CREATING FUTURE CAPABILITY

2013 DMTC ANNUAL REPORT

DMTC DEFENCE MATERIALS TECHNOLOGY CENTRE

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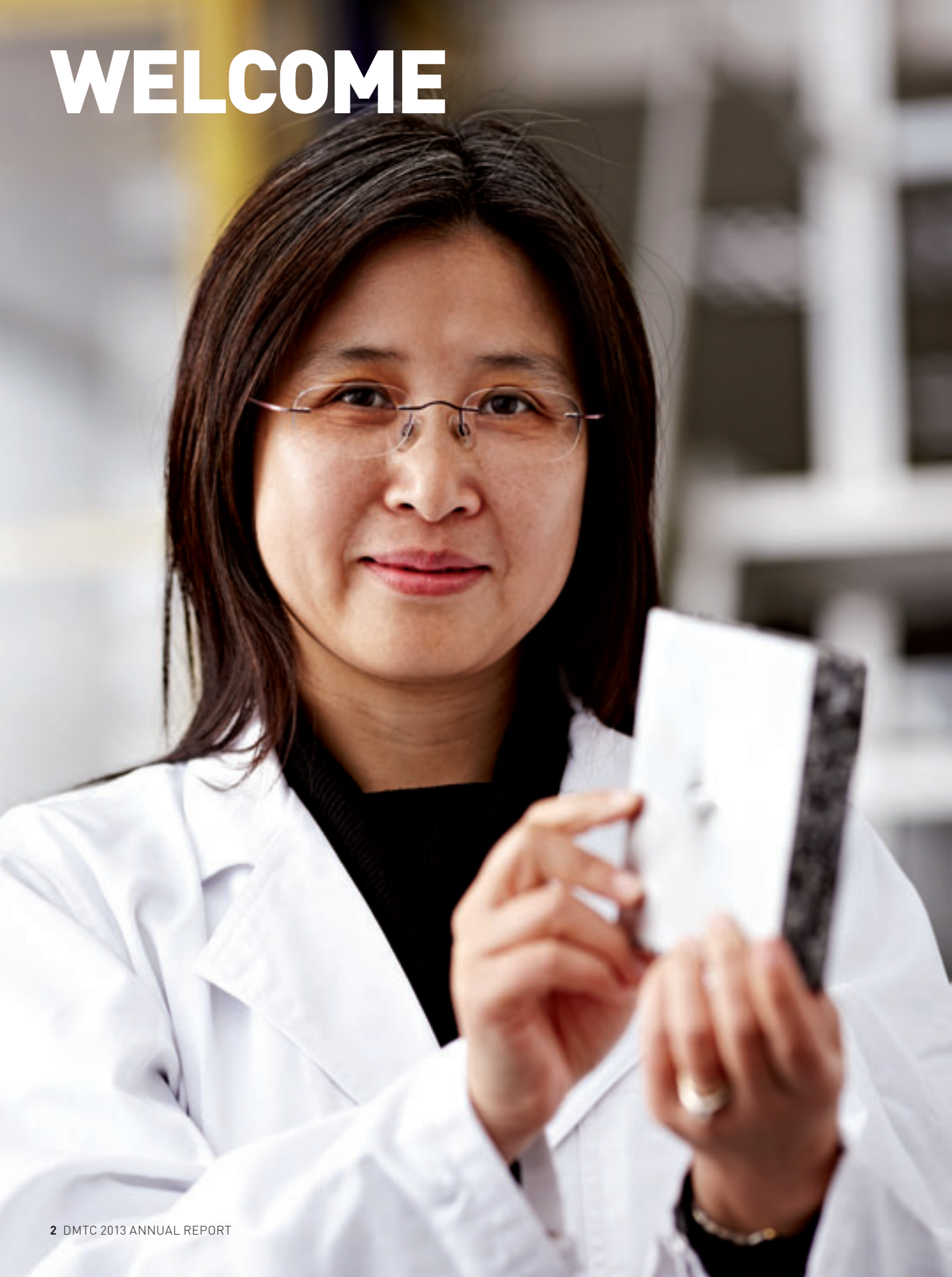
DMTC was established and is supported under the Australian Government's Defence Future Capability Technology Centre Program.
Design and art direction by BTP.

The Defence Materials Technology Centre drives the creation of Australian industry capability in advanced manufacturing, materials and associated technologies by leading collaborative research and commercialisation activities for Defence applications.

WELCOME



Welcome to the Defence Materials Technology Centre (DMTC) 2013 Annual Report. In its first five years DMTC has directly involved 680 people in projects, commenced a new $21 million program in addition to current programs and became a recognised leader of defence technology development and dissemination in Australia. Our project teams and relationships are mature, and much of the work undertaken through our programs is now progressing towards industry utilisation.

Our objectives are to:

- **decrease development time to capability impact** (for Defence and defence industry);
- **reduce costs** to Defence for new capability through a collaborative, risk sharing model that reduces development costs to Defence by approximately 60%;
- provide a vehicle for maintaining **access to intellectual property** for Defence;
- provide a link between industry **technical capability** and the Australian Defence Force (ADF);
- support a more **competitive and productive** Australian defence industry;
- create stronger and more **integrated supply chains**;
- foster **enduring collaborative relationships** between SMEs, major manufacturers, research organisations, industry bodies and Defence; and
- act to ensure diffusion of knowledge from Australia's research sector into the defence industry by **providing solutions** to problems faced by the ADF.

DMTC is an important enabler for the creation of the knowledge and capabilities required to secure a future for the Australian defence sector.

← Dr (Tracy) Dong Ruan is a Senior Lecturer at Swinburne University of Technology. She has contributed to several DMTC projects.

HIGHLIGHTS

680
PEOPLE
DIRECTLY INVOLVED
IN DMTC ACTIVITIES

5
PROGRAMS
ACROSS AIR,
LAND & SEA
DOMAINS

PROVEN COLLABORATIVE MODEL

32
PARTICIPANTS WORKING
TOGETHER FOR A MORE
SECURE FUTURE

34 ACTIVE PROJECTS

DELIVERING NEW TECHNOLOGIES & MANUFACTURING PROCESSES

$18.7M

ANNUAL EXPENDITURE ON IMPROVING THE CAPABILITIES OF AUSTRALIA'S DEFENCE SECTOR

$9.5M

ANNUAL IN-KIND CONTRIBUTIONS DIRECTED TO ENHANCING CAPABILITIES

Image of cutting tool tips manufactured at Sutton Tools, Australia

CHAIR'S REPORT

TONY QUICK, CHAIR

It has been a critical year for the Defence Materials Technology Centre. We are now five of seven years in to our original contract with the Commonwealth and a year and a half in to our newest program, Personnel Survivability. The Centre has proven itself by ensuring the continued on time delivery of technical milestones and this has enabled positive progress toward securing new funding and program opportunities for the Centre.

In a budget constrained and politically uncertain environment, the DMTC model stands out as a cost effective and efficient technology development solution for all of our stakeholder groups — Defence, industry and the research sector. Over the next few years we will be looking to complete our transition to becoming an enduring organisation with a rolling program of activity. As part of this we will look to expand the technical capabilities of the Centre by seeking new industry participants and greater research sector involvement.

DMTC has sought close engagement with DMO on the upcoming challenges facing the Australian Defence Force in sustaining its existing equipment and procuring significant new platforms. We firmly believe that for DMTC to be considered a success the technical outcomes must have a benefit for the Australian Defence Force and therefore must be of commercial value to our Australian industry participants.

I must acknowledge the outstanding and ongoing commitment from DMTC's industry and research sector participants, without them DMTC would not exist. Thank you to the enduring efforts of my fellow Directors and the management team who have tirelessly stayed the course in pursuing a future for this valuable Australian organisation.

