So what has the CTD program ever done for us?

…A surprising amount, actually. DSTO is keen to promote the CTD program's achievements in order to develop a stronger program with greater support from ADF users, policy makers and, crucially, innovative defence firms.

DEFENCE, and DSTO in particular, is looking to enhance the value that the Capability & Technology Demonstrator (CTD) program delivers to the ADF. In fact, the program has delivered some significant achievements and one of the challenges is communicating these, according to the Director of the CTD Program Office, Dr Alan Hinge.

The CTD program is funded by the Capability Development Group (CDG) but managed by DSTO. It's designed to fund the development of promising technologies – endorsed by sponsors in CDG – to the point where they can demonstrate potential to become a relevant and worthwhile operational capability.

2011 has been a 'bumper year' for CTD demonstrations, says Hinge with 12 of 13 being successfully demonstrated:

- CTD 2007-7 Ceramic Membrane Oxygen Generator
- CTD 2007-4 Flexible Integrated Energy Device
- CTD 2007-2 Carbon Nanotubes for Ballistic Protection (not demonstrated)
- CTD 2008-4 Haptically Enabled CIED Robotic system
- CTD 2008-4 Elongated Solar Cells
- CTD 2008-3 Incise
- CTD 2008-4 Elongated Solar Cells
- CTD 2008-11 BITES Battlefield Integrated Tactical Exploitation of Sensors
- CTD 2009-6 Monitoring Divers Vital Signs
- CTD 2009-2 Network Centric GIIS
- CTD 2009-4 Infrasonic Advanced Acoustic Generator
- CTD 2009-1 ADF C4I Connector
- CTDEP 2009-5 IR Thermal Threat Warner

All up, this represents the culmination of over $40m investment in Australian industry – with half going to SMEs.

The CTD program has seen some 80 successful CTD demonstrations over the years; 12 are in service, 2 failed CTDs saved over $100m by showing that certain technologies could not deliver capability, and today 15 CTDs have strong prospects for transi-

tion. However, the CTD program isn't funded to develop these technologies beyond the demonstration phase, except for a few supported under the CTD Extension Program (CTD EP). So without strong, ongoing support, many promising projects and technologies could wither on the vine.

The problem lies in the levels of risk associated with new and unproven technology: on the nine-point NASA scale a Technology Readiness Level (TRL) of 9 equates to a technology or product that's in service – essentially a MOTS product. At the completion of the acquisition cycle it will be at TRL 8 (that is, T&E completed); thus when a product or technology is offered in response to a defence RFT it is, or

EP ends in June 2012 with no new funding allocated beyond this time.

A systematic, funded program would appear to be required to bridge the transition gap and ensure that the ADF derives the full benefit of the R&D conducted under the CTD program.

This might take selected, successful CTDs through an Intermediate step to a TRL of around 5-6, followed if they are still successful by a Transition step to TRL 7-8. The Intermediate and Transition steps, between them, would probably require additional funding over and above the $13 million currently spent on the CTD program.

Such a 'Preparation for Transition' path could provide a development, project man-

> "A systematic funded program would appear to be required to bridge the transition gap and ensure that the ADF derives the full benefit of the R&D conducted under the CTD program."

should be, around TRL 7 – a prototype in operational environment.

But the new technology in most CTD projects generally lies between TRLs 2 and 4 – concept formulation, proof of concept or, at best, a component validated in a laboratory. At completion the technology may have climbed to between TRLs 3 and, possibly, 6 with a prototype demonstration in an operational environment.

That still leaves a big development (and funding) gap – the traditional 'valley of death', where CTDs either stall or fall over the edge. DSTO's Alan Hinge told *ADM* the CTD Extension Program (EP) aims to reach part-way across that gap by bringing a few selected CTDs up to or close to TRL 7, where an Endorsed Requirement exists within CDG.

The Sentient case study below describes how this can produce spectacular results. But as previously noted in *ADM*, the CTD

agement and governance environment which enables a promising technology to be developed to the point where it is a genuine TRL 7/8 contender in a Defence RFT.

There are concrete examples to support this argument: along with Sentient Vision Systems' moving target detection system (see below) three transition projects, all based on recent CTDs, are in the pipeline for DCP projects: SATCOM On The Move (SOTM) being developed by Brisbane firm EM Solutions; Broadband Sonar Advanced Processing System (BSAPS) with Thales Australia (UW Systems); and Autonomous Underwater Surveillance Network (AUSS-NET) with L3 Nautronix.

