CREATING FUTURE CAPABILITY

2014 DMTC ANNUAL REPORT

DMTC DEFENCE MATERIALS TECHNOLOGY CENTRE

WELCOME

Welcome to the Defence Materials Technology Centre (DMTC) 2014 Annual Report.

DMTC continues to deliver on its mission to drive the creation of Australian industry capability in advanced manufacturing, materials and associated technologies by leading collaborative research and commercialisation activities for Defence applications.

DMTC is a recognised leader of defence sector technology development and dissemination in Australia and provides this annual report to inform of our achievements to date, and of the significant opportunity for the sector by continuing our work. We look forward to working with all in the future.

DMTC was established and is supported under the Australian Government's Defence Future Capability Technology Centre Program.

Cover image courtesy of Thales Australia.

Design and art direction by BTP.

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MESSAGE FROM THE DEFENCE MATERIEL ORGANISATION

Industry innovation is a critical enabler for Defence capability whether in the acquisition or the through-life support of defence materiel. Innovation and adaptability must continue to be the hallmarks of our Australian defence industry support base.

The inter-relationships between Defence, a small but highly skilled industrial sector and a progressive research and development sector, are multi-faceted and complex. Through the agency of the Defence Materiel Organisation (DMO) and the Defence Science & Technology Organisation (DSTO), Defence has been both a partner with the DMTC and an enabler of its journey to date. Together, we have achieved significant capability outcomes for our Defence customers.

The DMTC has proven its commercial and technical credibility and become a great example of effective collaboration. Each partner or stakeholder is able to engage and interact positively in its DMTC program, without compromising either its own commercial position, or the ultimate goal of generating effective, value for money capability outcomes. Diggerworks is an obvious example of effective collaboration leading to positive capability outcomes for the Australian Defence Force.

Under the leadership of Tony Quick and Mark Hodge, and working with the DMO and DSTO, the DMTC is moving towards a sustainable business model, positioning it for future success. Through its investment in scholarships and development programs, the DMTC continues to harness some of Australia's brightest minds, and provide opportunities for them to make their mark.
I thank DMTC for its efforts in support of a smarter, more capable and better-equipped Australian Defence Force, and I am confident in its future success.

Harry Dunstall
Deputy Chief Executive Officer and
General Manager Commercial

"The DMTC has proven its commercial and technical credibility and become a great example of effective collaboration."

DRIVING INNOVATION

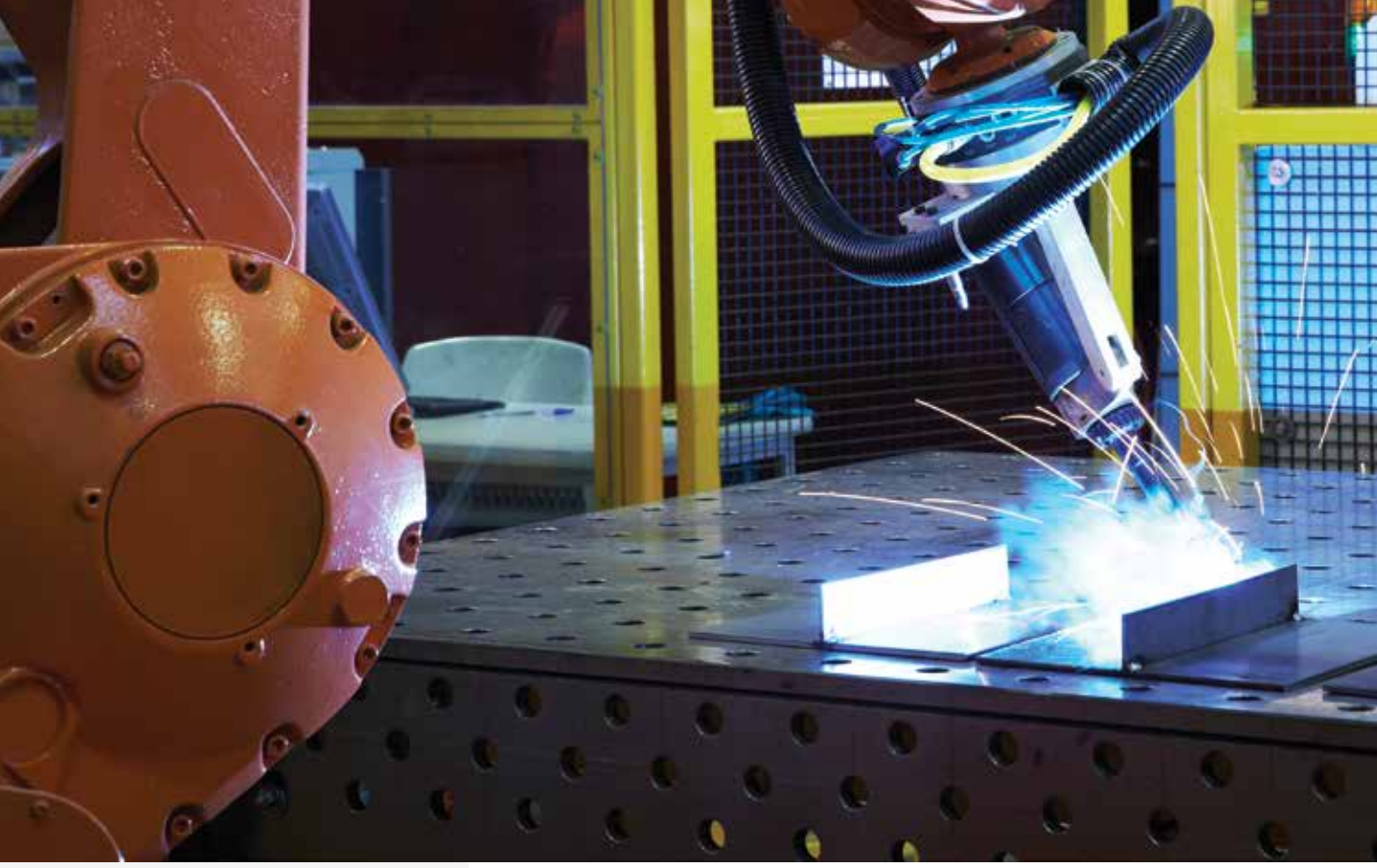
MESSAGE FROM ALEX ZELINSKY – CHIEF DEFENCE SCIENTIST

> "Australia is fortunate to have the Defence Materials Technology Centre as a key collaborative partner to DSTO, supporting Defence capability by improving industrial competitiveness underpinned by best practice research and development, and sound project management."
>
> DR ALEX ZELINSKY, CHIEF DEFENCE SCIENTIST,

In a turbulent world, safeguarding Australia through science and technology has become more important than ever before. Defence needs expert scientific advice and innovative technology solutions to complex and dynamic problems. The pace of technological change in the theatre of war is unprecedented, requiring ideas to be rapidly harnessed and turned into effective tools that aid the Australian Defence Force.

Australia is fortunate to have the Defence Materials Technology Centre as a key collaborative partner to DSTO, supporting Defence capability by improving industrial competitiveness underpinned by best practice research and development, and sound project management.

The relationship between DMTC and DSTO is important to both our organisations as we continue to face constrained resources. DMTC helps us deliver our desired outcomes by leveraging partnerships through its extensive networks and providing access to otherwise dispersed expertise across the Australian research sector. The DSTO role in this partnership is to provide the defence strategic context, and access to DSTO's unique capabilities and infrastructure. By working together, DMTC and DSTO can pursue opportunities that optimise the 'bang for the buck'.



The importance of our relationship will be further strengthened in coming years as DMTC and DSTO become even more client-focused and closely linked to Defence strategic needs.

A good example of the strategic partnership between Defence and DMTC was demonstrated in the Diggerworks collaboration which resulted in a high-performance ensemble for troops on deployment. The significant increase in our warfighters' confidence in the protective equipment is testament to the success of the Diggerworks team and DMTC's brokering role in linking Defence requirements with technology capabilities.

The DMTC has recently won several prestigious technology awards. DSTO is delighted to see our collaboration being recognised. Awards such as the Land Defence Australia National Industry Innovation Award exemplify the collaborative way we and other research and industry partners can respond quickly and effectively to new Defence requirements. The award commends the ability of DMTC to successfully lead a diverse consortium in developing boron carbide body armour plates. Boron carbide is the third hardest material on the planet with one third the density of steel.

With access to such advanced emerging technology the Australian Defence Force is assured of maintaining a capability edge.

It was also pleasing to see DMTC's Armour Applications Program win the 2013 DSTO Eureka Prize for Outstanding Science in Safeguarding Australia. This program has resulted in Australia retaining an in-country capability to design and manufacture high performance protected mobility vehicles. Congratulations are extended to all the team members of this highly successfully program.

The DMTC has successfully demonstrated its capacity to work with Defence and industry in addressing critical Defence capability issues. DSTO looks forward to growing our highly successful and productive program of collaboration in the years ahead.