CEO'S REPORT

MARK HODGE, CEO

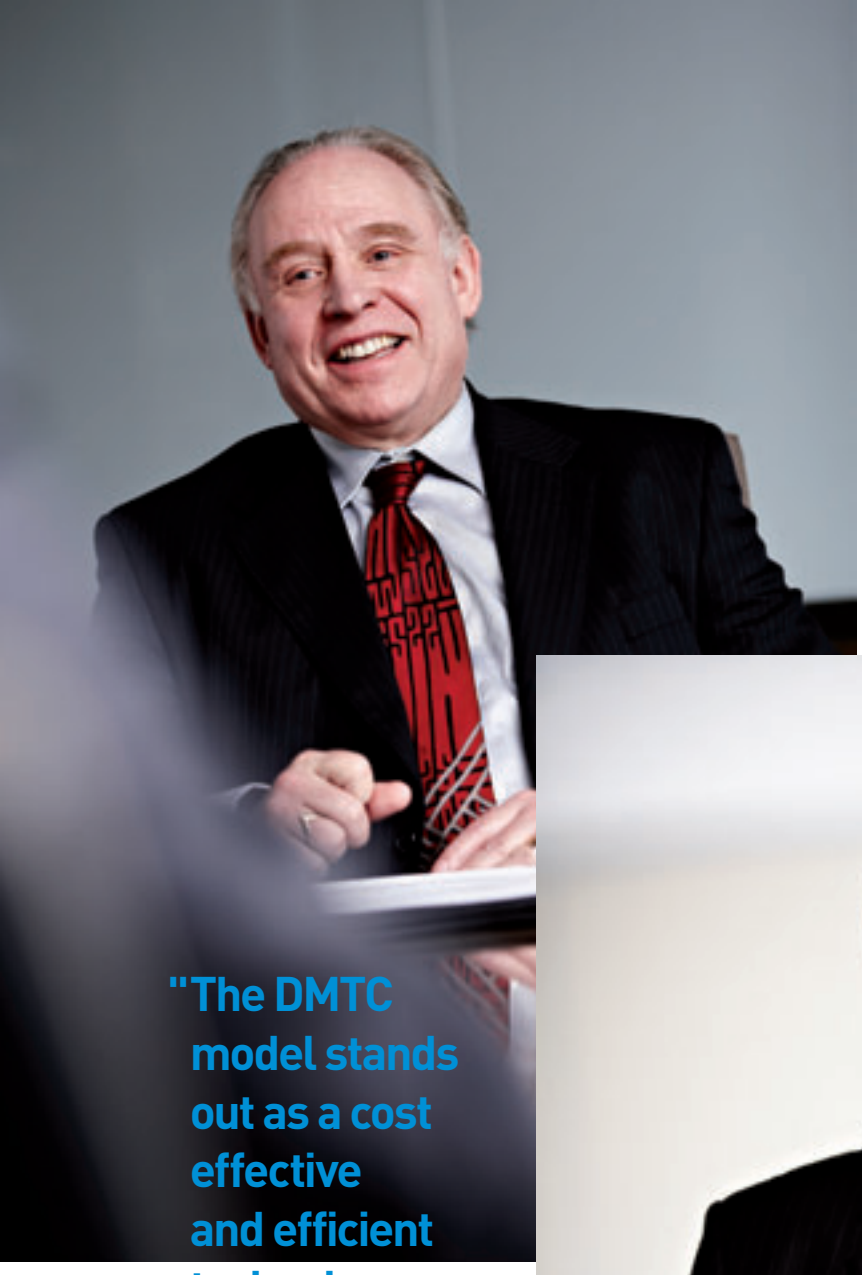
Achieving defence capability outcomes doesn't come without hard work and commitment from a diverse team of people. This year the DMTC community has once again delivered remarkable outcomes and excellence in research, technology and capability improvements. We have now completed five of our originally contracted projects and commenced 10 new projects which increase the technical breadth of the DMTC network and address strategically important challenges facing the defence industry. Since commencing activities in 2008, DMTC has involved 680 people in the development of new defence sector capabilities and delivered 117 technical milestones.

The past year has been a critical one for DMTC in terms of the medium term future of the organisation. Defence has actively engaged with us to evaluate and assess DMTC's performance and business model in the context of potential future program requirements. We have continued to receive endorsement of our strategic plan and have commenced formal discussions with Defence on appropriate mechanisms of future engagement. In this regard, the interactions with Defence and our industry and research sector partners have been most encouraging and indicate that the future for DMTC is bright indeed.

The maturation of much of our research this year has seen a number of our project teams and affiliated researchers recognised nationally and internationally for their work. It is a great tribute to the quality and excellence of Australian research in the defence sector and further evidence towards the case for continued support of these activities.

DMTC has a first-class management team dedicated to efficient and effective Centre operations and the continued delivery of outstanding capability outcomes underpinned by excellence in research, delivered through our industry partners.

I have great pleasure in presenting DMTC's 2013 Annual Report Highlights.



"The DMTC model stands out as a cost effective and efficient technology development solution for all of our stakeholder groups"

TONY QUICK, CHAIR

"DMTC has involved 680 people in the development of new defence sector capabilities and delivered 117 technical milestones"

MARK HODGE, CEO

OUR ORGANISATION

DMTC has established itself as a leader of defence industry capability development, technology creation and supply chain growth within Australia's manufacturing sector. The DMTC model provides an efficient approach to achieving sustainable defence industry capability improvement with measurable economic and strategic benefits to industry and Defence.

DMTC's primary business is the management of technology development programs in agreed areas of Defence priority, achieved by bringing together Australia's best research expertise and industry partners. The strategic intent of DMTC, embodied in the organisation's "capability through collaboration" statement is a central part of the DMTC model and culture, driving the cost effectiveness of the research and uptake of the outcomes. To ensure the maximum diffusion of capabilities, DMTC also provides a number of core operation and industry development programs.

For a DMTC project to deliver the most impact to Australia, we seek out projects which have the following elements:

DEFENCE
PRIORITIES & TIMINGS

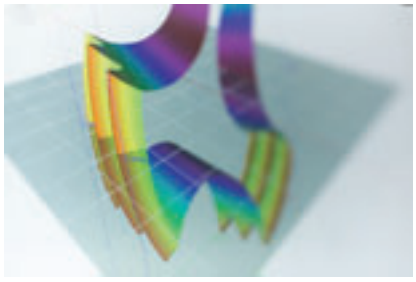
INDUSTRY
CAPABILITY & CAPACITY

RESEARCH
CREDIBILITY, EXPERIENCE & EXPERTISE

DMTC PROGRAM

OTHER ELEMENTS

- Balance between financial, capability and national security impacts
- Appropriate balance between 'R' and 'D'
- Directly aligned or a natural progression of experitise from materials, manufacturing and related themes
- Appropriate balance in contributions:
  - Cash & in-kind
  - Defence & non-Defence funds



DMTC's research programs emphasise improved productivity through optimisation of manufacturing and production processes. To complement this, DMTC provides a number of additional services. DMTC's technical and productivity **benchmarking** activities are tailored towards Australian companies and enable industry to understand the competitiveness of their capability. It also encourages companies to work together to provide complete solutions to the customer, rather than competing on a domestic level. Benchmarking activities have already resulted in productivity gains across all participating organisations. One such example has resulted in four collaborating companies halving their average machining times for a typical aircraft component.

It is also well recognised that engaging **SMEs** in domestic and global supply chains can improve the chances of a consistent flow of work. The DMTC model actively identifies supply chain opportunities within each project and engages with new organisations that have the potential to further strengthen those supply chains. This approach supports the growth and strengthening of Australian SMEs through:

→ transfer of new technology to industry;
→ increasing supply chain opportunities,
→ increasing awareness of defence priorities; and
→ providing low cost access to R&D.

DMTC'S MISSION

DMTC will lead, facilitate and manage cooperative research in the defence sector in materials, manufacturing and related themes with the Defence customer, industry and research sector as key stakeholders.

DMTC'S VISION

To provide technology solutions enabling industry to enhance Australian Defence capability.

DMTC'S STRATEGIC INTENT

Capability through Collaboration.

A PROVEN CAPABILITY PARTNER

DMTC performance is reviewed on a regular basis. This year, two independent reviews were carried out which included analysis of DMTC alongside other defence industry programs.

Review by the Defence Industry Innovation Board

The Defence Industry Innovation Board conducted a review of all Defence Materiel Organisation (DMO) supported defence industry assistance programs in Australia. Recommendations from the review included:

- → *future annual funding for DMTC ...be maintained at levels at least equal to those applying in recent years*; and
- → *Defence actively explore opportunities to expand the scope of the related Defence Future Capability Technology Centre Program.*

Review by the Defence Science and Technology Organisation

The Defence Science and Technology Organisation (DSTO) commissioned its own independent review of DMTC and found that overall DMTC is meeting its objectives of providing Australia with important defence capabilities.

"The Defence Industry Innovation Board's review of Defence industry programs has recommended that the DMTC model be maintained and expanded, and that Defence explores opportunities to utilise the DMTC collaborative model by diversifying into an expanded portfolio of activity"

DAVID MORTIMER, AO, CHAIR – DEFENCE INDUSTRY INNOVATION BOARD

"As the nation's lead defence science and technology agency, DSTO plays an important role in safeguarding Australia by delivering valued scientific advice and innovative technology solutions for Defence. DMTC is a key collaborative partner for DSTO, enabling us to expand our partnerships through its extensive networks and leverage additional expertise from across the Australian research sector. DMTC's IP model and supply chain development activities also provide DSTO with an effective way of achieving greater commercial uptake of new technical developments."

ALEX ZELINSKY, CHIEF DEFENCE SCIENTIST, CEO – DSTO

AWARDS 2012–2013

As the technology developed through DMTC programs has continued to mature, DMTC and our Participants have gained increasing recognition. This year DMTC and our participants received the following awards:

AWARD	RECIPIENT
Thales Daryl Page Award	Lean Automation Technology for Advanced Manufacturing of Armoured Vehicles (Project 3.5)
Aluminium Surface Science and Technology conference 2012, Italy – Best Industrial Poster Presentation	Simon Jacob, BAE Systems
JEC Innovation Award - Defence Category	High Curvature Armour Systems (Project 7.1.2)
Shortlisted – CRC Association Awards for Excellence in Innovation	Lean Automation Technology for Advanced Manufacturing of Armoured Vehicles (Project 3.5)

The DMTC Annual Conference 2013

The DMTC Annual Conference was held on the 19th and 20th of March at the Shine Dome in Canberra. This was the first time the conference was held in Canberra and it proved a great success. The new format incorporated a combination of technical presentations, panel discussions and guest speakers from industry and Defence. Guest speakers included: Dr Alex Zelinsky, *Chief Defence Scientist DSTO*; Mr Andrew Cawley, *Program Manager AWD and Head Australian Shipbuilding Industry Planning DMO, MAJGEN;* Jeff Sengelman, *Head Modernisation and Strategic Planning – Army*; Senator The Hon David Johnston, *Shadow Minister for Defence and AIRCDRE*; Cath Roberts, *Director General New Air Combat Capability*.