After many years of racking up successful CTD demonstrations, Dr Hinge has a list of 15 other candidate projects – all of them successful CTDs – which, if developed successfully, could make a direct and worthwhile contribution to ADF operational capability.

However, Hinge, a former naval officer and Director of Joint Systems in Defence's Investment Analysis Branch (responsible for DCP management), was careful to emphasise to *ADM* that while Government is and has been a very strong supporter of the CTD program for many years, not all good ideas or good programs can be ideally funded, adding that CTDs are essentially 'venture capital' projects and, as such, are at the lower end of the DCP priority list, and rightly so.

The CTD program has delivered other benefits, says Hinge: the collaborative environment it fosters has provided a catalyst for innovation amongst defence SMEs and has increased their exposure within the defence industry, both locally and overseas. Furthermore, alignment through the program to the multi-national prime contractors and their Global Supply Chains helps strengthen their commitment to Australia and to local investment and jobs, which in turn supports the intent of the Defence Industry Policy.

> "The CTD program has proven an effective vehicle for fostering the development of priority defence capabilities through local industry."

Additionally, the availability of CTD-developed leading edge technology supports Defence's contribution to collaborative technology sharing programs with the US and other coalition partners. With credible, even world-leading technology, to hand Australian program managers can demonstrate to the US that Australia has something unique to offer.

Overall, says Hinge, the CTD program has proven an effective vehicle for fostering development of priority defence capabilities through local industry, and in particular SMEs. The collaborative environment, support and access to expertise provided by the CTD Program Office has been vital in enabling companies like Sentient to bring their technology and products to market and helped position Sentient (as one example) to achieve success both locally and in export markets with its world-leading automated target detection technology.

CASE STUDY: Moving targets

MELBOURNE-BASED SME Sentient Vision Systems is an example of an SME that has benefited from the CTD Program and in return has successfully commercialised the capability that it demonstrated for front line use with the ADF and coalition forces.

Sentient develops computer vision and artificial intelligence software for defence and civilian applications. Since 1999, the company has specialised in imagery analysis, building practical software solutions that automatically detect and track moving objects.

In October 2006, under Round 13, Defence selected Sentient's CTD proposal to develop and demonstrate a high-definition, real-time Video Motion Target Indication (VMTI) system running on a PC that would locate and track small moving ground targets from the air.

Sentient had developed a spatially-aware computer-vision analysis technology that could detect movement; however, there were a number of practical limitations that required further development to overcome.

The original technology assumed the surface that was viewed was flat, without major obstacles such as trees and buildings. And it wasn't possible to process large images in real time, according to Dr Paul Boxer, co-founder and Managing Director of Sentient.

The CTD project enabled Sentient to continue developing its core technology, addressing the original limitations and ensuring the resultant technology could meet the requirements of the ADF. This later evolved into a successful commercial product called Kestrel.

DSTO provided critical support by linking Sentient to potential users within Defence and to partner companies, connections that for a SME would have been much harder to make otherwise. Working together with the CTD Program Office (CTDPO), 'Target Performance Measures' were then developed for the demonstrator ensuring realistic and practical goals.

"This was an excellent way to create a demonstration of leading edge technology and build in some challenging stretches, without committing to requirements that may be impossible to achieve," according to Dr Boxer.

CTDPO / DSTO linkages also helped Sentient to build a unique library of representative real-time imagery, including in-theatre footage, that enabled comprehensive testing and refinement of the technology.

Without Kestrel With Kestrel

In 2008, 16 months into the CTD program, Kestrel was tested by the RAAF's 92 Wing on an AP-3C Orion. Despite the immaturity of the software, it performed well enough to progress to operational flight testing in the Middle East with the Maritime Patrol Group. This evaluation in operational conditions showed Kestrel to be very useful on surveillance mission by providing additional situational awareness.

From the CTD project, Sentient Vision Systems developed Kestrel, a fast and accurate technology that can process up to 5 mega pixel imagery in real time and find targets that even humans can't see.

CTD Extension Program (2009 - 2011)

Following the success of the Kestrel demonstration, Sentient was awarded a CTD Extension Program (EP) contract in early 2009. This supported further development of the technology into a deployable solution and added new user requirements to extend detection to surveillance in the maritime environment, and to support enhanced on-board autonomous air vehicle systems.