COLLISION FREE ROBOTIC WELDING USING AUTOMATED OFFLINE PROGRAMMING

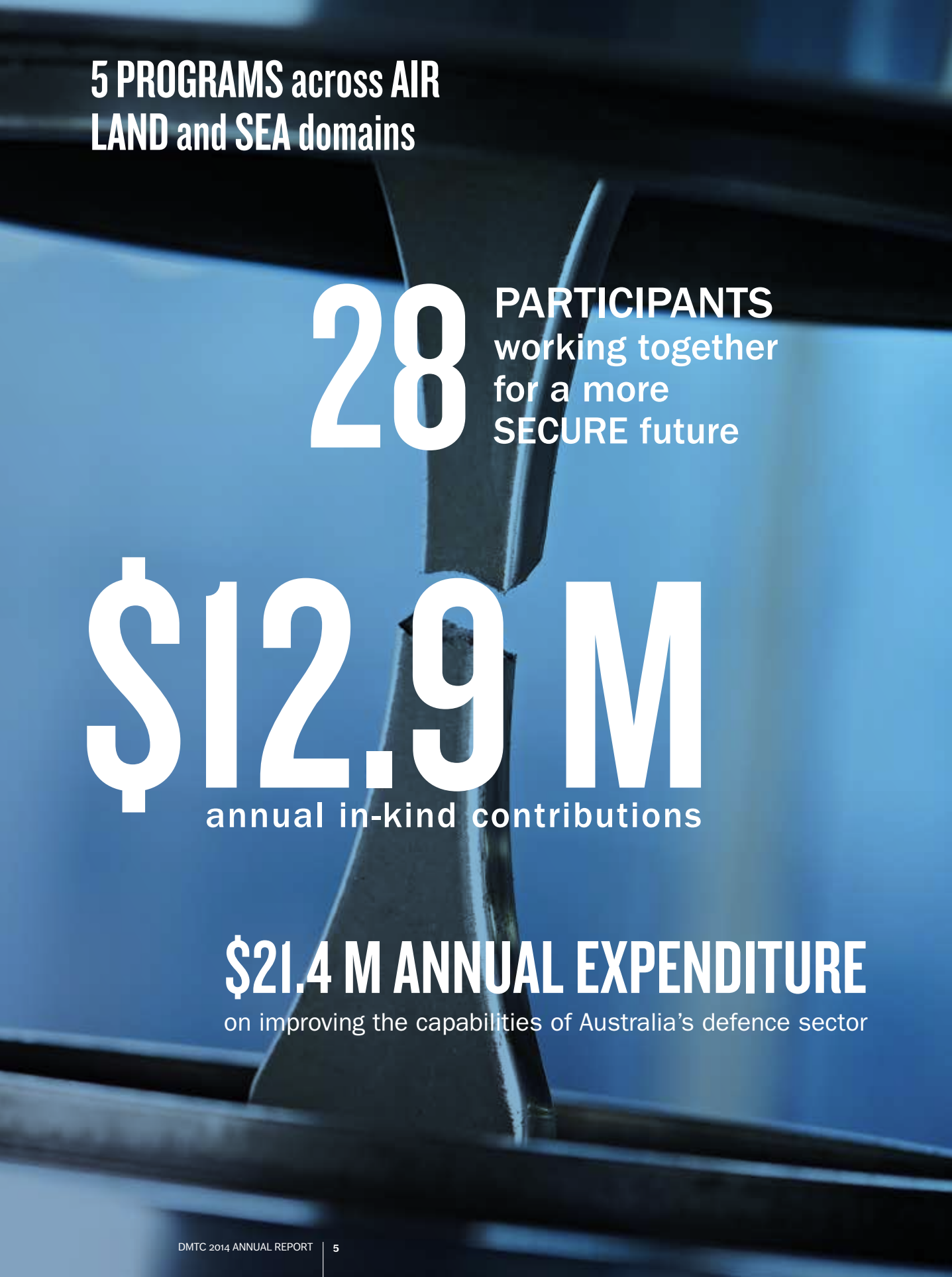
HIGHLIGHTS 2013 – 2014

489
PEOPLE
directly involved in DMTC activities

PROVEN COLLABORATIVE MODEL

41
PROJECTS
delivering new technologies and manufacturing processes

FATIGUE TESTING RIG AT BLUESCOPE STEEL



5 PROGRAMS across AIR LAND and SEA domains

28 PARTICIPANTS working together for a more SECURE future

$12.9 M annual in-kind contributions

$21.4 M ANNUAL EXPENDITURE

on improving the capabilities of Australia's defence sector

CHAIR'S REPORT

The Defence Materials Technology Centre has just completed arguably the most important year in our history. Early in the DMTC's life, the Board put in place a plan to transition our organisation into a future where our focus would be on structuring technology development programs to address specific capability challenges of Defence, utilising our collaborative model, built on a track record of real outcomes. We have always had strong confidence that the DMTC model represents a highly effective and efficient exemplar for all of our stakeholder groups – Defence, industry and the research sector – in generating defence capability based on materials and manufacturing technology.

The announcement in March by the Assistant Minister for Defence that Defence would continue to resource the DMTC model gives effect to the Board's strategy. We are of course delighted as we enter the final year in our establishment contract that Defence has continued to support DMTC's activities. We are encouraged to see that the overwhelming majority of our industrial and research sector participants have elected to recommit to the future activities with each maintaining or increasing the level of resource invested. Add to this the intention of several new participants from both the industry and research sector to join the centre and there is much cause to expect the future for DMTC will be every bit as bright as the immediate past.

Our research remains of the highest quality from a scientific standpoint, and continues to deliver real commercial impact for our industrial partners – a clear acknowledgement that we have an appropriate balance for both stakeholder groups. This is a key enabler for our success and a feature that we must strive to maintain.

I must thank my fellow Directors and the management team whose indefatigable resolve, energy and dedication have secured the immediate future for our organisation.

TONY QUICK,
CHAIR

"Our research remains of the highest quality from a scientific standpoint, and continues to deliver real commercial impact for our industrial partners..."

"I have great confidence that our business model, our track record of delivery and our relationships across the Defence organisation will provide a solid foundation for us to continue to build on our growing history of success."

CEO'S REPORT

Again throughout the past year, the DMTC community has delivered excellence in research, technology and capability improvements for Defence through our industrial partners.

Once again, our research, a number of our project teams and affiliated researchers were recognised nationally and internationally for their work. Our efforts in Continuous Improvement under the SCIP programme were recognised with an award, which I am confident makes our organisation one of very few anywhere in the world to have made a commitment to continually improving the efficiency of our research management processes. Our partners, stakeholders and customers rightfully expect us to manage resources effectively on their behalf, and this is a tribute to the quality and excellence of our project and program teams.

As noted by the Chair, the past year has been crucial for DMTC in terms of the medium term future of the organisation. Now that the immediate future is secure, we must look to the future for our organisation as we work with our partner organisations and Defence to develop the detail of our future program portfolio. In this regard I look forward to the discussions we will have with our stakeholder and partner group over coming months to work through the project definition and establishment activities necessary to maintain our momentum as we transition between contracts.

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

I am delighted to present DMTC's 2014 Annual Report Highlights.

MARK HODGE,
CEO

ABOUT DMTC

Despite the increasing complexity of defence platforms, systems and subsystems and the trend towards globalisation of Australian Defence procurement, Australian industry retains a critical role in servicing the Australian Defence Force in the context of acquisition, through life support and sustainment capability. Innovation in industry is a key component in developing and maintaining a cost-effective competitive edge and reducing supply chain risk. DMTC's model has been tailored and continually refined towards providing a best-practice engagement mechanism for Defence, industry and research sector stakeholders, enabling each to effectively, proactively and efficiently interact with the other as a means of driving capability outcomes for the Australian warfighter.

DMTC's model is based on clear lines of communication between each stakeholder group and a cooperative engagement between practitioners, developers, producers and buyers of defence sector technology, across an area broadly defined by materials and manufacturing technologies. Within this general context however, DMTC is a "technology unaligned" organisation with an operational model founded on the concept of "demand-driven" technology development where the technology field is guided by the capability challenge.

With gaps, challenges or requirements defined through dialogue with key agencies in Defence as a starting point, DMTC works to develop a best of breed solution that optimises the cost-capability balance from within its industry and research sector participant group, to address the stated problem. Importantly, this almost universally involves collaboration between several research sector organisations who work together with industry to provide a multidisciplinary approach to the defined development challenge.

We have a proven track record of leadership in Defence innovation with awards won in each of the areas of research excellence, commercialisation of technology and continuous improvement of our business processes. We are committed to continuing our journey of best-practice conception, management and delivery of technology for the benefit of our industry and research sector participant group, and of course for the ultimate benefit of the Australian Defence Organisation.

VISION

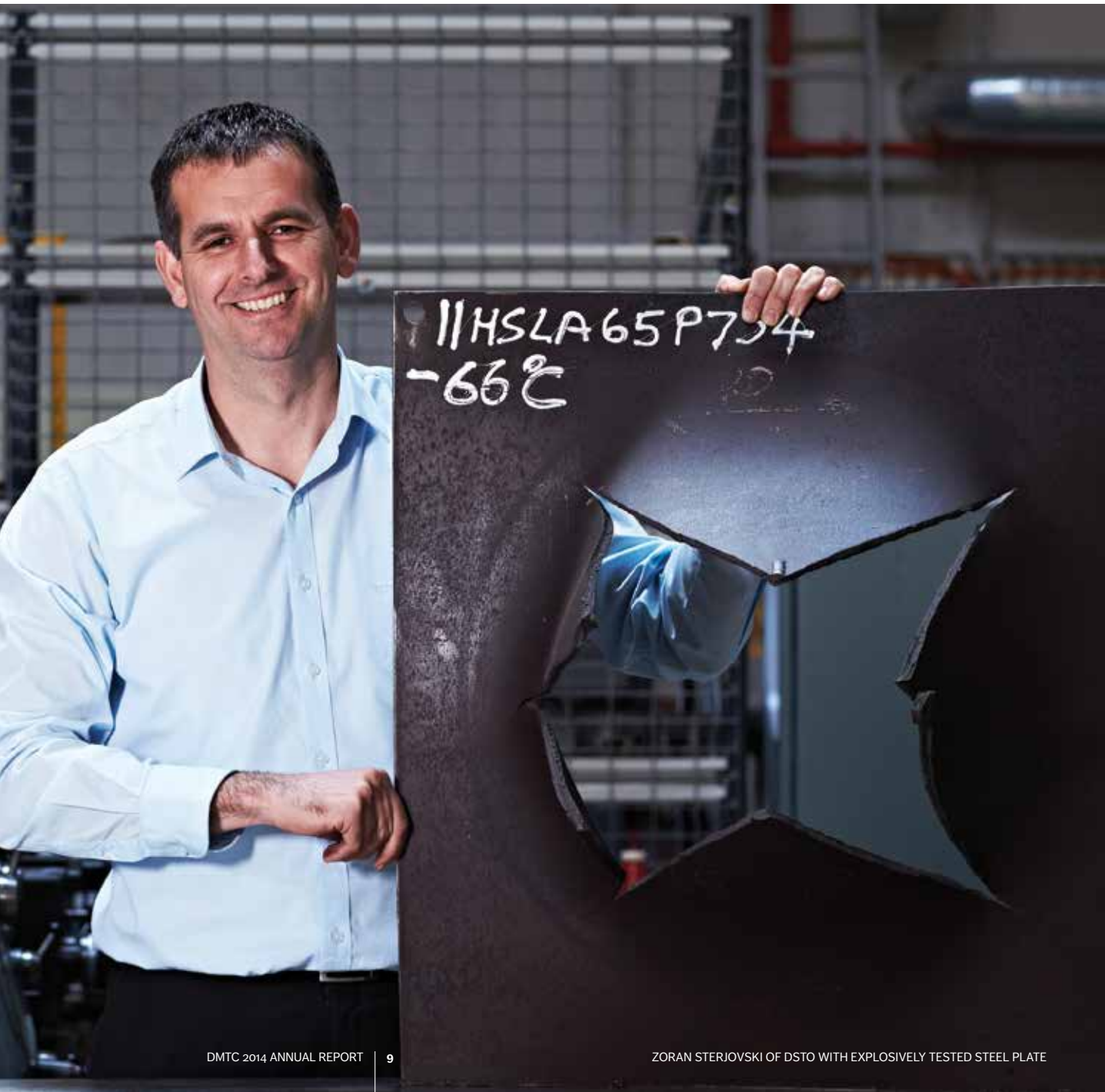
To provide technology solutions enabling industry to enhance Australian Defence capability

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

STRATEGIC INTENT

Capability through Collaboration



ZORAN STERJOVSKI OF DSTO WITH EXPLOSIVELY TESTED STEEL PLATE

CREATING FUTURE CAPABILITY

One of the key challenges for the defence sector is to align the capabilities of a broad stakeholder group, including prime contractors, supply chain participants and the research sector. DMTC not only allows, but relies on the active participation of each stakeholder group, ensuring dynamic interaction between Australia's highly skilled industrial sector and the range of research, development and innovation organisations.

In this manner, Defence can mitigate procurement risk by providing guidance to industry on likely future capability requirements without compromising the principles of best-value capability for the taxpayer by supporting and guiding industry capability development efforts in a pre-competitive environment. Industry benefits are derived from increased competitive advantage, and optimised cost-effectiveness while the research sector gains a more mature understanding of the particular demands and features of technology development unique to the Australian Defence sector.

DMTC is fortunate to have a highly capable participant group, and through our interactions with a range of Australian Defence Organisation agencies, most notably DMO, DSTO and Capability Development Group, these participant organisations are able to focus their development efforts in a cohesive manner, each leveraging the financial and technical capabilities of the other. The result is improved cost-effectiveness and accelerated capability development for Australia's defence needs.

MEASURABLE IMPACT

DMTC deals with three key stakeholder groups, each with fundamentally different needs. DMTC projects are structured with clearly defined outcomes that will benefit each stakeholder group, and reviews progress towards these outcomes on a regular basis.

ECONOMIC RETURN AND IMPROVED DEFENCE CAPABILITY

INDUSTRY ADOPTION AND UPDATE

RESEARCH AND DEVELOPMENT

DR GERRY TRIANI OF ANSTO USING TAPE CASTING TO GROW TEXTURED CRYSTALS FROM SEEDS

A PROVEN CAPABILITY PARTNER

CHRIS DEAN WITH ACOUSTIC SONAR SYSTEM AT THALES

DMTC performance is reviewed on an ongoing basis. In addition to annual and quarterly reports to the Defence Materiel Organisation and Department of Industry, DMTC is reviewed by other external panels and associated organisations.

A key enabler of DMTC's success is constant monitoring and management of our research and development activities to ensure that each of our key Defence, industry and research sector stakeholder groups derives benefit from their investment in the DMTC model. From an industrial standpoint, this relates to our ability to deliver applied research outcomes and technology capability that is able to be rapidly adopted and folded into specific products and services. Simultaneously, research partners must see benefit from their interaction with DMTC in terms of their ability to conduct high quality research.