The DMTC Annual Conference also hosted the Annual DMTC Awards for Excellence. The recipients of the four awards were:

- **Industry Partnership Award**
  Nathan Larkin and Zengxi Pan, University of Wollongong
- **Research Collaboration Award**
  Michael Ling, DSTO
- **Early Career Award**
  Lenka Kuzmikova, University of Wollongong
- **Capability Improvement Award**
  Project 7.1.2 – High Curvature Armour Systems

CORE PARTICIPANTS

Vital to DMTC success is the active and full engagement of our research and industry participants. By working together in our collaborative environment our participants all receive far greater technology and performance gains in less time and with less cost than by pursuing R&D activities independently.

DMTC's collaborative model:

- → fosters enduring cooperative relationships between major manufacturers, SMEs, research organisations, industry bodies and Defence;
- → features an IP model focused on rapid, royalty free transfer to participant organisations;
- → simplifies the formalisation of collaboration with standardised agreements; and
- → ensures all participants receive outcomes which are greater than that of each participant acting independently.

SUPPORTING PARTICIPANTS

FUTURE DIRECTIONS

DMTC is now fully engaged in developing new program opportunities and securing the ongoing operations of the Centre. At the 2012 Annual General Meeting the Members unanimously supported the DMTC Strategic Plan which outlines the vision for an enduring Centre with a new funding structure and rolling pipeline of program opportunities. The programs being considered are in line with Defence acquisition and sustainment requirements. Industry's capacity to utilise R&D outcomes are also being considered, as is the expertise within the Australian research sector to work on planned projects.

A considerable number of new projects have commenced which build on technologies and knowledge already developed within DMTC's programs. We continue to review opportunities for the further development, dispersion and utilisation of project outcomes and see this as a way of supporting the overall growth of knowledge and capability within the Australian defence sector.

Image of steel casting at BlueScope steelworks, Port Kembla

PROGRAMS

DMTC currently operates five technology development programs across the air, land and sea domains. DMTC projects are primarily focused on materials, manufacturing processes and associated technologies. Technology areas that DMTC has existing expertise in include:

- new manufacturing technologies such as additive manufacturing and thermally managed machining;
- performance modelling, simulation and validation of manufacturing processes and components;
- design, production and joining of new materials including composites and ferritics;
- titanium component repair and fabrication technologies;
- robotics and automation technologies;
- prognostics and defect detection capabilities;
- repair and life extension technologies;
- weight reduction, design integration and lightweight materials;
- advanced ceramics and coatings; and
- smart textiles and fabric technologies.

PROGRAM 1
AIR PLATFORMS
PROGRAM 4
PROPULSION SYSTEMS
PROGRAM 3
ARMOUR APPLICATIONS
PROGRAM 7
PERSONNEL
SURVIVABILITY
PROGRAM 2
MARITIME
PLATFORMS

AIR

Improving aircraft sustainment practices and supporting niche aircraft component manufacturing capabilities

DR MATT DARGUSCH
PROPULSION SYSTEMS
PROGRAM LEADER

DR SURESH PALANISAMY
AIR PLATFORMS
PROGRAM LEADER

COMPLETED PROJECTS

THERMAL & COOLANT MANAGEMENT
1.1.2.B EXTENDED TITANIUM BENCHMARKING

CORROSION
1.6.1 DISTRIBUTED FIBRE OPTIC PAINT DEGRADATION SENSOR

HEAT TREATMENT
1.8 DEVELOPMENT OF HEAT TREATMENT CAPABILITY FOR BETA TITANIUM ALLOYS

ADVANCED MANUFACTURING
1.4 LASER DIRECT MANUFACTURING OF SMALL SCALE HIGH VALUE JSF TYPE COMPONENTS

NON-DESTRUCTIVE TESTING
1.7 RAPID AND RELIABLE DETECTION AND ANALYSIS OF COMPOSITE DEFECTS

PROJECTS IN PROGRESS

NUMBER	TITLE	TECHNOLOGY
1.1.1a	Development of new titanium fabrication technology	Machining
1.1.1b	Next generation tooling development	Cutting Tools
1.1.2	Advanced process monitoring tools and transfer to manufacturing supply chain	Process Monitoring
1.3	Evaluation of Titanium Direct/Additive Manufacturing and Robotic Machining	Advanced Manufacturing
1.6	Aircraft prognostic tools to reduce corrosion impacts	Health Monitoring
1.6.2	Cost of ADF Aircraft Corrosion	Corrosion
1.9	Evaluation of Different Additive Manufacturing and Machining	Advanced Manufacturing
4.1	Repair Technologies for Current and Next Generation Aircraft Systems	Repair
4.2	High Temperature Materials for Hyper and Supersonic Flight	Advanced Materials

AIR CASE STUDY

SUTTON TOOLS MAINTAINS CUTTING EDGE TOOL PRODUCTION

Sutton Tools aims to remain a world class manufacturer of cutting tools for multiple industrial sectors, including local and global aerospace and defence markets. Sutton Tools began its partnership with DMTC in 2008 to be involved in cost effective R&D programs and access a broad range of Australian research knowledge.

DMTC has worked with Sutton Tools to establish the Advanced Surface Solutions Facility (ASSF). The ASSF gives DMTC participants access to a unique Plasma Vapour Deposition (PVD) coating capability and equipment enabling the design, manufacture and testing of new cutting tools. The ASSF has been the centre point for the examination of the behaviour between coatings and the cutting tool and the development of new advanced coatings.

PVD coating research has concentrated on increasing knowledge in advanced coatings, the development of new nitride, oxide and oxy-nitride based coatings and on the duplex treatment of high speed steel through combining the diffusion process and PVD process in one chamber.

Research into cutting tool design has been focused on the impact of “micro design” on cutting tool performance. It has been shown that a microscopic change in the cutting edge radius from 5µm to 15µm can have a combined tool life and productivity increase of 50% or more. Similarly, a change in surface roughness on a cutting tool flute from 0.3Ra to 0.2Ra can mean the difference between the tool failing prematurely by fracture or failing in a predictable way through wear out.

Additional research has led to the development of robust and sensitive test methodologies, including statistical data analysis techniques. The enhanced testing and verification methodologies have greatly complemented further air domain research within the DMTC.

DMTC’s research collaboration with Sutton Tools has resulted in the development of new cutting tools and increased sales opportunities for the company including local and international markets. Sutton Tools has now produced titanium alloy application cutters and taps which are being used by a number of industry partners. The increased communication of the technical advances being achieved at Sutton Tools has also increased brand awareness and collaboration opportunities through greater access to technical information by research partners and customers. Sutton Tools’ reground cutters (including reground competitor cutters) for titanium applications have also been found to perform as well as, or better than, the current competitor tools at an Australian customer’s facility. This is due to the application of coatings and techniques developed through DMTC facilitated research projects.

"Being part of the DMTC community has assisted Sutton Tools to remain at the forefront of cutting tool manufacture and continue to be a truly innovative Australian company"

PETER SUTTON, CHIEF MANUFACTURING EXECUTIVE, SUTTON TOOLS

AIR CASE STUDY

BAE USES LATEST TITANIUM MACHINING CAPABILITIES TO MANUFACTURE JSF COMPONENTS

Over the next two decades BAE Systems Australia will provide titanium parts for the Joint Strike Fighter program. DMTC has been working with BAE for a number of years to develop and optimise machining and finishing strategies for titanium component production, ensuring they remain at the forefront of titanium machining capability.

Research has examined methods for improving both the roughing and finishing stages of the machining process. One of the critical factors in machining is the application of appropriate coolant technology. The team used Seco Tools facilities to benchmark high pressure coolant (HPC) against flood coolant and explored the productivity gains associated with HPC technology when milling and drilling deep pocketed titanium components. Using conventional end mill and insert cutter tooling, the application of HPC suppressed the rate of tool wear and permitted higher material removal rates. Using end mill tooling, the cutting speed could be increased by up to 20% when using HPC without sacrificing tool life. In drilling, substantial improvements in productivity and tool life were achieved with HPC, significantly reducing drilling cycle times. The use of HPC can potentially reduce the net cycle time to manufacture components due to a combination of fewer required tool changes and the ability to increase material removal rates without sacrificing tool life. A preliminary financial analysis of the manufacturing data has shown that the use of HPC has the potential to significantly reduce component manufacturing costs.

Further research has focused on the causes of ‘chatter’ between the work piece and the cutting tool. The frequency response function obtained through model impact testing determined the overall rigidity of the system, as well the resonant properties such as natural frequency, stiffness and damping. Using this information, a part specific damping system was designed and applied at the component fixture points. The resulting system has been designed for easy installation and has improved part quality and effectively removed the need for re-machining due to chatter.