(PHOTO: VIA CTD PROGRAM OFFICE)
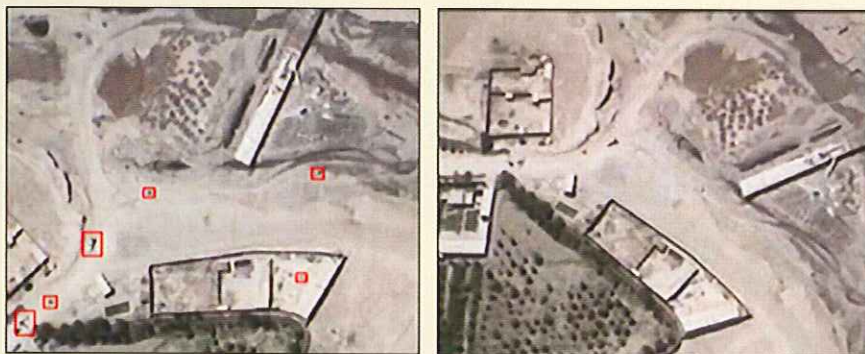
Sentient's moving target identification technology was tested in Afghanistan, rather than a laboratory, and found to be very effective.

> "DSTO specialists provided critical insights to Sentient on the needs and requirements of the services that would use the technology.

The EP recognised that you could take demonstrable technology at a low TRLand transition it briskly towards service entry.

"The EP award was a key step for Sentient," said Dr Boxer. "It gave us the confidence and funding to continue development. Without this support it is unlikely we would have got Kestrel to the high TRL it is at today and hence into a leading product."

DSTO specialists provided critical insights to Sentient on the needs and requirements of the services that would use the technology. The CTDPO and other DSTO groups also saw the opportunity to drive future international technical standards through submitting the data formats developed for Kestrel to NATO's STANAG (Standardization Agreement) group for VMTI processes.

As the EP progressed, further evaluations took place with defence users on a wide range of UAVs and manned air platforms including AAI Shadow, Insitu ScanEagle, AV Wasp and Raven. This led to deployment of Kestrel with the RAAF's Heron UAVs in Afghanistan where the value of its automated VMTI capability has been strongly endorsed by the operators.

Automated detection of maritime targets proved to be equally challenging given the significant issues presented by whitecaps, sea states and lighting conditions. Again, the CTDPO and DSTO domain experts were able to guide the Sentient team as requirements were refined and invaluable access was given to real-time maritime surveillance imagery enabling a comprehensive library to be built up for testing.

Kestrel Maritime was evaluated by Defence through 2010 and in 2011 was enhanced with automated Life Jacket detection – the ability to detect small, high visibility objects within wide maritime surveillance areas, a capability with significant search and rescue benefits.

Exports!

DSTO's, and the CTDPO's, connections helped Sentient spark some interest among coalition partners, in particular the US. In 2010, DSTO helped Sentient execute a Data Exchange Agreement with the US DoD enabling the US Army, the largest UAV user in the world, to evaluate and successfully demonstrate Kestrel. This access to US Defence would have been impossible for Sentient to achieve without the backing of DSTO and the CTD program.

Sentient's positive experience and the benefits it received from the initial CTD project encouraged it, in 2009, to apply successfully for a further CTD project to demonstrate a close-in situational awareness system for ground vehicles. This aims to detect and highlight potential threats from vehicles and personnel providing ground forces with enhanced intelligence and situational awareness.

Through collaboration with other Australian SMEs, including UAV Vision, OccularRobotics and Cybertech, connections that CTDPO and DSTO scientists helped to establish, Sentient has been able to exploit state-of-the-art technology to refine and test its software.

Thanks in large part to the CTD program, Sentient has successfully established a commercial Computer Vision development capability within Australia which has demonstrated and produced world-leading technology that has already been adopted by Defence. The products from this development are on the threshold of producing strong domestic and export revenues, creating strong economic and reputation benefits for both Sentient and the Australian defence industry.

This success story is one of several examples of the benefits to the ADF and Australia of a properly managed CTD Intermediate and Transition Pathway says CTD Program Director Dr Alan Hinge. He told *ADM* he looks forward to continued growth of the CTD program and more success stories from this vital Defence / Industry partnership.

Sentient's technology is now being developed to identify life-jacket size targets in a cluttered seascape.

(PHOTO: VIA CTD PROGRAM OFFICE)