As part of its commitment to continuous improvement of business process and R&D management philosophies, DMTC continually monitors our ongoing programs to ensure that they are progressing along an appropriate trajectory in terms of research maturity and development timelines. Around 80-85% of our research activity is conducted across Technology Readiness Levels 3-8, spanning the range from proof of technical concept through to system prototype validation.

Our track record indicates that we continue to be an effective capability partner for research and industry sector organisations alike. For its part, Defence has been and continues to be a strong supporter of DMTC and the results of the various reviews of our performance metrics bear out DMTC's continued achievements and record of delivery. The recent confirmation of continuation of our contractual relationship with Defence is of course a significant development in this regard.

Australian museum Eureka Prizes 2013 Winner

RECOGNITION AND AWARDS 2013-2014

As the technology developed through DMTC matures, our Project Teams, associated individuals and Participants are gaining increasing recognition for the impact of their work. DMTC received the following awards, all thanks to the hard work of contributing Participants and individuals:

AWARD	RECIPIENT
2013 Australian Museum Defence Science and Technology Organisation Eureka Prize for Outstanding Science in Safeguarding Australia	DMTC Armour Applications program team. The team includes representatives from the Australian Nuclear Science and Technology Organisation, Thales Australia, BlueScope Steel, Bisalloy Steels, University of Wollongong, The University of Melbourne, Defence Science and Technology Organisation and Swinburne University of Technology.
Maritime Australia – Innovation Award 2013 "Young Innovator Scholarship for Defence Industry Innovation"	Cameron Barr of The University of Melbourne
AC Kennett Memorial Award for Best Paper on Non-Metallic Corrosion	Dr Antony Trueman of Defence Science and Technology Organisation
Materials Australia "Borland Forum Award'	Cameron Barr of The University of Melbourne

DMTC ANNUAL CONFERENCE 2014

The DMTC Annual Conference was held on 26 and 27 March at the Shine Dome in Canberra. The format incorporated a combination of technical presentations, panel discussions and guest speakers from industry and Defence. Guest speakers included the Hon Stuart Robert MP, Assistant Minister for Defence, VADM Peter Jones Chief Capability Development Group, Dr Alex Zelinsky, Chief Defence Scientist DSTO, Mr David Gould, General Manager Submarines DMO, and RADM Greg Sammut, Head Future Submarines RAN.

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

- Industry Partnership Award: Aaron Seeber of CSIRO and Theo Sinkovits, of University of Wollongong
- Research Collaboration Award: James Waldie of BAE Systems
- Early Career Award: Cameron Barr of The University of Melbourne
- Capability Improvement Award: Project 2.7 "New Steels for Submarine Application" and Armour Applications Program 3
- Special Achievement Award – Bronwynne McPherson

CONTINUOUS IMPROVEMENT

DMTC commenced participation in the Defence Industry Innovation Centre's Supplier Continuous Improvement Program (SCIP) in 2012. SCIP is a three year change program that accelerates industry competitiveness by raising the performance of suppliers and supply chains. It focuses on embedding best practice leadership and continuous improvement and provides benchmarked performance measures and an improvement plan.

For DMTC, this has meant challenging existing collaborative research practises and processes and implementing improved approaches across all areas of the business and service delivery strategy. The result is a program of research and commercialisation activity that is continuously improving collaborations and relationships between the defence industry sector and research agencies; and enhancing the performance of the defence capabilities made available for Defence.

DMTC also sees significant value being gained from the SCIP through our supply chain development work involving defence Primes and SMEs. DMTC is able to communicate with Primes about Continuous Improvement and encourage the adoption of the culture within the many participant organisations we work with.

The SCIP includes an annual self-assessment that has enabled DMTC to undertake a comprehensive and holistic review of every aspect of the business and broader strategy. DMTC's 2014 assessment showed significant improvement over the initial assessment in 2012 and can be attributed to the ongoing focus on leadership and process improvement. A few examples of the continuous improvement activities DMTC has actioned include:

- Implementation of an Information Management System (IMS), essential for information storage, document sharing, reporting and communication between the project teams;
- Implementation of standard work processes including project start up and closure;
- Implementation of a new accounting system that can accommodate changes to program structure and number of participating organisations; and
- Waste reduction across all areas of the business including physical and electronic storage systems, meeting efficiency, email and reporting processes.

DMTC is still relatively new to Continuous Improvement and unsurprisingly we have many areas we wish to further enhance in the near future listed on our Continuous Improvement Plan. The SCIP assessment has helped articulate where the focus of future improvement initiatives should be directed in the immediate term.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PARTICIPANTS

The Defence Materials Technology Centre is comprised of participant organisations who all contribute resources towards the research and development activities. By working together in a collaborative environment our participants achieve far greater technology and performance gains in less time and with less cost than by pursuing research and development activities independently.

RESEARCH PARTICIPANTS

ANSTO

CAST

CSIRO

Australian Government
Department of Defence
Defence Science and Technology Organisation

QUT Queensland University of Technology

RMIT UNIVERSITY

SWINBURNE UNIVERSITY OF TECHNOLOGY

MELBOURNE SCHOOL OF ENGINEERING

THE UNIVERSITY OF QUEENSLAND AUSTRALIA

UNIVERSITY OF WOLLONGONG AUSTRALIA

VCAMM accelerating innovation

DMTC's collaborative model:

- fosters enduring collaborative 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.

INDUSTRY PARTICIPANTS

PROGRAMS

DMTC currently operates five technology development programs across the air, land and sea domains. DMTC projects have historically focused on materials, manufacturing processes and associated technologies. As DMTC continues to grow and deliver technology improvements to industry the technology focus is naturally broadening to include complementary areas. Current and planned areas in which DMTC facilitates projects includes:

Manufacturing – Fabrication

> Machining
> Tooling
> Additive Manufacturing
> Bonding and Joining
> Welding
> Casting
> Automation
> Design for light weighting
> Modelling and Simulation

Materials – Sustainment

> Prognostic Health Monitoring
> Repair
> Fatigue
> Coatings
> Corrosion
> Modelling and Simulation

Materials – Advanced

> Metals
> Composites
> High Temperature
> Modelling and Simulation
> Armour
> Steels
> Textiles
> Ceramics
> Piezoelectric Crystals
> Power and Energy

ADVANCED TOOLING ON THREAD CHECKING MACHINE AT SUTTON TOOLS


AIR

Improving aircraft sustainment practises and supporting niche aircraft component manufacturing capabilities

Program leaders

Propulsion Systems
Dr Matt Dargusch

Air Platforms
Dr Suresh Palanisamy

The Royal Australian Air Force has a medium to long term air capability focus on the acquisition of numerous new platforms including the F-18 Super Hornet and Growler, Joint Strike Fighter, Multi-role Tanker Transport and MH90 helicopter introduction into service. This provides Australian industry with significant opportunity to supply into these programs and in the process grow the advanced skills required to sustain the aircraft once they are introduced into service. DMTC Air domain Programs are seeking to address key manufacturing and sustainment challenges including machining, additive manufacturing, composite repair, corrosion, fatigue and structural health monitoring.

UNDERSTANDING AIRCRAFT CORROSION

"Aircraft corrosion cost Defence an estimated $238 million in 2013 alone."

DMTC has been actively promoting collaboration between Australian industry and research agencies to increase knowledge and improve monitoring practises of aircraft corrosion since 2008. The importance of this work was recently emphasised by the discovery that the cost of aircraft corrosion to Defence is estimated at $238 million in the 2013 year alone. The figure was derived by applying the methodology of detailed US studies to the Australian context, analysing DMO sustainment data and by collecting detailed BAE maintenance costs of Seahawk, Hawk Mk127 and F/A-18 Classic Hornet.

DSTO, RMIT University, Swinburne University of Technology, Queensland University of Technology and The University of Queensland have all worked on projects to develop prognostic models with greater accuracy and more sensitive sensor systems. As a prime contractor to the sustainment of Defence aircraft in Australia, BAE Systems has played a critical role in identifying opportunities for improvement and contributing to the development of practical solutions in addressing corrosion.

A considerable amount of work has gone into investigating the performance of primers and topcoats over time in different environmental conditions including the use of Corrosion Inhibiting Compounds. This research has resulted in a better understanding of the initiation and propagation of inter-granular corrosion and has subsequently enabled prognostic models to be improved and new algorithms for corrosion management to be developed. There has also been ongoing research into the development of a fluorescent compound that can be used to understand the stages of aircraft paint degradation. This compound can be readily incorporated into paint systems.

All of this work is being integrated into a corrosion management system called Environmental Degradation Monitoring and Prognostics (EDMAP) by BAE Systems. By employing better sensors and a comprehensive model in a proven and certified system, EDMAP will be deployed on Defence aircraft to show the current and predicted status of airframe corrosion and improve inspection, prevention and repair logistics. These improvements are anticipated to reduce corrosion related costs by up to $50 million a year.

AIR – HIGHLIGHTS

SMEs GAIN ADVANCED TITANIUM MACHINING KNOWLEDGE

DMTC has commenced a project that will raise the collective capability of Australian SMEs in titanium machining. Researchers at Swinburne University of Technology and The University of Queensland have worked with BAE Systems to develop a representative titanium component that requires manufacturing capabilities equivalent to those required to produce improvements for use on the Joint Strike Fighter aircraft. A number of Australian SMEs will now work with the DMTC research team to adopt and optimise advanced machining technologies and demonstrate these new capabilities by machining the sample component with a range of manufacturing data benchmarked for best practice across the participating supply chains. When the project is complete, BAE Systems will have access to a broader pool of Australian titanium machining capability and the Australian industry will be more globally competitive.

RECYCLING TITANIUM SWARF

Titanium production and manufacturing costs are often prohibitively high, partially driven by machining operations that can waste up to 90% of the material. Recycling titanium machining chips helps to recover some of the cost, however traditional melt-based techniques are often expensive and inefficient owing to high melting temperature and chemical reactivity of the material. DMTC researchers have been investigating recycling processes that are more affordable and produce a high grade billet as the process output. Solid state recycling techniques such as extrusion, rolling, forging and sintering are attractive as no melting occurs, thereby reducing energy consumption and negating the need for a vacuum and thus reducing the overall cost of the process. However, an inability to breakdown and disperse the oxide layer surrounding each chip leads to reduced ductility and is the main drawback associated with solid state recycling techniques. This project has demonstrated titanium swarf can be successfully recycled into products with acceptable properties for future use in a range of niche aerospace applications.

TITANIUM HEAT TREATMENT CAPABILITY POSSIBLE IN AUSTRALIA

Titanium and its alloys are widely used in aircraft applications because of their high strength-to-weight ratio and excellent corrosion resistance. Recent advances in low cost titanium production and net shape processing are stimulating increased demand for titanium and its alloys. To date, Australia has not had large scale titanium heat treating capability or knowledge. A DMTC project has been established to investigate heat treatment of titanium alloys and is being carried out by the research team at the Centre for Advanced Manufacturing and Material Processing, The University of Queensland and Heat Treatment Australia. All stages of the process are being examined including stress relieving, annealing, solution treating and aging. This project will improve vertical integration of Australia's supply chain in titanium component manufacture and repair.

GRAPHICAL USER INTERFACE FOR LASER CLADDING

A Graphical User Interface (GUI) has been developed using optimised laser cladding parameters for a range of substrate and clad layer alloy systems by DMTC researchers at Swinburne University of Technology. Designed specifically to improve defence sustainment process in place at Rosebank Engineering, the GUI was written in MATLAB and has been compiled as a user-friendly stand-alone program. The GUI can select the optimum laser power setting based on empirical calculations with the addition of a latent heat of fusion calculation to take into account the extra energy required to melt the alloy. This results in the GUI now delivering hours of time saving in the process optimising stages for the laser cladding at Rosebank Engineering. The laser cladding process will be used for repairing a number of defence components once it has completed the required process certification steps.