By reviewing the entire machining process it has been possible to make a number of incremental improvements to BAE’s JSF titanium machining processes. DMTC will continue to work with BAE on further refinements to its roughing and finishing processes over the coming years.

"The DMTC team has developed a number of tools which have assisted our CAM programmers and machine operators in producing high quality titanium components."

STUART LINDLEY, MANAGER – ADVANCED MANUFACTURING BUSINESS STREAM, BAE SYSTEMS AUSTRALIA

AIR HIGHLIGHTS

CORROSION PROGNOSTIC TOOLS

New methods for reducing the frequency and extent of corrosion inspections are being investigated. One approach used by the ADF to reduce airframe corrosion is to routinely apply Corrosion Inhibiting Compounds (CICs) on susceptible areas of the airframe. DMTC researchers are conducting chamber tests and developing a model to predict the performance of various CICs in different environments and surface orientations with the aim of optimising operational CIC application rates. DMTC is also supporting an additional study to determine the annual cost of aircraft corrosion to the ADF, based on published US corrosion studies and detailed analysis of BAE Systems maintenance activities.

UP-SCALED TITANIUM CHIPS RECYCLING PROCESS

Ti-6Al-4V machining chips have been successfully recycled by using a solid-state, severe plastic deformation process. The technology has attracted significant commercial interest from metal recycler RTI International and end-user Alcoa Fastening Systems. Laboratory sized recycling trials utilising titanium machining chips from RTI International has proven the process to be effective. The research team is now looking at the feasibility of up-scaling the process to provide a commercially viable solution for recycling titanium for the aerospace and marine sectors.

ROBOTIC GTAW DIRECT MANUFACTURING

Robotically-controlled Gas Tungsten Arc-Wire (GTAW) direct manufacturing is being investigated as a low cost and highly flexible additive manufacturing process for the production of titanium alloy components. The GTAW process produces smooth, clean and full-density deposits with excellent arc stability. The deposited weld metal can then be machined using conventional CNC equipment and standard carbide tooling to produce a smooth surface finish. A cost comparison of GTAW versus traditional CNC billet machining indicates that GTAW could potentially achieve a cost reduction of over 50%.

For more of our air domain achievements and highlights, visit www.dmtc.com.au

TECHNOLOGIES

- → Thermal and Coolant Management
- → Advanced Manufacturing
- → Corrosion
- → Health Monitoring
- → Non-destructive Testing
- → Heat Treatment
- → Machining
- → Cutting Tools
- → Process Monitoring
- → Repair

AIRCRAFT COMPONENTS CREATED USING SELECTIVE LASER MELTING

Selective Laser Melting (SLM) is an additive manufacturing technique that creates components by laser melting raw metal powders together layer by layer. DMTC is investigating the application of this technology for the manufacture of small scale JSF type components. Samples have been examined to determine the microstructure, tensile and fatigue properties resulting from this manufacturing process. A thorough understanding of the relationship between the manufacturing process and resulting material properties has been gained and now optimisation strategies to improve the efficiency of the SLM process are being investigated. If the process is developed sufficiently, potential benefits will include dramatic savings in time, materials, energy and labour.

FIBRE OPTIC EMBEDDED PAINT SENSORS

A Profluorescent Nitroxide (PFN) molecule has been developed to monitor the integrity of aircraft paint coatings. The molecule fluoresces when exposed to free-radicals produced during coating degradation, thereby indicating the health of the protective paint barrier. The PFN is also able to trap the free radicals responsible for the degradation and stabilise against further damage. Additional work has created a distributed fibre-optic system to sense the PFN fluorescence from multiple internal bays, thereby reducing the need for costly airframe disassembly and paint inspection.

LASER CLADDING TECHNIQUE

A new heat treatment has been developed to relax residual stresses introduced during the laser cladding of Ti-6Al-4V. Research has shown that by applying a heat treatment to a laser clad component the residual stresses created at the clad substrate interface can be removed. Analysis of heat treated specimens showed a reduction in inter-granular stresses and a growth in β phase, resulting in an overall reduction in residual stresses. This research work increases the feasibility of using laser cladding as a repair technique for aircraft components.

LAND

Enhancing the protection of diggers for mounted and dismounted operations

JAMES SANDLIN
ARMOUR APPLICATIONS
PROGRAM LEADER

DEEPAK GANGA
PERSONNEL SURVIVABILITY
PROGRAM LEADER

COMPLETED PROJECTS

NEW FERRITIC MATERIALS & JOINING TECHNIQUES
3.1 EVOLUTION OF ARMOUR REQUIREMENTS AND DEVELOPMENT OF IMPROVED SYSTEMS AND MANUFACTURING TECHNIQUES

NICHE MANUFACTURING PROCESSES
3.6 DEVELOPMENT AND COMMERCIALISATION OF CERAMIC PROTECTIVE EQUIPMENT

NICHE MANUFACTURING PROCESSES, PERFORMANCE MODELLING, SIMULATION & VALIDATION
3.3 ADVANCED PERSONNEL ARMOUR

COMPOSITE MATERIALS, NICHE MANUFACTURING PROCESSES
3.7 RESEARCH, DEVELOPMENT, DESIGN AND MANUFACTURE OF A NEW COMBAT HELMET

PROJECTS IN PROGRESS

NUMBER	TITLE	TECHNOLOGY
3.1c	Lower Pre-Heat Welding Technique for Armour Steels	Automated Manufacturing
3.2	Alternative 'Next Generation' Ferritic Armour System for Vehicles	New Ferritic Materials, Performance Modelling, Simulation & Validation
3.4	Comparison of Mechanical and Welded Joints for Construction of Components for Armoured Vehicles	Joining Technologies, Performance Modelling, Simulation & Validation
3.5	Lean Automation Technology for Advanced Manufacturing of Armoured Vehicles	Automated Manufacturing
3.8	Alternate Materials and Manufacturing for Next Generation Armoured Vehicles	Composites, Niche Manufacturing Processes
7.1.1	Ceramic Armour Technologies	Niche Manufacturing Processes
7.1.2	High Curvature Armour Systems	Niche Manufacturing Processes, Textile Technologies
7.1.3	Low Profile Body Armour	New Ferritic Materials
7.2.1	Improved Anti-Ballistic Soft Armour	Composites, Textile Technologies, Performance Modelling, Simulation & Validation
7.3.1	High Strength Fabrics for Combat Clothing	Textile Technologies, Composites, Performance Modelling, Simulation & Validation
7.4.1	Portable Power Generation	Niche Manufacturing Processes
7.4.2	Portable Power Storage	Niche Manufacturing Processes

LAND
CASE
STUDY

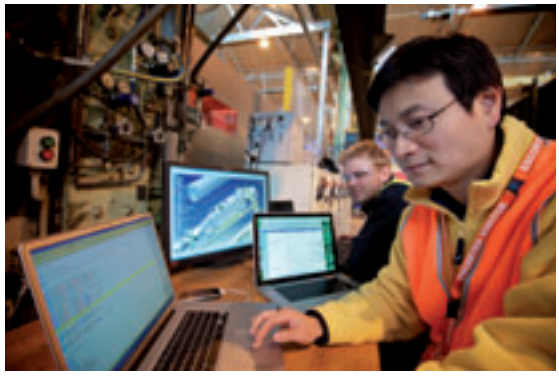
PROTECTED VEHICLE TECHNOLOGIES

The Armour Applications Program is focused on improving the available protection and performance technologies for use on protected land vehicles. With the goal of seeing these technologies integrated into vehicles operated by the ADF and in future applications on other Defence platforms, the research has also considered cost effective adoption opportunities for Australian industry and the application of technologies across all Defence platforms. To date, projects have focused on a number of vehicle relevant technologies including blast and ballistic performance modelling, fabrication technologies and welding automation techniques.

Recent advances in computational power have enabled the increased use of numerical modelling techniques in ballistic and blast analysis. DMTC's industry partners are progressively using more numerical modelling to gain better insight into the performance of materials including fracture mechanics, nonlinear materials, contact mechanics and fluid-structure interactions. The additional access to expertise from the Australian Nuclear Science and Technology Organisation (ANSTO), The University of Melbourne and Swinburne University of Technology has seen the team develop tools to predict armour performance and optimise armour design, reducing the need for as many expensive real life tests and accelerating the armour development process.

The technologies behind protected vehicle fabrication are equally complex. Researchers from the University of Wollongong, Swinburne University of Technology and The University of Melbourne are studying the behaviour of welded and bolted joints under extreme loading and the application of new automation techniques to the welding processes. Through the use of novel collision avoidance and path planning algorithms, robotic programming can now be artificially generated, which allows the assembly robotics to determine a welding or assembly action through simulation and self-generate code that is similar to what would be produced by a human programmer. The capability can now be used on even the most complicated robotics and complex structures, opening the door to cost effective low rate production runs and customisations.

