative agreements.

Commercial arrangements include the licensing of DSTO's intellectual property and contracts for the purchase of technical support services. In straight expenditure terms, in 2005-06 DSTO spent approximately $60 million on external industry interactions. This represents some 19% of DSTO's total operating budget.

DSTO's collaboration with industry benefits Defence by developing in-country industry capabilities tailored to meet its requirements. Recent examples of successful collaboration include:

- Laser Airborne Depth Sounder
- Nulka Active Missile Decoy
- Starlight
- Surface Wave Radar
- Software verification research
- Advanced landmine detection equipment
- UV missile approach warning technology
- Composite bonded repair technology
- Australian Minesweeping and Support System
- Towed arrays – KARIWARA, SENTRY and FOTASS
- C-130J flaps
- Fiobuoy
- Helicopter Gearbox Diagnosis Technology
- Thermal vest
- Australian raingear
- Biosensors to detect potential biological warfare agents

Industry benefits from exposure to DSTO's research base, access to new technology and defence markets, potential for spin-off products for civilian applications, and income from domestic sales and exports.

Capability and Technology Demonstrator Program

A major program, which demonstrates technological innovation and in turn has lead 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 was expanded in 2005/06, in line with the recommendations of the Trenberth Review (see Benefits from DSTO research), and effectively doubled in value to $26 million per year.

Since its inception the CTD Program has invested more than $160 million in 64 Australian industry technology projects; in June 2006 14 successful projects under Round 10 were announced for progression after 1 July. Applications for Round 11 of the CTD Program are currently being assessed.

An example of a successful CTD project is the Advanced Landmine Detection System, a three-year project that received $3.45 million of CTD funding. The project 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.

Alliances

Industry and Strategic 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.

DSTO has active alliances with IBM Australia, Thales Underwater Systems, SAAB Systems, Nautronix Pty Ltd, Austal Ships Pty Ltd and Boeing Australia.

Advanced Sonar Systems
In 1997, DSTO and the Australian Defence Force entered into an alliance agreement with Thales Underwater Systems (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 Australian Defence Force'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.

Collaborative Arrangements

Collaboration is an effective means for DSTO in leveraging innovative research and development (R&D) and sharing risks and benefits. A particularly successful example of the success of collaborative arrangements has been Starlight, 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 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 Defence and industry, demonstrating that the development of DSTO technology contributes to both capability and national wealth.

Starlight technology development is 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.

Commercialisation of DSTO technologies

DSTO's primary goals for industry interaction and commercialisation of its technologies are to enhance industry capability to serve Defence; and to create national wealth. DSTO's goal is not to generate a licensing income stream 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", DSTO established the Technology Transfer Advisory Group (TTAG) in late 2004. TTAG is composed of representatives from an ASX-listed technology commercialisation company and a Melbourne-based venture capital provider together with senior representatives from DSTO's Business and Commercialisation Office.

TTAG has assisted DSTO by 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's experience with commercialisation suggests that maximizing royalty income is often counter-productive to creating industry capability, including through incubation. Thus, while DSTO has some 71 active licences, only a small number of these licences generate significant income returns for DSTO.

A number of these licenses have generated considerable exports for Australia, for example over $85M of exports created through two DSTO-based technologies AMAS, described below, and Advanced Sonar Systems, see under Alliances (above).

The Australian Minesweeping System (AMAS)
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 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 $4 million. The system is in service with the navies of Australia, Denmark, Indonesia, Japan, Poland, Thailand and the USA.

The 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. It was invented by DSTO to enable faster, more efficient underwater depth mapping than was possible using conventional shipborne sonar methods.

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.

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

Benefits from DSTO research

In June 2003 Robert Trenberth was commissioned to conduct a Review of "DSTO's External Engagement and Contribution to Australia's Wealth". Implementation of the recommendations of the Trenberth review is ongoing and established outcomes include:

- the expansion of the CTD Program to $26 million;
- the creation of a Defence Science Access Network to improve science and technology access to industry, especially SMEs; and

- the establishment of a Technology Transfer Advisory Group (TTAG) to bring industry expertise to bear in assisting DSTO to evaluate and commercialise its Intellectual Property.

In addition, the current renewal and reorganisation of DSTO will support the development of DSTO's capability to deliver cutting-edge R&D projects and to engage more effectively with its major clients and industry.

As part of the Trenberth review ACIL Tasman was commissioned to develop a conceptual framework for determining the broad economic impact in Australia of DSTO's industry engagement and other national wealth creation activities; and to examine a series of case studies that used this framework to illustrate the benefits and costs of such engagement.

ACIL Tasman concluded that, based on the six case studies examined, sufficient value was generated to cover, effectively, all DSTO's budgets since 1990. ACIL Tasman further concluded *"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"*.

DSTO's international collaboration

DSTO maintains close links with defence science organisations around the world in support of its research activities and Defence's wider goals for regional and international engagement. These international networks facilitate information exchange and collaboration, and help Australia to maintain a cost-effective research program at the cutting edge of science and technology.

The Technical Cooperation Program (TTCP) with the UK, USA, Canada and New Zealand is Australia's most valuable collaborative agreement in defence science. It enables Defence to access important technologies, and allows DSTO staff to benchmark their activities. Up to 1200 defence scientists from the member countries undertake nearly 350 cooperative activities under TTCP and DSTO contributes to 60 specialist areas of technology, winning many awards annually for joint research. DSTO scientists have received TTCP awards for their work on aircraft engine life extension, network-centric maritime warfare and chemical/biological defence.

DSTO also maintains separate bilateral agreements with the TTCP member countries as well as France, Sweden, Netherlands and Singapore. Annual steering committee meetings and high-level visits are organised as a part of these bilateral arrangements, providing appropriate oversight of cooperative activities.