ADDITIVE MANUFACTURING BENCHMARKED FOR AEROSPACE APPLICATION

Additive manufacturing is a group of technologies that produces near net shape components by gradually building up a component layer by layer from a powder or wire precursor material. While additive manufacturing is becoming increasingly popular in a number of industries, adoption in the defence and aerospace sectors has been slower due to the additional demands on the materials that make up the final components. With the support of a Victorian Government Manufacturing Productivity Network grant, DMTC has conducted a SME benchmarking exercise to evaluate and compare the commercial potential of the four most common metallic additive manufacturing techniques within an aerospace context:

- Selective Laser Melting (SLM) by RMIT University and Monash University;
- Electron Beam Melting (EBM) by CSIRO;
- Direct Metal Deposition (DMD) by Swinburne University of Technology; and
- Wire and Arc Additive Layer Manufacturing (WALAM) by the University of Wollongong.

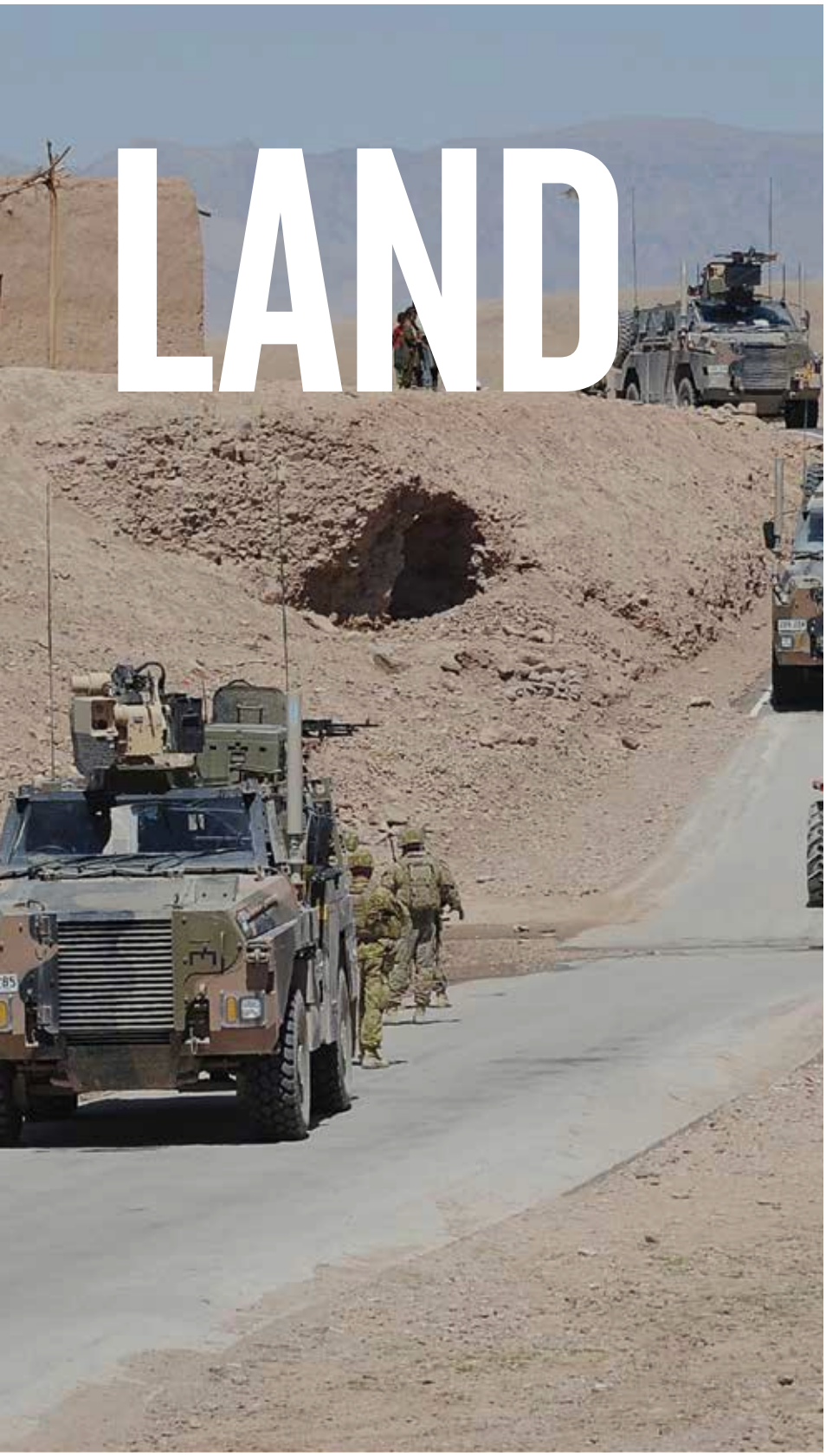
A model component for production and evaluation was designed incorporating a series of typical engineering features such as bolt holes, a ribbed section, a complex spline curve and four threaded holes. The four additive manufacturing techniques being compared each differ in the level of detail and required amount of post machining that could be achieved and it was observed that SLM and EBM-produced components were closest in final dimension to the specifications. The results also showed that EBM, DMD and WALAM processes all produce a very low residual stress while SLM on the other hand was shown to produce a high compressive stress state. This result makes SLM a more promising technology for aerospace components as high compressive stress states are known to increase the structural integrity of metallic structures and therefore extend the fatigue life.

Key to the benchmarking was the active involvement of Victorian based SMEs Baeur Engineering, Brenco Surface Engineering, Rosebank Engineering, Sutton Tools, and United Surface Technologies along with primes BAE Systems Australia and Thales Australia. Every industry partner contributed to the evaluation and production of the sample components and had the opportunity to share knowledge.

The benchmarking project has illustrated some of the high-level features of each of the additive manufacturing techniques and has assisted the industry sector in its understanding of a preliminary business case for adoption of these technologies. DMTC will continue to work with its existing and new partners to further develop this work.

COMPONENTS MANUFACTURED BY DMTC PARTICIPANTS USING MACHINING AND ADDITIVE MANUFACTURING PROCESSES

LAND



Enhancing the Protection of Personnel for Mounted and Dismounted Operations

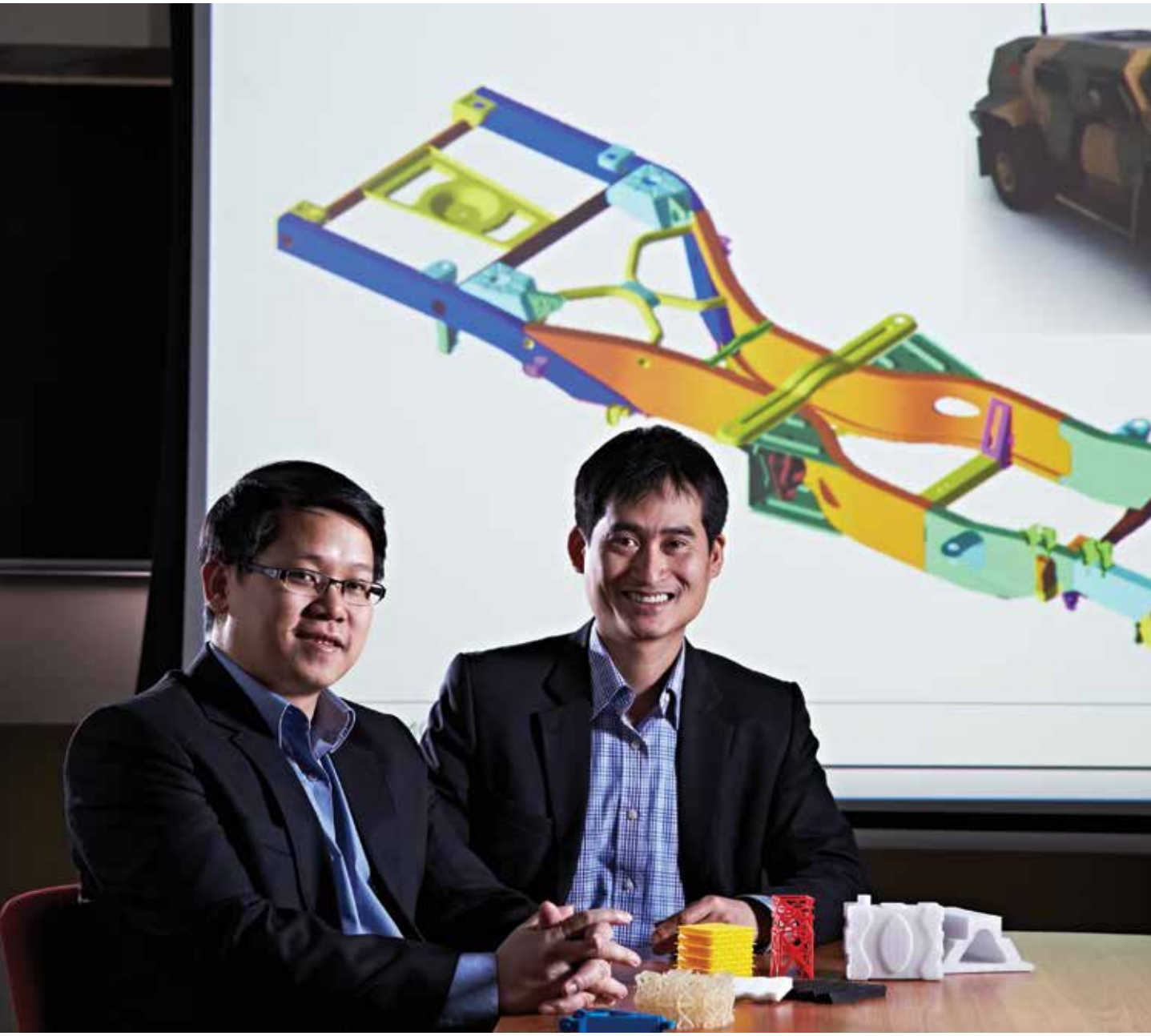
Program leaders

Armour Applications
James Sandlin

Personnel Survivability
Deepak Ganga

The Australian Army is emerging from a decade of high-tempo operations in Iraq and Afghanistan. With the global security environment becoming increasingly more uncertain and having to operate within a fiscally constrained environment, Army has developed a modernisation program that is modular, adaptive and increasingly interoperable. DMTC's Land domain Programs seek to address both mounted and dismounted materials and manufacturing challenges to ensure the best fighting and protective capabilities are available in Australia for use by the Australian Defence Force.

STRUCTURAL OPTIMISATION DRIVES DESIGN OF LIGHT WEIGHT VEHICLES



JONATHAN TRAN AND TUAN NGO OF THE UNIVERSITY OF MELBOURNE WITH OPTIMISED VEHICLE CHASSIS CONCEPTS

"Engineers are faced with the challenge of minimising the weight of the vehicle while still meeting structural performance, protection levels and endurance requirements."

Force structure planning by the Australian Defence Force is driving an evolution in the design and development of protected military vehicles. Future vehicle acquisition plans include vehicles that are smaller and lighter and this is influencing the types of vehicles being developed by defence companies. Engineers are faced with the challenge of minimising the weight of the vehicle while still meeting structural performance, protection levels and endurance requirements. Meeting these challenges has pushed engineers to embrace lightweight materials, explore new design concepts and take advantage of state of the art engineering tools.

To assist with these challenges, Thales Protected Vehicles engaged DMTC to conduct a collaborative research project involving The University of Queensland and The University of Melbourne, with the objective of determining the mass and cost impact of light weight material alternatives. In addition to investigating lightweight materials such as carbon fibre and changes to the manufacturing route, such as casting instead of fabrication, the project also used topological optimisation to redesign some components.

While design optimisation tools have been around for decades, effective use of these tools to provide real time usable solutions requires highly skilled personnel with significant experience. Experts in the field from the Advanced Protective Technologies for Engineering Structures (APTES) group at The University of Melbourne were embedded in the design team at Thales to work side by side on the actual vehicle components. This approach fast tracked what would otherwise have been sequential activities and enabled real time updates of the design based on research outcomes.