During the initial part of this program the development of modelling, fabrication and automation capabilities with industry partners Thales, BlueScope Steel and Bisalloy Steels had been focused exclusively on application to the Bushmaster protected vehicles. The potential to apply these capabilities to other platforms was recently demonstrated on Thales'



"Hawkei" vehicle. The Hawkei, which has a modular construction incorporating tube frame chassis and composite construction, is currently being engineered using the very same automation technologies and improved welding and joining techniques developed earlier in the Armour Applications program. In this example, the automated and low distortion welding techniques originally designed for seam welding of armoured plate have been adapted for fabrication of space frames, and where bolted joints are employed the artificial programming is being adapted for the application of mechanical fasteners. The end result is Australian owned capabilities that can be applied to a variety of current and future platforms.

LIGHT WEIGHT POWER FOR THE COMBAT SOLDIER

LAND CASE STUDY

The number of electronic devices used by a dismounted solider on any given military operation is continuing to rise and as a result there is an increasing requirement for portable power. Lithium-ion batteries are gradually replacing lead-acid or nickel-cadmium batteries which are reducing some of the burden of battery weight, however extended operations still necessitate spare batteries or a diesel generator. On a 72 hour patrol, a soldier can carry up to 18 batteries weighing a total of 65kg.

An investigation is underway into the use of portable hydride based fuel cells as a lightweight power generation solution capable of recharging batteries in the field. Horizon Energy Systems, which has a world-wide reputation in making portable, high energy density fuel cells for a broad range of applications, has partnered with DSTO and VCAMM in a DMTC project to design and prototype a portable field fuel cell.

In just six months the team has designed and demonstrated a prototype field fuel cell. Unique to this design is the use a non-flammable fuel which can be carried in a dehydrated form, making it ideally suited for the rugged military environment. Adding water turns this fuel into a liquid chemical feedstock from which hydrogen can then be extracted on the go to generate electricity. The use of water provides a non-volatile fuel source which is critical in military operational environments. It is able to produce 912Wh of energy for charging 24V batteries typical of those carried by combat soldiers. The prototype can provide enough charging capacity to potentially reduce the battery weight burden on a soldier on a 72 hour patrol from 65kg to just 20kg.

Work will continue on refining the field fuel cell design next year with the intent of achieving a commercially available Personal Fuel Cell product for use by individual soldiers as a light weight power generation solution.

↑ Fuel Cell prototype

LAND HIGHLIGHTS

ADVANCED WELDING TECHNIQUES FOR ARMOUR GRADE STEELS

Armour grade steels have a number of unique metallurgical features which make them suitable for ballistic protection but challenging to weld using traditional techniques. DMTC research is examining the use of new technologies such as hybrid laser welding and austenitic welding consumables to improve the safety and significantly reduced the cost and complexity involved in joining armour grade steels. Results to date suggest that the extensive pre-heating technique specified in the defence and civilian standards for welding these steels may not be necessary if using an austenitic consumable. Success of this research will reduce the energy, time and welding complexities and open the door for the development of field repairs.

NON-METALLIC VEHICLE ARMOUR

Australia's current fleet of protected mobility vehicles are constructed primarily from armour grade steels. Research is investigating whether it is possible to further enhance the effectiveness of these steels by using them in combination with other armour materials such as aramid and Ultra High Molecular Weight Polyethylene. Traditionally these materials are used behind metallic armour in the role of "spall" liners and curtains however their light weight provides potential for use in the manufacture of complete vehicle hulls. The ballistic penetration mechanics of these armour fabrics are being examined at a weave scale and modelled as large scale fabric packs and laminates.

AFFORDABLE REAL LIFE TEST AND VALIDATION

Modelling and simulation capabilities for explosive bond testing have continued to advance, however real life tests are still required to validate the results. DMTC research has developed a novel low cost device for measuring the key parameters needed to determine the quality of an explosive bond. The device consists of a series of plate contact wires, novel data acquisition hardware and a simple jig for calibrating the position of the contact wires. This low cost and simple device promises to make conducting real world explosive bonding tests quicker and more cost effective, leading to a reduced development cycle for technologies relying on this underpinning science. Tests conducted include blast and ballistics, fatigue, high strain rate compression and tensile tests on materials and vehicle assemblies.

For more of our land domain achievements and highlights, visit www.dmtc.com.au

TECHNOLOGIES

- → New Ferritic Materials and Joining Techniques
- → Niche Manufacturing Processes
- → Performance Modelling Simulation and Validation
- → Composites
- → Automated Manufacturing
- → Titanium Component Fabrication
- → Textile Technologies

HIGH STRENGTH FABRICS FOR COMBAT CLOTHING

The current combat uniform provides a basic level of protection to the wearer, however is not expected to stop penetration by high velocity fragments from munitions. DMTC researchers are examining a number of high performance fibre blends and fabric structure combinations to inform on the performance trade-offs and optimum fibre and fabric structure combinations for a range of ADF fabric and garment applications. The project is currently developing concept garments that incorporate and utilise the properties of new fabrics which could provide an improved level of fragmentation protection, comfort and service life.

LOW PROFILE BODY ARMOUR

Leveraging previous research into the heat treatment and shaping of Ultra High Hardness Steels (UHHS), DMTC researchers have been able to bend plates in the annealed condition through 6° angles at 10mm intervals and heat treat the plates to optimal hardness. UHHS provides bullet stopping performance at a fraction of the thickness of ceramic materials however is much denser. This means that UHHS is a potential candidate for body armour applications where manoeuvrability of the combatant is of greater importance than the mass of the body armour system. Australian Defence Apparel is currently considering the use of UHHS plates in the concept demonstration of “trauma plates”.

SEMI-RIGID COMBAT ARMOUR

DMTC researchers have come up with a novel approach to improve the fit and comfort of current body armour systems. Semi-rigid armour is an emerging concept that introduces flexible areas in places needing increased conformability to the body while rigidity is maintained where it needs to protect the body and provide an interface behind the hard armour plate. Four semi-rigid armour concepts have been developed and evaluated for ballistic performance and comfort. Two of those concepts demonstrated equivalent ballistic performance when compared to the standard issue product. These same two concepts were then subjected to a wearer trial and rated as being more comfortable than the standard issue product.

SEA

Advancing fabrication techniques and improving sustainment practices for the Australian maritime fleet

DR STEPHEN VAN DUIN
MARITIME PLATFORMS
PROGRAM LEADER

COMPLETED PROJECTS

NEW FERRITIC MATERIALS & JOINING TECHNOLOGIES
2.1 HIGH STRENGTH STEELS FOR DEFENCE APPLICATION

CORROSION, PROGNOSTICS & REPAIR
2.2 SURFACE PROCESSING TECHNOLOGIES FOR REPAIR AND IMPROVED PERFORMANCE FOR SUBMARINE AND SURFACE SHIP COMPONENTS

NICHE MANUFACTURING PROCESSES
2.6 PERFORMANCE OPTIMISATION IN PZT CERAMIC BY ADVANCED MATERIALS PROCESSING FOR SONAR APPLICATIONS

PROJECTS IN PROGRESS

NUMBER	TITLE	TECHNOLOGY
2.3	Technology Development for Multifunctional Composite Structures	Composites, Component Integration
2.4	Lean Automation Technology for Advanced Manufacturing of Marine Defence Components and Assemblies	Joining Technologies, Performance Modelling and Simulation
2.5	Corrosivity of Australian Naval Bases	Corrosion
2.7	Evaluation of Candidate Hull Steels for Submarine Applications	New Ferritic Materials

SEA CASE STUDY

AUTOMATED WELDING IN SHIPBUILDING

Forgacs Engineering Pty Ltd (Forgacs) is an Australian privately owned company, headquartered in Newcastle, NSW. Forgacs specialises in marine and heavy engineering and is one of three Australian companies contracted by Defence to manufacture Air Warfare Destroyer modules. Forgacs has partnered with DMTC to investigate and install new automation and robotic welding capabilities to improve productivity at their Newcastle shipbuilding facility.

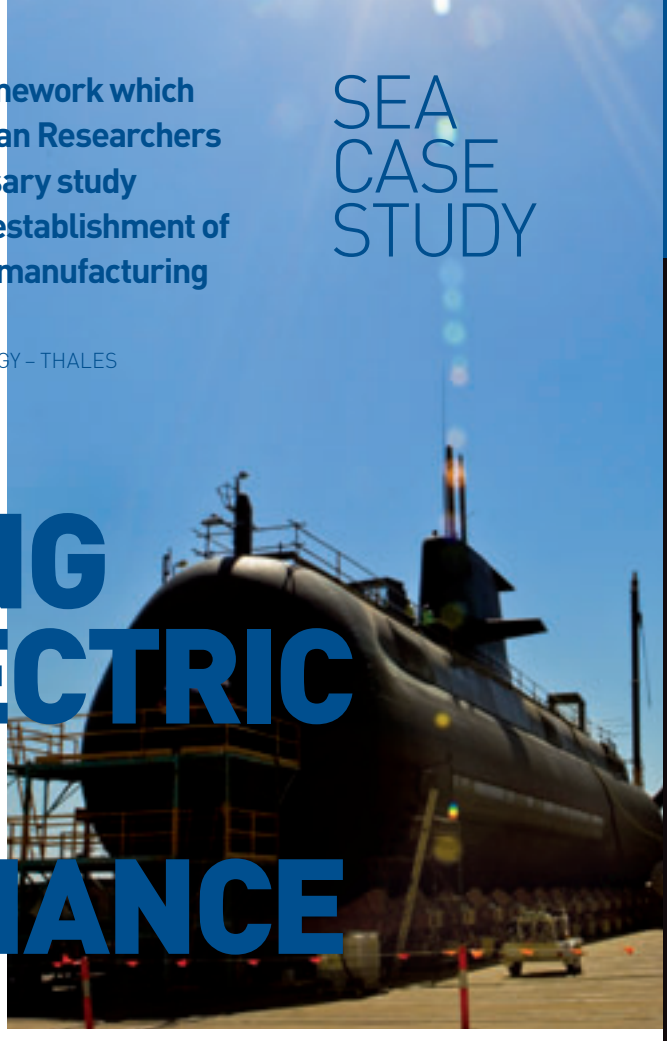
Industrial robots can provide many benefits for both productivity and flexibility. Most advanced welding technologies require some level of automation, however programming an industrial robotic system for a specific application is still very complex, time-consuming and expensive. Due to these time and cost constraints, many shipbuilders are not able to gain benefit from robotic automation. Automated Offline Programming (AOLP) is a capability initially developed within the DMTC Armour Applications Program and transferred to the Maritime Platforms Program to simplify manual planning and robot programming. AOLP is rapid and reduces traditional programming to a series of automated steps that generate structured collision free robotic process paths.

Forgacs is now working with DMTC to integrate the AOLP capability into its weld planning and programming processes. As part of this work, researchers are further enhancing the capability by developing a self-programming function, thereby removing the reliance of computer aided design information through the mapping of the environment using “Time of Flight” sensing. It is particularly suitable for parts with simpler geometry, such as ship panel and stiffener assemblies, but is also beneficial in complex blind geometries such as confined bulk heads. These capabilities are systematically being tested and proven in a laboratory at the University of Wollongong in preparation for production trials.

SEA
CASE
STUDY

"DMTC is providing a collaborative framework which is connecting Thales with key Australian Researchers with whom we can conduct the necessary study activities to evaluate and support the establishment of a single crystal piezoelectric ceramic manufacturing capability in Australia."

MICHAEL CLARK, DIRECTOR RESEARCH AND TECHNOLOGY – THALES



IMPROVING PIEZOELECTRIC CERAMIC PERFORMANCE

Thales Australia – Underwater Systems is a world leading supplier of sonar systems for surface ships, submarines and mine hunting applications. A key component of sonar systems is the piezoelectric ceramic which enables the hydrophone transducer to detect acoustic signals and identify objects at sea. On-going improving of sonar system performance is driven by the increasing stealth of modern naval platforms, and the need to operate in the harsh acoustic environment of littoral waters. Thales has joined forces with ANSTO's Institute of Materials Engineering in a DMTC project to develop new piezoelectric ceramic production techniques to complement the existing capabilities with the intention of remaining a world leading supplier of sonars.

Thales uses slurry processing of powders and hydraulic pressing methods to prepare materials prior to kiln firing in order to manufacture bulk piezoelectric ceramics for use in sonar hydrophones. Under a recently completed project, ANSTO researchers focused on implementing a complementary process called 'tape casting' to pre-process the ingredients prior to pressing in order to improve the material properties. The tape casting process creates a ceramic material with uniform thickness and refined microstructure creating near net shape components and making it ideal for niche sonar applications.

Building on the success of this partnership, Thales has expanded its research portfolio and recently commenced another DMTC project with ANSTO's Institute of Materials Engineering and the University of Wollongong to examine the feasibility of manufacturing single crystal piezoelectric ceramics in Australia. The findings of this study will guide Thales future investment plans for implementing a single crystal manufacturing capability, and will complement the existing tape casting work being developed with ANSTO. This new project will report its findings to the DMTC early next year.

SEA HIGHLIGHTS

CORROSIVE MICROBES IN AUSTRALIAN WATERS

Work to analyse Navy relevant Australian ports and harbours is continuing in an effort to identify what microbiological species are present in these waters and how these attribute to Microbiologically Influenced Corrosion (MIC). MIC is responsible for accelerating aggressive corrosion damage of marine components during both the operational and idle time of Australia's naval fleet. An understanding of the water's composition is being used to generate a strategy to mitigate their effect on metal corrosion and therefore extend the operational life of our naval vessels and other maritime assets. This work is particularly important as new maintenance programs are developed for vessels entering service.

EXTENDING THE LIFE OF NICKEL ALUMINIUM BRONZE

New methods for extending the life of Nickel Aluminium Bronze (NAB) components using surface treatment laser processing or Equal Channel Angular Pressing have been evaluated. DMTC researchers have discovered that by affecting the onset and propagation of selective phase corrosion, the rate of degradation of NAB components can be significantly reduced. Modelling of corrosion has resulted in an extremely high predicted corrosion rate (several mm/year) when related to microstructural changes brought about by the different processing techniques. By gaining a better understanding of the corrosion and erosion mechanisms of this alloy researchers have been able to develop treatment techniques which extend the useful life of critical surface ship and submarine components.

For more of our sea domain achievements and highlights, visit www.dmtc.com.au

TECHNOLOGIES

- → New Ferritic Materials
- → Component Integration
- → Joining Technologies
- → Corrosion, Prognostics & Repair
- → Niche Manufacturing Processes
- → Composites
- → Performance Modelling and Simulation
- → Automated Manufacturing

DISCREET ANTENNAS TAKING THE LOAD

DMTC has continued to increase knowledge in antenna design manufactured from Carbon Fibre Reinforced Plastic (CFRP). The researchers have developed a comprehensive understanding of the fundamental radio frequency (RF) behaviour of CFRP and methods of accurately modelling this behaviour using commercially available computational electromagnetic modelling (CEM) software packages. This allows computer based design of conformal antenna concepts where CFRP both supports structural load and acts as the antenna radiator. This includes concepts of microstrip antennas with a CFRP ground plane, cavity backed resonant slots in CFRP skins with a coaxial slot feed, cavity backed ultra-wide-band (UWB) slots in CFRP skins with a coaxial pin-feed and meta-material concepts to enhance the performance of slot antennas. A technology demonstrator has been built which allows the performance of new embedded antenna designs to be tested under varying physical conditions.

FUTURE SUBMARINE STEEL DESIGNED SPECIFICALLY FOR AUSTRALIA

A modified steel composition designed specifically as a candidate for the SEA1000 Future Submarine Program has been developed. Based on the steel used in the Collins Class submarines, BlueScope Steel, Bisalloy Steel and the University of Wollongong are working together to develop a steel composition which is specifically suited to Australia's unique operational requirements. The second of two 220 tonne steel heats was recently produced at BlueScope's Port Kembla steelmaking facility which will be used for a series of mechanical tests evaluating severe loading conditions for use in a Defence program.

"The DMTC collaborative framework is enabling BlueScope Steel to proactively develop a steel which is specifically designed for Australia's naval requirements."

CHRIS KILLMORE, MANAGER HOT ROLLED PRODUCT RESEARCH BLUESCOPE STEEL

FINANCIALS AT A GLANCE

DMTC receives funding from Commonwealth and State Government sources in anticipation of project and administration expenditure over the life of the Centre. Income not fully applied in the year of receipt is recognised as a current liability (deferred revenue). As expenditure increases to accommodate growth in research activities, deferred revenue is applied to meet the gap between current year revenue received and expenditure incurred.

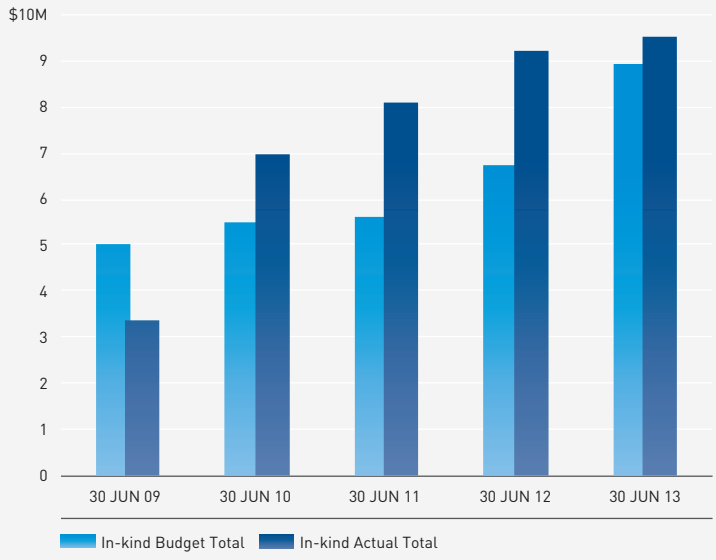
In-kind contributions from DMTC Participants remained strong with annual contributions from research and industry stakeholders exceeding budget by 7%. Current year cash contributions from research and industry Participants also increased by 4%. The increase reflects Participant recognition of the value DMTC projects are delivering to their organisations.

Income from the Commonwealth Government, industry and research sectors and other sources totalled $18,091,122 including $9,491,850 of in-kind contributions from Participants.