The approach also turned the risks associated with the use of different software packages by the design and research teams into an opportunity for skills transfer. Thales was able to establish an optimisation capability within their design team and build an optimisation loop into the design work flow. In the process DMTC was able to understand and address the commercial sensitivities and information bottlenecks that exist in this type of project. The project successfully delivered a number of engineering solutions, some to be incorporated into the next Hawkei build at Thales.

LAND – HIGHLIGHTS

NEW TECHNIQUE FOR EXPLOSIVE BONDING OF ARMOUR GRADE METALLICS

Researchers at DSTO, with support from University of Wollongong, ANSTO, BlueScope, Bisalloy and Thales have pioneered a new technique in the explosive bonding of armour grade steels. Based on the hardness of the steel to be bonded there has historically been theoretical limits to the alloys that can be successfully joined. DSTO has devised a method for increasing the energy transfer between the two plates without increasing the bonding velocity by changing the geometry of the explosive bonding technique and therefore allowing harder steels to be joined. This new technique could lead to weight optimised vehicle structures which offer superior performance without the fatigue life compromises often associated with building vehicles from high hardness armour steel.

EVOLUTION OF AUTOMATED OFFLINE PROGRAMMING

DMTC's unique Automated Offline Programming technology lends itself to opportunities in cost effective mass-customisation, where full scale production efficiencies and economies of scale can be realised while each platform coming out of an assembly cell is tailored. The technology that allows assembly robots to be automatically programmed on the basis of assembly drawings is now fully implemented on the Thales Bushmaster production line and completing more than 90% of the vehicle welds. The next adaptation of the technology is being developed by University of Wollongong and Thales for assembly of lightweight welded tubular space frames in the next generation land vehicle chassis. This flexible and adaptable technology is finding uses beyond its original purpose into a wide range of assembly techniques, allowing high volume economies of scale to be realised by the low and medium volume equipment manufacturers which make up the Australian defence industry.

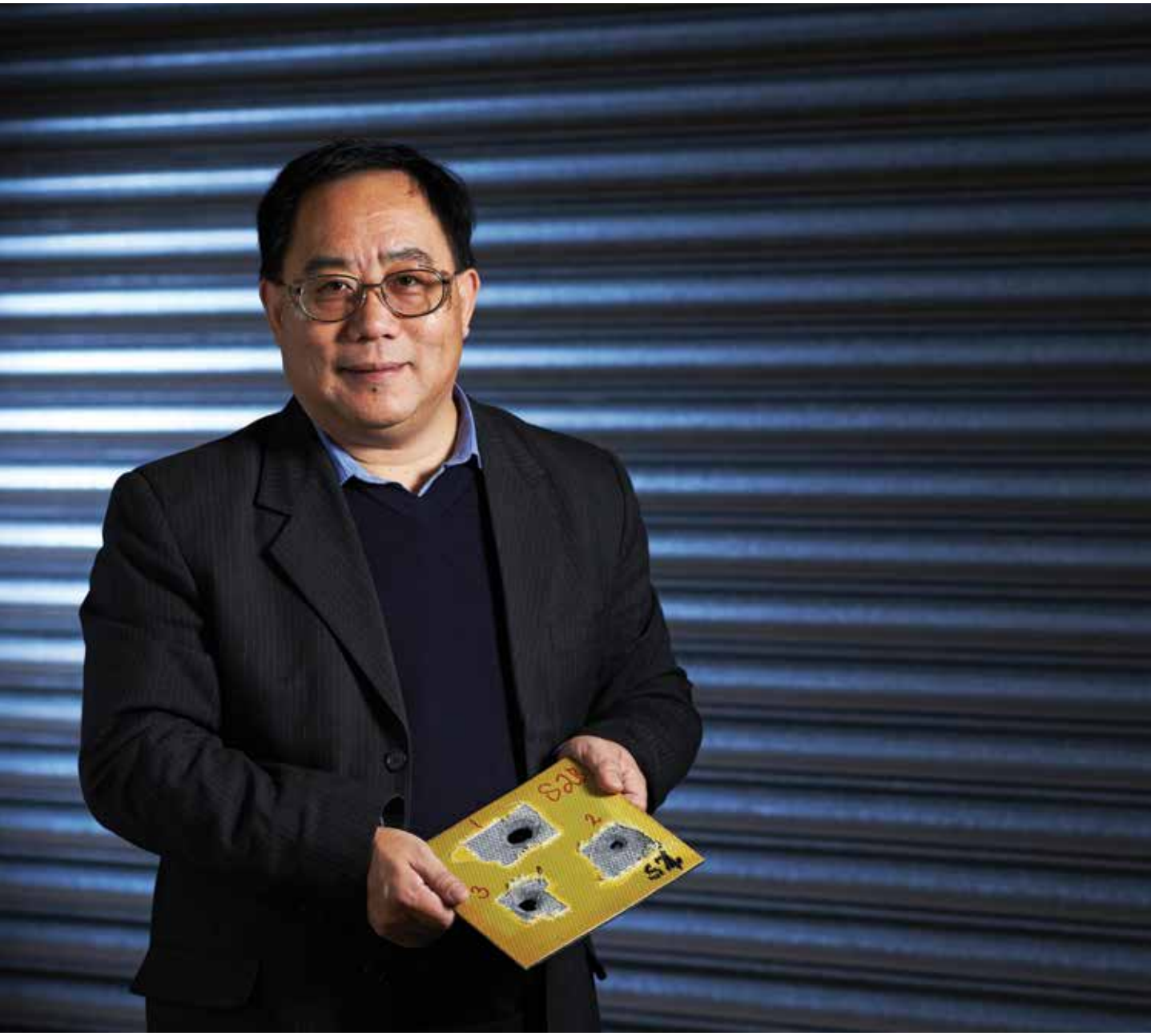
RENEWABLE ENERGY FOR OUR SOLDIERS

Having access to power in theatre is a key operational requirement for the Australian Defence Force. Reversible fuel cells combined with solid state metal hydride storage of hydrogen offers a system that can be recharged by photovoltaic array, wind generator or other local power source. Through RMIT University and with support from the Defence Science Institute and DSTO, DMTC is conducting a scoping study into a portable power supply for defence applications based on reversible hydrogen fuel cell technology. The study is assessing the Australian industrial capability to develop and manufacture a portable power supply system for Defence applications. It is hoped that there is sufficient industry capability in Australia to manufacture the essential components of the reversible fuel cell, those being the metal hydride storage and the balance of the system. The study will therefore also develop a technology and commercialisation roadmap outlining the proposed technology development path. The outputs of this study will greatly assist RMIT University in a subsequent project under the Department of Defence Capability Technology Demonstrator (CTD) program to design and construct a portable 2 kW demonstrator that can be readily scaled up to 20 kW.

POLYMER CERAMICS CONSIDERED FOR NEXT GENERATION BODY ARMOUR

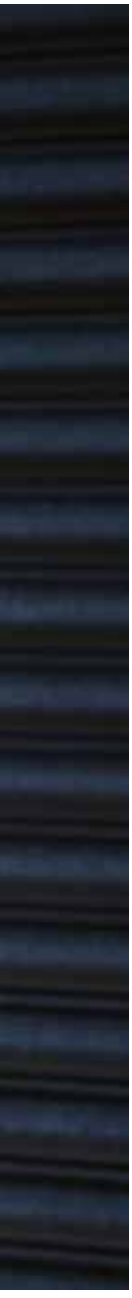
Lightweight body armour systems are typically made of high hardness, low density ceramic tiles based on the high specific compressive strength and very effective blunting of projectiles. Despite its overall suitability, a number of challenges with many of the ceramics used in armour systems remain, including limited formability and poor multi-hit capability. DMTC researchers at VCAMM, ADA and Deakin University are looking at alternative materials and systems in an effort to provide new solutions for body armour that can deliver both increased performance and reduced weight. Polymer Ceramic is one material under investigation that is produced by infusing hard ceramic particulate with high modulus polymers and nano-technology. The resulting material has been shown to offer a number of advantages over traditional ceramics including low temperature processing, ease of moulding and extreme multi-hit performance. The ultimate goal of the research is to achieve equivalent ballistic performance to silicon carbide and thus create a more cost effective and easily fabricated body armour material option.

NEW CONCEPTS IN LOW PROFILE BODY ARMOUR



HUIJUN LI, UNIVERSITY OF WOLLONGONG WITH UHHS BODY ARMOUR PLATE

"Changes in Australian Defence Force operational requirements over the last ten years have driven significant technological advancements in body armour design and materials."



Changes in Australian Defence Force operational requirements over the last ten years have driven significant technological advancements in body armour design and materials. Iraq operations were biased toward mounted operations, creating the need for maximum protective coverage of the soldier and led to the uptake of lightweight materials such as Silicon Carbide for the Hard Armour Plates (HAP). Afghanistan operations were characterised more by dismounted operations where soldiers patrolled on foot, often for extended periods, and engaged the enemy at close quarters in village settings. In this scenario endurance and weight reduction was key to survivability and this drove designers of HAPs to consider ultra-lightweight materials like Boron Carbide.

The main advancement in body armour during this period was the uptake of ceramics as a strike face material in the body armour system. With a density almost one third that of steel and with hardness values close to that of pure diamond, ceramics are the ideal material for high-end ballistic protection. However, for these ceramic-based systems to be effective, a thickness in the range of 20mm to 30mm is required. While this thickness range is considered acceptable for most Australian Defence Force operations, Special Forces would benefit from a thinner, lower profile solution at the expense of weight, to optimise for manoeuvrability. A design alternative could be a substitution of the ceramic strike face with a much thinner, Ultra High Hardness Steel (UHHS). For this to be possible, the UHHS would need to be thinner than 20mm while providing the same level of ballistic protection as a ceramic.

A DMTC project involving the University of Wollongong, Australian Defence Apparel, BlueScope Steel and DSTO is developing a UHHS to function within a low profile body armour system for use by the Australian Special Forces personnel. The objectives of initial research included the identification of suitable steels that with heat treatment could reach the desired hardness; to find ways of shaping the strike plate into the desired curvature without affecting the integrity of the product; and being able to roll the strike plates down to a thickness of less than 3.5mm.

The research team has now down-selected four candidate steels and through a series of heat treatment trials at the University of Wollongong have been able to achieve the desired hardness levels in two of those steels. The University of Wollongong scientists have also identified the most appropriate set of parameters to bend a strike plate into the desired curvature without affecting the performance. These two achievements have provided sufficient confidence to move forward with the development of a UHHS-based HAP. The next stage of the project will look at the challenges of rolling the steel down to the target thickness of less than 3.5mm without diminishing the hardness. Full-scale ballistic tests will then be carried out to determine the mass efficiency of a UHHS-based HAP.

SEA

Improving productivity and enhancing sustainment practices of the Australian maritime industry

Program leader

Maritime Platforms:
Stephen van Duin

The Government has outlined a plan for naval shipbuilding over the next 20 years that includes the acquisition of over 40 naval ships comprised of a number of submarines, frigates, offshore combatant vessels, heavy landing craft, a strategic sealift ship, and a replenishment and logistic support platform. If Australian industry is to achieve a competitive productivity level and high fabrication quality standards there needs to be a considerable investment to improve many technologies and manufacturing processes used by industry. DMTC's Maritime domain Program is seeking to address key materials, manufacturing and productivity challenges facing the industry and Navy to ensure Australia can deliver on the acquisition and sustainment requirements.

AUSTRALIAN MANUFACTURING CAPABILITY TO PRODUCE SINGLE CRYSTAL PIEZOELECTRIC MATERIALS

Single crystal piezoelectric materials are the latest generation of acoustic transducers that are expected to improve the sensitivity of sonar equipment. Single crystal piezoelectric materials are currently imported into Australia and this supply uncertainty is limiting local technology development. In response to increasing demand and need for supply certainty, DMTC has undertaken a feasibility study with Thales Australia, ANSTO and the University of Wollongong to investigate single crystal growth technologies and production processes that will enable the establishment of a manufacturing capability in Australia.