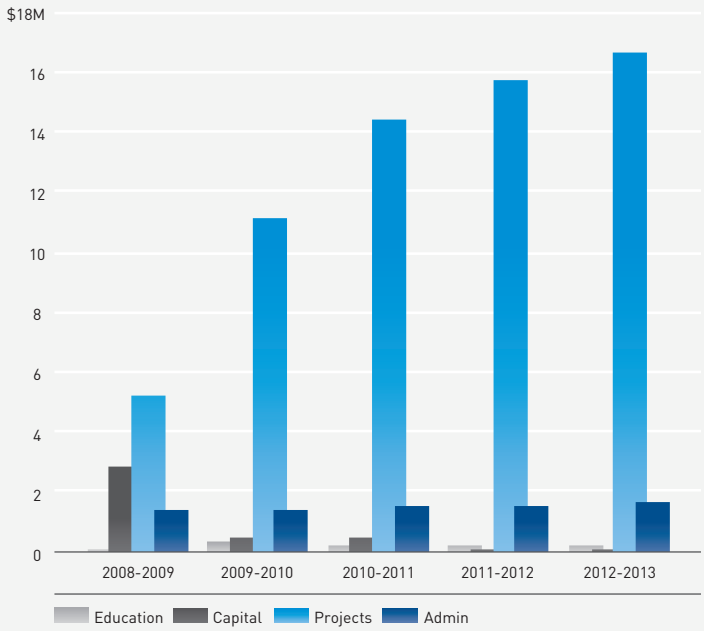
Total spend on research activity increased by 6% for the year while administration costs remained low.

THE YEAR IN SUMMARY	($)	($)
Revenue (Total Cash & In-kind)	2013	2012
Commonwealth Government	6,800,000	5,400,000
Industry and Other Income	3,998,606	4,378,707
Research Sector	7,792,516	6,956,599
	18,591,122	**16,735,306**
Expenditure (Total Cash & In-kind)		
Education	259,012	259,852
Capital	119,938	37,678
Projects	16,639,338	15,731,488
Administration	1,675,354	1,586,489
	18,693,642	**17,615,509**
Deferred revenue liability	3,468,922	3,391,822
Full time equivalent staff in-kind contributions	49.4	48.7
Post graduate students	30	26
Centre management employees (including part time)	8	7

TOTAL ANNUAL IN-KIND CONTRIBUTIONS



TOTAL EXPENDITURE



REVENUE SOURCES

42%
$7,792,516
RESEARCH INCOME

36%
$6,800,000
COMMONWEALTH GOVERNMENT

22%
$3,998,606
INDUSTRY & OTHER INCOME

TOTAL REVENUE 2012-2013 $18,591,122

NEW KNOWLEDGE, GREATER SKILLS

Supporting the development of new talent, knowledge and skills is an integral part of DMTC's objectives. DMTC takes a holistic approach to knowledge and skill development to ensure new knowledge is captured, embedded and leveraged by Australian businesses. In addition to research activities, DMTC supports new knowledge and greater skills through a range of activities including technology transfer projects, supporting students to work on industry led projects and commercialisation of new technologies.

In line with these supporting activities, DMTC operates an Education Program which incorporates:

- → an annual Student Conference where students present their research to their peers;
- → professional development workshops for broader skill development;
- → competitive selection to present at the DMTC Annual Conference;
- → involvement in project reviews and research utilisation discussions with industry partners;
- → support to attend conferences; and
- → online community and forums.

WORKSHOPS 2012-2013

Every year DMTC supports a number of professional development workshops to encourage the sharing and development of new knowledge. Workshops held in the 2012-2013 year include:

WORKSHOP	LOCATION
Manufacturing Innovation in Laser Additive Manufacture	RMIT University, Melbourne
Professional Skills for Post Graduate Students	DMTC, Melbourne
Use of Neutron Diffraction in Thermal and Cold Spray Applications	Swinburne University of Technology, Melbourne
Emerging Helmet Padding Technology	Deakin University, Geelong
Obtaining Accurate Performance and Cost Estimates of Energy Storage Systems	Deakin University, Burwood
Titanium Technologies Workshop	Victorian Government Investment Centre, Melbourne, Vic
Titanium Technologies Workshop	QMI, Eight Mile Plains, Qld
The Shock and Impact of Materials and Structures	Swinburne, Melbourne

The DMTC Annual Student Conference

The DMTC Annual Student Conference was held in Melbourne in late 2012. Sixteen students presented updates on their research, with the best judged presentations from each of the three domains (air, land and sea) given the opportunity to present their work at the 2013 DMTC Annual Conference in March. The three winners were:

- → **Land** Eric Yang, *The University of Melbourne, Structural Performance of Armour Connections Subject to Impulsive Damage*
- → **Sea** Cameron Barr, *The University of Melbourne, Equal Channel Angular Processing of Nickel Aluminium Bronze for Marine Platforms*
- → **Air** Donna Capararo, *The University of Queensland, Mechano-Chemical Rate Determining Step and Mechanisms of Crack Initiation in Aircraft Coatings*

Professional Skills for Post Graduate Students

DMTC conducted a two day workshop in February for its sponsored post graduate candidates. The workshop covered innovation, IP management, collaboration, commercialisation and negotiation. The second day provided an overview of the defence sector. The workshop provided students with a framework for innovation and commercialisation and how this fits with the DMTC operating model. The workshop also provided an opportunity for students to network, discuss their research and identify areas for collaboration across projects and universities.

PHD & MASTERS CANDIDATES

DMTC currently supports the research of 30 post graduates through scholarships and professional development courses. Post graduate scholarships are awarded based on alignment with the future defence capability requirements and industrial opportunities for Australian industry. Three students have now submitted their theses.

*Theses submitted

CURRENT POST GRADUATE PROJECTS

NAME	INSTITUTE	RESEARCH TITLE
Vanessa Lussini	Queensland University of Technology	The Synthesis and Evaluation of Novel Perylene-based Profluorescent Nitroxides Probes
Nicholas Orchowski	RMIT University	Investigation into the Post-Repair Performance of Ti6Al4V after the Occurrence of Foreign Object Damage
Shi Da (Stephen) Sun	RMIT University	Laser cladding of High Strength Steel for Aerospace Applications
Mohammad Mehdizadeh	RMIT University	The Durability, Reliability and Functionality of SHM Systems in Multifunctional Composites
Andre Rosseau	RMIT University	Metallurgical Characterization and Performance of Modern Tool Materials used in Metal Cutting Applications
Jimmy Toton	RMIT University	Metal cutting mechanics and the challenges of real life cutting tool testing
Tony Pilkington	RMIT University	Plasma Based Alumina Deposition Technologies and Applications
Rajneesh Jaitlee*	RMIT University	Interdependence of Soft and Hard Armour Systems
Long Nguyen	RMIT University	Ballistic performance of UHMW polyethylene armour
Kelvin Nicholson	RMIT University	SRR Loaded Slot Arrays
Toby Joel Seidel	RMIT University	Phase Compensation Methods for Load Bearing Antenna Array
Kamran Shafiee	RMIT University	Development of Lean Automation Systems for use in Marine Defence Manufacturing
Mitchell Sesso	Swinburne University of Technology	Design of Thermal Barrier Coatings for Hypersonic Applications

NAME	INSTITUTE	RESEARCH TITLE
Manasa Kesharaju	Swinburne University of Technology	Ultrasonic Sensor-based Approach to Defect Detection and Characterization of Armour Ceramics
Michael Wang	The University of Melbourne	Modelling two phase material properties using Monte Carlo approach
Paul Mignone	The University of Melbourne	Modelling two phase material properties using Finite Element Analysis and microstructure
Peng Luo	The University of Melbourne	Recycling of Ti Machining Chips
Damith Jayasekara	The University of Melbourne	The use of polymer coating to enhance the projectile impact resistance of steel and aluminium plate structures
Eric Yang	The University of Melbourne	Influence of Fabric Structures on the Blast and Impact Resistance of Textile Composite Materials
Silvia Leo	The University of Melbourne	Colloidal processing of difficult to densify ceramics
Cameron Barr	The University of Melbourne	Equal Channel Angular Processing of Nickel Aluminium Bronze for Marine Platforms
Bing (Kathy) Han	The University of Queensland	Modelling of Aircraft Coating Degradation
Donna Capararo	The University of Queensland	Mechano-chemical rate determining step and mechanisms of crack initiation in aircraft coatings
Sayedmojtaba Navabi	The University of Queensland	Prediction Modelling & Analysis of Machine Tool Chatter while machining Titanium Alloys
Rizwan Abdul Rahman Rashid*	The University of Queensland	Laser-assisted machining of beta titanium alloys
Theo Sinkovits	University of Wollongong	Experimental setup and preliminary investigation of coated tool wear, heat generation and the role of oxygen in face milling of K1045 carbon steel
Lenka Kuzmikova*	University of Wollongong	An Investigation of the weldability of High hardness Armour Steel
Alex Visser	University of Wollongong	Offline programming in a dynamic environment
Joseph Polden	University of Wollongong	The automation assisted manufacture of defence vehicles and land platforms
Nathan Lane	University of Wollongong	An investigation into the toughness and weldability of high-strength steels for Australian naval surface vessels

MANAGEMENT

MARK HODGE
CHIEF EXECUTIVE OFFICER

DMTC maintains an efficient operational structure with a low overhead cost to the business. Our management staff all work towards achieving the business's objectives which includes ensuring maximum funding and resources are directed to our research and technology development activities.