An extensive literature review has revealed several competing technologies are available for the growth of single crystal piezoelectric materials. Laboratory scale trials have been conducted at the Institute of Semiconductor and Electronic Materials (ISEM) labs at the University of Wollongong and at the Institute of Materials Engineering at ANSTO to assess the “modified flux growth” and “solid state conversion” methods.

The modified flux growth method creates a liquid solidification interface using a gradient profiled furnace to grow lead-based crystals. Cost is an impediment of this method due to the use of platinum as the containment material however other materials are being investigated to reduce this cost. The narrow processing window of crystals grown by the solid state method has also been evaluated and mapped to both seed-crystals and piezoelectric composition.
In addition to the single crystal solid state growth method, ANSTO has investigated ceramic tape technology to develop a ‘near net-shaped’ ceramic. This thin cast piezoelectric material is sintered to full density followed by a prescribed annealing step.

This preliminary project has been completed and subsequent research is focussed on optimising process scale-up. Demonstrating large-scale processing capacity and its repeatability will allow single crystal piezoelectric technology to be considered for commercial production.

"Single crystal piezoelectric materials are the latest generation of acoustic transducers that are expected to improve the sensitivity of sonar equipment."

ELECTRO-OPTIC HYDROPHONE ASSEMBLY AT THALES UNDERWATER SYSTEMS

SEA – HIGHLIGHTS

AGGRESSIVE CORROSION IN SUBMARINES PREVENTED

Microbiological Influenced Corrosion (MIC) is responsible for accelerating aggressive corrosion damage of marine components during operational and idle time of Australia's naval fleet. Researchers at Swinburne University of Technology have been working with ASC to assess Australian naval ports and harbours to identify what microbiological species are present in these waters and how this influences the development of MIC. An understanding of the water's composition is being used to generate a strategy to mitigate the effect on metal corrosion and therefore extend the operational life of our naval vessels and other maritime assets. The project has determined the levels of dissolved O_2, pH, temperature and electrical conductivity of the water along with levels of pollutants, bacteria, metal ions, hardness, biochemical oxygen demand, and determined the change in level of these parameters with respect to seasonal variance. Results have been referenced against the Defence standard and have resulted in ASC modifying the maintenance and operational procedures for relevant equipment.

NEW COATINGS TO INCREASE CORROSION PROTECTION FOR NAVY

MacTaggart Scott Australia, United Surface Technologies (UST) and Swinburne University of Technology have evaluated new High Velocity Oxygen Fuel (HVOF) coatings with the intent of increasing the corrosion protection technology applied to components that experience high wear in maritime environments.

Conventional coating technologies including Electroplating Hard Chrome (EHC) or plasma sprayed ceramic coatings are prone to micro-cracking both in service and during initial deposition. This allows subsurface corrosion of the base materials to occur that then requires expensive refurbishment or replacement. In contrast, the coatings generated using the HVOF method can have increased density and are less porous than EHC coatings. HVOF also produces a result that has a high coating adhesion strength, absence of fatigue debit, no hydrogen embrittlement imparted to the alloy substrate and superior functional properties. These properties all result in a final coating which has high antifouling, anti-corrosion and excellent wear-resistant properties, making the coating technology ideal for components subjected to extreme marine environments. The analysed HVOF coatings can be readily applied during manufacturing or maintenance, repairs and overhaul stages of maritime components.

SELF-PROGRAMMING ROBOTS INCREASE PRODUCTIVITY

Researchers at the University of Wollongong have built on the success of Automated Offline Programming (AOLP) further by eliminating the need to rely on CAD data when programming a robot. AOLP was successfully implemented in the armour platform for fabrications that have concise 3D drawings. In contrast, this newly developed technology uses visual and spatial data from sensors to detect and build up component geometries, weld positions and obstacles from an unknown state that can then be used to autonomously produce the robot programs. This concept is particularly relevant in shipbuilding where drawings often mismatch the assembly due to variations in processes. The system was applied to a deck panel supplied by Forgacs Engineering and demonstrates the potential to reduce costs and improve production rates in non-repetitive welding tasks.

ACTIVE DISTORTION CONTROL ELIMINATES WELD REWORK

The Dynamically Controlled – Low Stress No Distortion (DC-LSND) process involves applying a localised heating or cooling source behind the welding arc. It is known to significantly reduce welding induced distortion caused by the Gas Metal Arc Welding (GMAW) process. Numerical modelling performed by ANSTO researchers has provided important guidelines for properly selecting parameters in applying DC-LSND to GMAW. Results were validated at the University of Wollongong with butt welds on DH36 shipbuilding plate showing a significant reduction in longitudinal and transverse distortion. The University of Wollongong also developed a cryogenic robotic applicator for butt welding and ANSTO's modelling helped researchers define the mechanisms of residual stress reduction, predicted changes in mechanical properties around the fusion zone and gave a better understanding of the optimised positioning of the cooling relative to the weld pool.

IN PURSUIT OF AN AUSTRALIAN SUBMARINE STEEL

DMTC has continued to work with BlueScope Steel, Bisalloy and the University of Wollongong on the development of a 690 MPa candidate steel which will satisfy the anticipated requirements of a new submarine steel for Australia. BlueScope Steel, in conjunction with Bissalloy Steels, successfully supplied the steel plate for the Collins Class submarine fabrication and is now drawing on this experience to work with DMTC on developing a modified steel that is specifically designed to suit the construction of Australia's future submarines and their unique operating conditions.

The research team is experimenting with the steel chemistry and process conditions to resolve costly production difficulties originally identified during the Collins Class submarine build. The weldability of a steel has a significant effect on the cost of fabrication and correspondingly the key focus of research has centered on maintaining or improving the weldability whilst improving the Australian specific mechanical property capability, particularly the toughness and fatigue performance, whilst also resolving the steel manufacturing difficulties.

The project team recently cast the second of two 250 tonne iterative steel heats and had it benchmarked against other steels in an independent mechanical testing program. The results have provided data that will enable further optimisation of the steel design, including changes to chemistry, thermo mechanical processing and heat treatment.

By commencing this work before the future submarine design is selected, DMTC researchers hope to provide a path for an Australian produced steel to be certified for selection. It is also hoped that the early optimisation of the steel chemistry and weldability characteristics will enable advanced welding and joining processes to be incorporated into the submarine design.

TESTING OF THE STEEL TOUGHNESS AT BLUESCOPE STEEL

DMTC PROJECTS

CHANG-HO CHOI OF DSTO WITH EXPLOSIVE BULGE TEST SAMPLE

AIR DOMAIN PROJECTS

NUMBER	TITLE	TECHNOLOGY FOCUS	STATUS
1.1.1a	Development of New Titanium Fabrication Technology	Machining	*In progress*
1.1.1b	Next Generation Tooling Development	Cutting Tools	*In progress*
1.1.2	Advanced Process Monitoring Tools and Transfer to Manufacturing Supply Chain	Process Monitoring	*In progress*
1.1.2b	Extended Titanium Benchmarking	Thermal and Coolant Management	*Complete*
1.3	Evaluation of Titanium Direct/Additive Manufacturing and Robotic Machining	Advanced Manufacturing	*Complete*
1.4	Laser Direct Manufacturing of Small Scale High Value JSF Type Components	Advanced Manufacturing	*Complete*
1.6	Aircraft Prognostic Tools to Reduce Corrosion Impacts	Health Monitoring	*In progress*
1.6.1	Distributed Fibre Optic Paint Degradation Sensor	Corrosion	*Complete*
1.6.2	Cost of ADF Aircraft Corrosion	Corrosion	*In progress*
1.7	Rapid and Reliable Detection of Analysis of Composite Defects	Non-destructive Testing	*Complete*
1.8	Development of Heat Treatment Capability for Beta Titanium Alloys	Heat Treatment	*Complete*
1.9	Evaluation of Different Additive Manufacturing and Machining	Advanced Manufacturing	*Complete*
1.11	Residual Stress of Additive Manufacturing	Advanced Manufacturing	*Complete*
4.1	Repair Technologies for Current and Next Generation Aircraft Systems	Repair	*In progress*
4.2	High Temperature Materials for Hyper and Supersonic Flight	Advanced Materials	*Complete*

LAND DOMAIN PROJECTS

NUMBER	TITLE	TECHNOLOGY FOCUS	STATUS
3.1	Evolution of Armour Requirements and Development of Improved Systems and Manufacturing Techniques	New Ferritic Materials and Joining Techniques	Complete
3.1c	Lower Pre-Heat Welding Technique for Armour Steels	Automated Manufacturing	Complete
3.2	Alternative 'Next Generation' Ferritic Armour System for Vehicles	New Ferritic Materials, Performance Modelling, Simulation & Validation	Complete
3.3	Advanced Personnel Armour	Niche Manufacturing Processes, Performance Modelling, Simulation & Validation	Complete
3.4	Comparison of Mechanical and Welded Joints for Construction of Components for Armoured Vehicles	Joining Technologies, Performance Modelling, Simulation & Validation	In progress
3.5	Lean Automation Technology for Advanced Manufacturing of Armoured Vehicles	Automated Manufacturing	In progress
3.6	Development and Commercialisation of Ceramic Protective Equipment	Niche Manufacturing Processes	Complete
3.7	Research, Development, Design and Manufacture of a New Combat Helmet	Composites, Titanium Component Fabrication	Complete
3.8	Alternate Materials and Manufacturing for Next Generation Armoured Vehicles	Composites, Titanium Component Fabrication	Complete
7.1.1	Ceramic Armour Technologies	Niche Manufacturing Processes	In progress
7.1.2	High Curvature Armour Systems	Niche Manufacturing Processes, Textile Technologies	In progress
7.1.3	Low Profile Body Armour	New Ferritic Materials	In progress
7.2.1	Improved Anti-Ballistic Soft Armour	Composites, Textile Technologies, Performance Modelling, Simulation & Validation	In progress
7.3.1	High Strength Fabrics for Combat Clothing	Textile Technologies, Composites, Performance Modelling, Simulation & Validation	In progress
7.4.1	Portable Power Generation	Niche Manufacturing Processes	In progress
7.4.2	Portable Power Storage	Niche Manufacturing Processes	Complete

SEA DOMAIN PROJECTS

NUMBER	TITLE	TECHNOLOGY FOCUS	STATUS
2.1	High Strength Steels for Defence Application	New Ferritic Materials and Joining Technologies	Complete
2.2	Surface Processing Technologies for Repair and Improved Performance for Submarine and Surface Ship Components	Corrosion, Prognostics & Repair	Complete
2.3	Technology Development for Multifunctional Composite Structures	Composites, Component Integration	Complete
2.4	Lean Automation Technology for Advanced Manufacturing of Marine Defence Components and Assemblies	Joining Technologies, Performance Modelling and Simulation	Complete
2.5	Corrosivity of Australian Naval Bases	Corrosion	Complete
2.6	Performance Optimisation in PZT Ceramic by Advanced Materials Processing for Sonar Applications	Niche Manufacturing Processes	Complete
2.7	Evaluation of Candidate Hull Steels for Submarine Applications	New Ferritic Materials	In progress
2.8	Feasibility Study Single Crystal Piezoelectric Ceramics	Piezoelectric Ceramics	In progress
2.10	High Velocity Oxygen Fuel Carbide Based Coating for Marine Corrosion Protection: Preliminary Study	Coatings	Complete

FINANCIALS AT A GLANCE

DMTC continued to focus the majority of its expenditure on the successful delivery of project outcomes across the existing portfolio of projects. DMTC receives a portion of its income from the Defence Materiel Organisation (DMO) and this is pooled with additional contributions from Australian industry, research agencies and other sources including State Governments.

Income for the 2013-2014 financial year totalled $21.84 million which included $12.99 million of in-kind contributions from DMTC's industry and research Participants. Total in-kind contributions from industry and research Participants exceeded commitments by 76% for the year and 28% on a cumulative basis. Cash contributions from industry and research Participants also exceeded original commitments both for the 2013-2014 financial year and cumulatively.

Cash on hand totalled $6.08 million at 30 June 2014 which included $3.97 million of unspent funds received from Commonwealth and State Governments. The majority of these funds will be applied to fulfil existing project programming during the 2014-2015 financial year. Any remaining unallocated funds will be directed to new projects that will both grow participation in the DMTC and that are of strategic importance to overall defence sector capability in Australia.

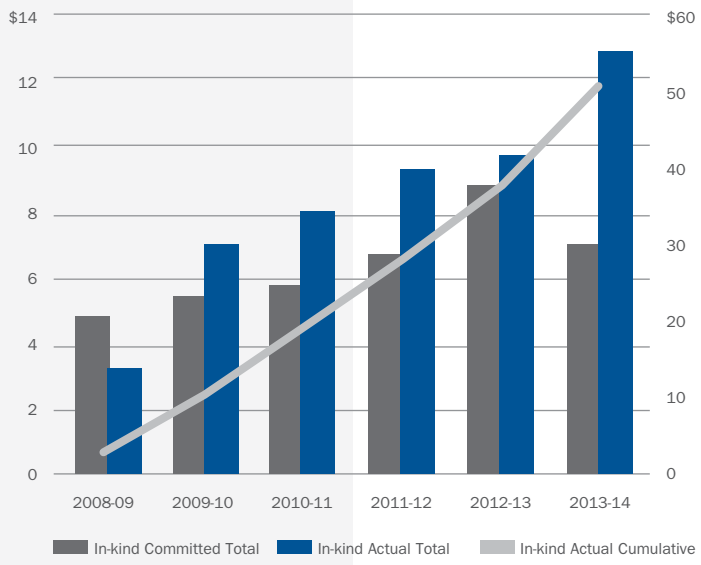
DMTC successfully introduced a new accounting and reporting system on 1 July 2013. The new system has greatly enhanced the financial reporting capability during the 2013-2014 financial year and will be able to seamlessly incorporate new program finances as they arise into the future.

THE YEAR IN SUMMARY	2014	2014
Revenue (Total Cash & In-kind)	($)	($)
Commonwealth Government	6,800,000	6,800,000
Industry and Other Income	6,371,482	3,998,606
Research Sector	8,665,040	7,792,516
	21,836,522	**18,591,122**

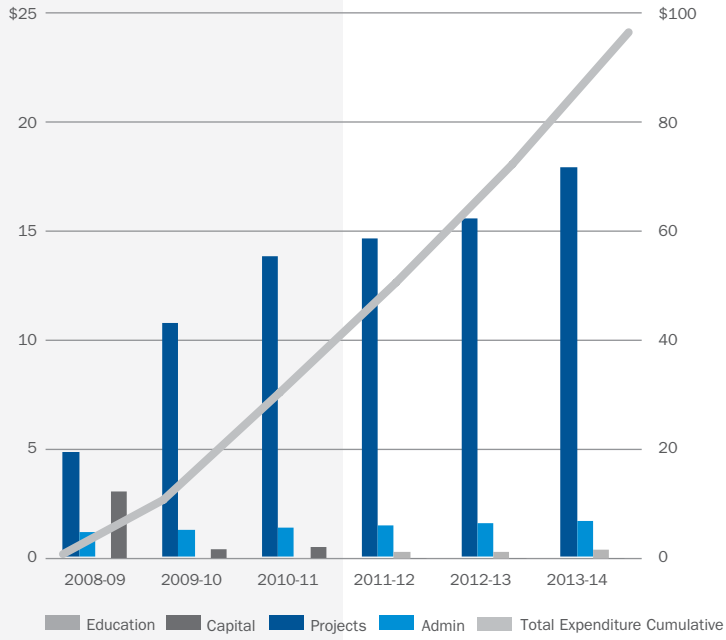
EXPENDITURE (TOTAL CASH & IN-KIND)	$	$
Capital	31,769	119,938
Education	346,297	259,012
Projects	19,151,732	16,639,338
Administration	1,797,354	1,675,354
	21,327,152	**18,693,642**

HUMAN RESOURCES SNAPSHOT		
Full time equivalent staff in-kind contributions	53.6	49.4
Post graduate students	31	30
Centre management employees	9	8

TOTAL ANNUAL IN-KIND CONTRIBUTIONS



TOTAL EXPENDITURE



REVENUE SOURCES

40%

$8,665,040
Research

31%

$6,800,000
Commonwealth Government

29%

$6,371,482
Industry and Other

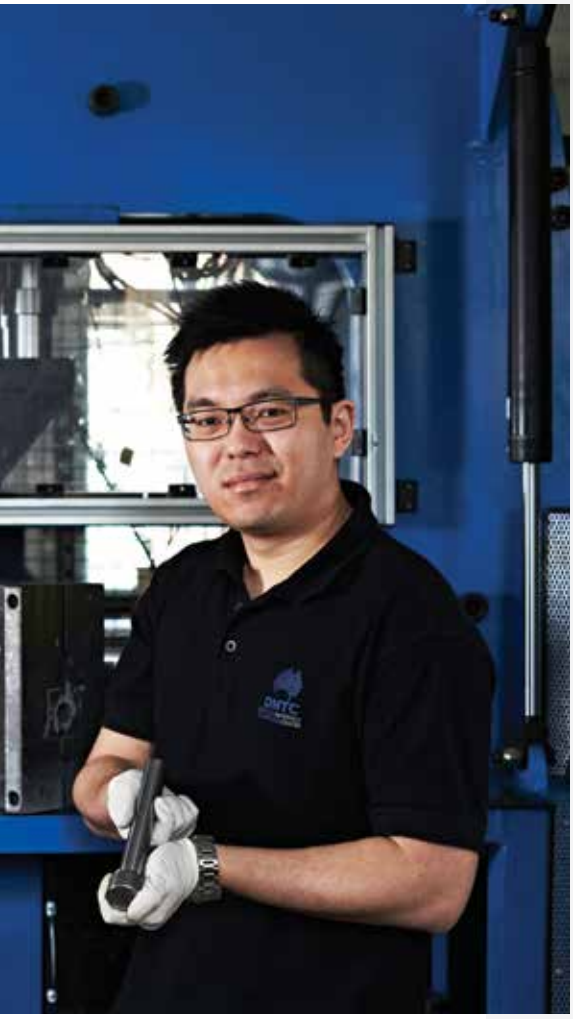
TOTAL REVENUE 2013-2014 $21.84 MILLION

TOTAL IN-KIND 2013-2014 $12.99 MILLION

EDUCATION PROGRAM

Supporting the development of new talent, knowledge and skills is an integral part of DMTC's objectives. Developing new knowledge through our research programs is just the start of our skill creation activities. 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 knowledge transfer projects, supporting students to work on real industry led projects and through the commercialisation of new technologies. The DMTC Education Program activities include:

- an annual Student Conference where students present their research to their peers;
- professional development workshops for broader sector-relevant skills development that align with the needs of DMTC industry and research partners;
- competitive selection to present at the DMTC Annual Conference;
- involvement in project reviews and research utilisation discussions with industry partners; and
- support to attend conferences.



THE YEAR IN REVIEW

The DMTC Education Program had an extremely successful year with six DMTC scholarship holders being awarded the Doctor of Philosophy degree. DMTC also continues to expand the program, bringing on two new students from Swinburne University to complement our corrosion activities in the Maritime Platforms program. Also in the maritime space, DMTC student Cameron Barr from the University of Melbourne won the Maritime Australia Innovation Award 2013 "Young Innovator Scholarship for Defence Industry Innovation", presented at the Pacific 2013 International Maritime Exposition in Sydney.

Ensuring the DMTC Education Program continues to support a critical mass of students during its transition to a new funding model has been of major consideration this year. In this light, the DMTC has partnered with the Australian Maritime College along with other research and industry partners for an ARC Industry Transformation Training Centre grant. This Centre has been awarded funding for ten PhDs and three post-doctoral researchers to establish a "Research Training Centre for Naval Design and Manufacturing". DMTC's support is through in-kind contributions to include the PhD candidates in the Annual DMTC Student Conference and professional development workshops.

DMTC also reintroduced our Vacation Student program, sponsoring five final year engineering students in completing 12 weeks of vacation employment. Students were located at University of Wollongong, Rosebank Engineering, RMIT University, Sutton Tools and DMTC.

Furthermore, three DMTC students were awarded at the DMTC Annual Conference for the excellent work being conducted in their PhD projects. These include:

> Early Career Award – Cameron Barr, The University of Melbourne

> Best Student Poster Award – Shi Da (Stephen) Sun, RMIT University

> Best Student Presentation Award – Silvia Leo, The University of Melbourne

EDWARD LUI, THE UNIVERSITY OF MELBOURNE WITH ECAP-RECYCLED TITANIUM COMPONENT

TITANIUM ADDITIVE MANUFACTURING USING THE WIRE ARC PROCESS AT THE UNIVERSITY OF WOLLONGONG

ANNUAL STUDENT CONFERENCE

DMTC held its Annual Student Conference at the Australian Nuclear Science and Technology Organisation in NSW in October 2013 with 21 DMTC sponsored PhD and Masters Candidates attending along with over 20 supervisors, industry and research participant representatives.

Each student presentation was evaluated by an experienced panel that selected the best presentation from each domain to be given the opportunity to present their work at the DMTC Annual Conference.

The best presentations from each domain were:

- Land: Silvia Leo, The University of Melbourne
- Sea: Muhammad Awais Javed, Swinburne University of Technology
- Air: Michael Wang, The University of Melbourne

WORKSHOPS

MODELLING AND SIMULATION

DMTC held a modelling and simulation workshop in March 2014. The workshop gained significant interest across DMO, DSTO and Army as well as our industry and research partners with approximately 25 people attending. The workshop discussed the capabilities and expertise in modelling that exists within the DMTC community and its importance to modern technology development. The workshop had a series of speakers from Thales, ANSTO, Pacific ESI and The University of Melbourne, each with expertise in particular areas of modelling followed by an open forum discussion on collaboration opportunities, issues and challenges.

PROJECT MANAGEMENT

In June, 2014, DMTC ran a two day training workshop in Project Management to develop the skills of current DMTC sponsored postgraduate students and partner organisation employees. The workshop was aimed specifically at preparing the attendees for a smooth transition to Project Leader roles within DMTC and our partner organisations with a specific focus on collaborative and research based projects. The workshop was attended by 25 people and included training in project management tools, techniques, and DMTC project management processes.

CAREERS

DMTC conducted a careers workshop for sponsored post graduate students in October 2013. With many students scheduled to finish their research projects within the next 12 months, it was considered timely to discuss different career paths that exist for PhD graduates. Four guest speakers gave their perspective on different career paths with tips and tricks for getting ahead. DMTC also provided PhD and Masters students with access to a CV writing service that provided students with a professionally written resume that they can update and tailor for future job applications.