JIM ARTHUR
CHIEF OPERATING OFFICER

MATT DARGUSCH
CHIEF TECHNICAL OFFICER
PROPULSION SYSTEMS
PROGRAM LEADER

DEEPAK GANGA
PERSONNEL SURVIVABILITY
PROGRAM LEADER

HEIDI GARTH
PROGRAM DEVELOPMENT
MANAGER/COMMUNICATIONS

ANNE JUPP
PROGRAM SUPPORT OFFICER

MILES KENYON
PROGRAM DEVELOPMENT
MANAGER/EDUCATION

BRONWYNNE MCPHERSON
EXECUTIVE COORDINATOR

SURESH PALANISAMY
AIR PLATFORMS
PROGRAM LEADER

JAMES SANDLIN
ARMOUR APPLICATIONS
PROGRAM LEADER

JANE TISDALL
FINANCIAL CONTROLLER

STEPHEN VAN DUIN
MARITIME PLATFORMS
PROGRAM LEADER

BOARD OF DIRECTORS

MR TONY QUICK, CHAIR
DEFENCE ADVISORY PANEL

DR ROGER LOUGH AM, DEPUTY CHAIR
AUDIT RISK AND REMUNERATION COMMITTEE
CHAIR, DEFENCE ADVISORY PANEL

DR JOHN BEST, DIRECTOR
AUDIT RISK AND REMUNERATION COMMITTEE

MRS BRONWYN CONSTANCE, DIRECTOR
CHAIR, AUDIT RISK AND REMUNERATION COMMITTEE

DR PETER JONSON, DIRECTOR

PROFESSOR JOHN NORRISH, DIRECTOR
RESEARCH ADVISORY PANEL

PROFESSOR DAVID STJOHN, DIRECTOR
CHAIR, RESEARCH ADVISORY PANEL

MR TONY QUICK is Chair of Quickstep Ltd and the Textiles, Clothing and Footwear Supplier Advocate for the Federal Government. With an extensive career in aerospace and defence industries, Mr Quick has spent the majority of his career in management, international business development and program management. Mr Quick is an Adjunct Professor at RMIT University. Mr Quick was the inaugural director of Enterprise Connects' Defence Industry Innovation Centre, and from 2001 to 2009 was the director and General Manager of GKN Aerospace Engineering Services and chaired the Joint Steering Committee for the implementation of the Action Agenda for Aerospace. *Meetings attended: 7/7*

DR ROGER LOUGH led several DSTO divisions from 1987 to 1999 until his appointment to First Assistant Secretary Science Policy at DSTO Headquarters. Dr Lough then held the position of director of the DSTO Laboratory in Melbourne and was subsequently promoted to Chief Defence Scientist and CEO of DSTO in 2003. Dr Lough is Chair of the Defence Science Institute, member of the Defence Council of Victoria and Fellow of the CRC for Integrated Asset Management. He is a fellow of the Academy of Technological Sciences and Engineering and was made a member of the Order of Australia in 2009. *Meetings attended: 7/7*

DR JOHN BEST currently holds the position of Vice President Strategy & Technical at Thales Australia. Dr Best joined ADI Limited in 2003 and was appointed as CTO upon the formation of Thales Australia in 2006. In this role he was responsible for the technical capability of the company, including technical strategy, research and development, innovation, engineering process and engineering development. In 2013 he additionally assumed responsibility for strategy within the company. The move to ADI Limited followed a 15-year career with DSTO. Dr Best is a director of Eurotorp Pty Limited and member of the University of Technology Sydney Faculty of Engineering and IT Industry Advisory Network. *Meetings attended: 7/7*

MRS BRONWYN CONSTANCE has held many senior executive positions including finance director of Kraft Foods Limited Australia and New Zealand, Vice President Finance of Kraft Foods Asia, Executive General Manager Finance and Administration of Pasminco Limited and finance director of Nylex Limited. She spent her early career with the ACI Group of companies. Mrs Constance is an independent director of the CRC for Advanced Automotive Technology and Chair of its Audit Committee. She is also an independent director of Colorpak Limited. She is a former independent director of the Melbourne Market Authority, Plantic Technologies Limited and The Just Group Limited. *Meetings attended: 7/7*

DR PETER JONSON is an independent director and Lead Independent Director and Chair of the Remuneration Committee for Village Roadshow Limited. Dr Jonson is Chair Emeritus of the Melbourne Institute and Chair of Paranta Biosciences Limited. He is an adjunct professor at RMIT University and a member of the Board of Trustees of RMIT University. Dr Jonson is a former Chair of the Australian Institute for Commercialisation, AADI Limited, Bionomics Limited and the CRC Committee. Dr Jonson was an economist with the Reserve Bank of Australia for 17 years, CEO of Norwich Financial Services Limited and managing director and Chair of ANZ Funds Management. *Meetings attended: 6/7*

PROFESSOR JOHN NORRISH is an Emeritus Professor at the University of Wollongong. Holding a Bachelor of Science in Metallurgy and Masters of Science in Welding Technology, Professor Norrish has more than 150 publications in refereed journals and international conferences and has received numerous awards including the International Institute of Welding E.O. Paton Prize for 'a lifetime of contribution to welding technology'. He is author of "Advanced Welding Processes", re-published several times by the Institute of Physics. He is a Board member of the Physical Employment Standards Centre of Excellence and Vice Chair of the International Institute of Welding Commission XII. *Meetings attended: 7/7*

PROFESSOR DAVID STJOHN is director of Major Projects, Faculty of Engineering, Architecture and Information Technology at The University of Queensland and a director of the Centre for Advanced Materials Processing and Manufacturing. Professor StJohn worked at RMIT University, CRA Advanced Technical Development and CANMET (Canada). He was inaugural Chair of Solidification Technology at The University of Queensland and joined CRC in Alloy and Solidification Technology in 1994. In 2003 he was appointed CEO of CAST Metals Manufacturing CRC and CEO of CAST CRC in 2005. Professor StJohn is a member of Materials Australia and The Minerals, Metals and Materials Society. *Meetings attended: 6/7*

GOVERNANCE

The DMTC Board is responsible for overseeing the management and strategic direction of the company. Each Director is elected for a two year term by the company members at the Annual General Meeting. As required by the constitution, the seven Directors have a comprehensive collective range of skills including experience in defence industry, systems and policies, research, financial and risk management and corporate governance.

Annual General Meeting and Participants Workshop

DMTC held its Annual General Meeting and Participant Workshop on 8 November 2012. The Participants Workshop provided an update to all attending participants on DMTC's strategic plan and progress towards securing future financial support. The Annual General Meeting was held immediately after the Participants Workshop and DMTC Members provided unanimous endorsement of DMTC's future plans and engaged in discussion on a range of issues relating to current and planned activities for the Centre. Directors Bronwyn Constance, Peter Jonson, Roger Lough and David StJohn each retired at the Annual General Meeting in accordance with constitutional requirement and were subsequently re-elected to the Board of Directors.

Committees and Advisory Panels

Audit, Risk and Remuneration Committee

The Audit, Risk and Remuneration Committee (ARRC) is a formal subcommittee of the Board. The Committee was formed to assist the Board in its decisions on financial reporting and statutory audit functions, internal control structures, risk management, compliance, and governance. The Committee is comprised solely of non-executive Directors of DMTC Ltd, and the majority are independent. The Committee met three times during the financial year and its members are as follows:

- Mrs Bronwyn Constance (Chair)
- Dr Roger Lough
- Dr John Best

Research Advisory Panel

The Research Advisory Panel provides guidance to the CEO on technical research areas including: suggested areas of technology focus; possible linkages across research expertise; and ensuring the research undertaken is of world-class standing. Panel membership is drawn from eminent researchers and industrialists with knowledge and experience relevant to DMTC programs. The Panel members are as follows:

- Professor David StJohn (Chair)
- Professor John Norrish (DMTC Director)
- Dr Richard Chester (DSTO)
- Professor Ian Polmear (Independent)
- Dr Bruce Hinton (Independent)
- Professor Aleksandar Subic (RMIT University)

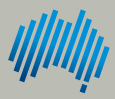
Defence Advisory Panel

The Defence Advisory Panel provides advice and guidance to the CEO in relation to its program structure and content to help ensure that DMTC continues to address the priority technical concerns of Defence in terms of both current and future planned activities. The Panel comprises of representatives from DMTC and the Commonwealth. The Panel Members are as follows:

- Dr Roger Lough (Chair)
- Mr Tony Quick
- Dr Ian Sare (Deputy Chief Defence Scientist)
- MAJGEN John Caligari (Head – Capability Systems)
- Mr Mark Reynolds (Head – Commercial & Industry Programs, DMO)
- Mr Mike Lawson (Head – Manufacturing Division DIICCSRTE)

Program Development Panel

The Program Development Panel provides strategic advice on effective strategies, tactics and activities required to win new business for DMTC. The Panel also advises on upcoming program opportunities that are of strategic importance and benefit to Defence industry and DMTC stakeholders.



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