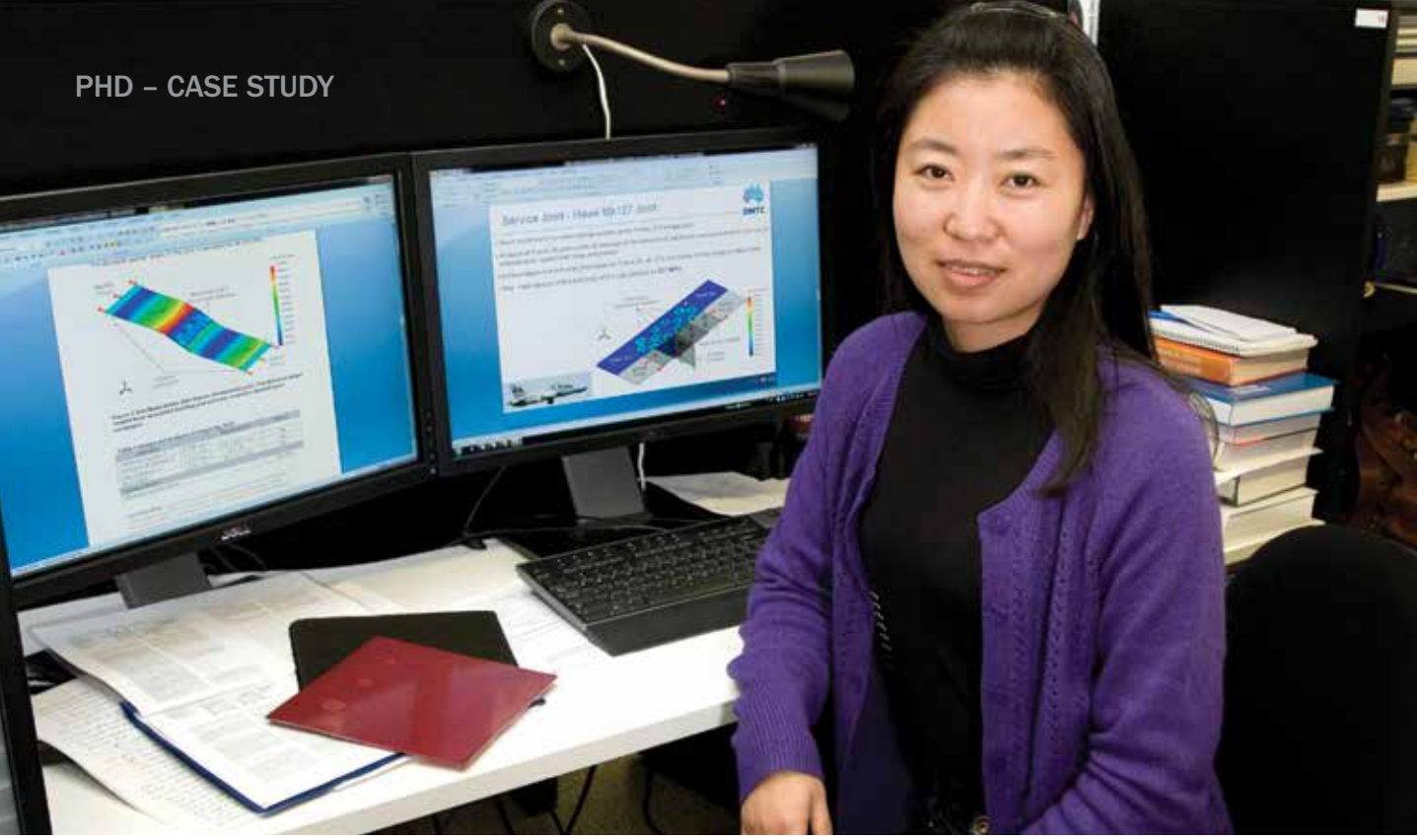
PHD AND MASTERS CANDIDATES

DMTC is currently supporting 25 post graduate candidates with scholarships and involvement in the DMTC Education Program. Post graduate scholarships are awarded based on alignment with the defence capability requirements and placement opportunities within Australian industry. Six sponsored PhD candidates have been awarded their Doctor of Philosophy since DMTC began its operations.

CURRENT POST GRADUATE PROJECTS

NAME	INSTITUTE	RESEARCH TITLE	DOMAIN
Alex Visser	University of Wollongong	Offline Programming in a Dynamic Environment	Land
Andre Rousseau	RMIT University	Metallurgical Characterization and Performance of Modern Tool Materials used in Metal Cutting Applications	Air
Cameron Barr	The University of Melbourne	Equal Channel Angular Processing of Nickel Aluminium Bronze for Marine Platforms	Sea
Damith Mohotti	The University of Melbourne	The Use of Polymer Coating to Enhance the Projectile Impact Resistance of Steel and Aluminium Plate Structures	Land
Donna Capararo	The University of Queensland	Mechano-Chemical Rate Determining Step and Mechanisms of Crack Initiation in Aircraft Coatings	Air
Eric Yang	The University of Melbourne	Influence of Fabric Structures on the Blast and Impact Resistance of Textile Composite Materials	Land
Jimmy Toton	RMIT University	Metal Cutting Mechanics and the Challenges of Real Life Cutting Tool Testing	Air
Joseph Polden	University of Wollongong	The Automation Assisted Manufacture of Defence Vehicles and Land Platforms	Land

Long Nguyen	RMIT University	Ballistic Performance of UHMW Polyethylene Armour	Land
Manasa Kesharaju	Swinburne University of Technology	Ultrasonic Sensor-based Approach to Defect Detection and Characterization of Armour Ceramics	Land
Michael Wang	The University of Melbourne	Modelling Two Phase Material properties Using Monte Carlo approach	Air
Mitchell Sesso	Swinburne University of Technology	Design of Thermal Barrier Coatings for Hypersonic Applications	Air
Mohammad Mehdizadeh	RMIT University	The Durability, Reliability and Functionality of SHM Systems in Multifunctional Composites	Air
Muhammad Awais Javed	Swinburne University of Technology	Role of Metallurgical Features on Microbiologically Influenced Corrosion (MIC) of Ferrous Substrates	Sea
Mya Myintzu Hlaing	Swinburne University of Technology	Study of Factors Influencing Bacterial Biofilm Formation	Sea
Nathan Lane	University of Wollongong	An Investigation into the Toughness and Weldability of High-Strength Steels for Australian Naval Surface Vessels	Sea
Nicholas Orchowski	RMIT University	Investigation into the Post-Repair Performance of Ti6Al4V after the Occurrence of Foreign Object Damage	Air
Nicholas Paul Hoye	University of Wollongong	Control of Material Properties in Wire-arc Deposited Welds of Titanium Alloys	Air
Paul Mignone	The University of Melbourne	Modelling Two Phase Material Properties Using Finite Element Analysis and Microstructure	Air
Peng Luo	The University of Melbourne	Recycling of Ti Machining Chips	Air
Shi Da (Stephen) Sun	RMIT University	Laser cladding of High Strength Steel for Aerospace Applications	Air
Silvia Leo	The University of Melbourne	Colloidal Processing of Difficult to Densify Ceramics	Land
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	Air
Toby Joel Seidel	RMIT University	Phase Compensation Methods for Load Bearing Antenna Array	Sea
Vanessa Lussini	Queensland University of Technology	The Synthesis and Evaluation of Novel Perylene-based Profluorescent Nitroxides Probes	Air



DR BING (KATHY) HAN

MODELLING OF AIRCRAFT COATING DEGRADATION, THE UNIVERSITY OF QUEENSLAND

Dr Kathy Han was awarded her degree in 2014. Kathy's dissertation reports on the development of a special purpose finite element simulation program designed to combine an augmented finite element method and cohesive zone model to simulate initiation and propagation of both cohesive and adhesive cracks in heterogeneous aircraft coating systems. The effects of filler particles on the coating lifetime were studied, including particle size, shape, volume fraction, and particle/matrix interface adhesion. Results indicated that low volume fraction, high interface adhesion and smaller size particles improve coating durability. Among the three factors (filler size, shape and volume fraction), the filler volume fraction had the most prominent influence on coating lifetimes while the filler shape had the least.

The output of this research made an important and fundamental contribution to DMTC Project 1.6 – Aircraft prognostic tools to reduce corrosion impacts.

This project focused on developing and delivering a Corrosion Prognostic Health Management (CPHM) capability through a variety of measuring, detecting and management tools with DSTO and BAE Systems the major partners. These tools will be used to reduce the impact of corrosion on structural integrity, availability, maintenance effort and support costs for military platforms. Dr Han's project contributed by providing a body of knowledge to better understand fundamental failure mechanisms of aircraft coatings and the potential to be used as a design tool to optimize the expected lifetime characteristics of new coatings.

Dr Han is working towards becoming an expert in her professional area. Currently Dr Han is assessing career opportunities in both academia and industry in positions that offer professional enhancement and are of technological interest.

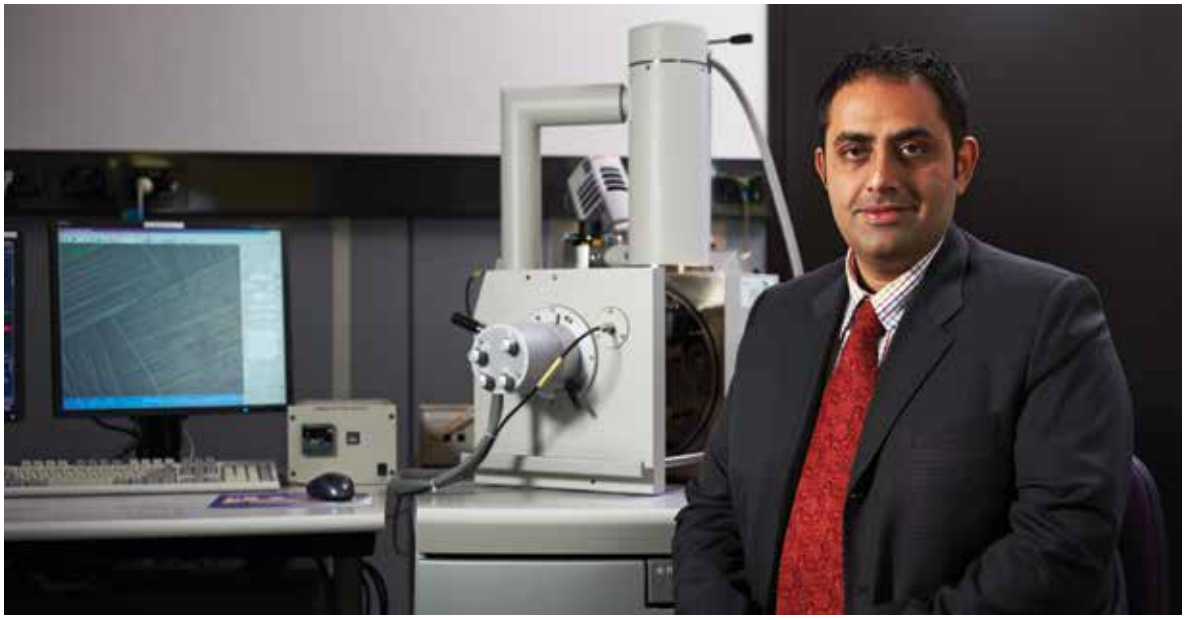
DR RAJNEESH JAITLEE

PHYSICAL PROTECTION: INTERDEPENDENCE BETWEEN HARD ARMOUR AND SOFT ARMOUR, RMIT UNIVERSITY

Dr Rajneesh Jaitlee from RMIT University completed his PhD dissertation in 2014. The aim of Dr Jaitlee's research work was to study the interdependence between hard armour and soft armour systems. The study investigated the effects of cladding on ceramics and improving their fabrication methodology. During the research work, different composite armour styles were fabricated using commercial grade aramids. The research focus was complemented by a series of mechanical tests followed by a series of ballistic tests against a range of military grade projectiles across different velocity ranges. The research concluded that by improving the fabrication techniques used for cladding the ceramic tiles using high performance commercial grade aramid, the back face signature can be reduced and can thus have the potential to mitigate soldier injury.

Dr Jaitlee's work contributed to DMTC Project 3.3 – Advanced Personnel Armour. The project emphasised the design and development of armour styles using new advanced material systems for physical protection comprising advanced textile substrates- such as commercial grade aramids, ceramics, polymer composites and commercial-grade epoxy resins. As threats to Australian Defence Force personnel continue to evolve, there is an urgent requirement for higher performance armour materials to increase the level of protection offered, with a simultaneous requirement for reducing weight and bulk for increased mobility. Dr Jaitlee's project contributed directly to the project aims by building a body of knowledge in the area of hard and soft armours. The project adopted a collaborative approach among defence industry and research organisations Australian Defence Apparel (ADA), Defence Science and Technology Organisation (DSTO) and RMIT University. The project contributed to enhancing new fabrication methodologies that may be used to minimise Back Face Signature.

Dr Jaitlee is keen to establish his career where he can utilise his skillset in the area of ballistics and armour applications and dedicate the experience gained during his research work.



DR LENKA KUZMIKOVA

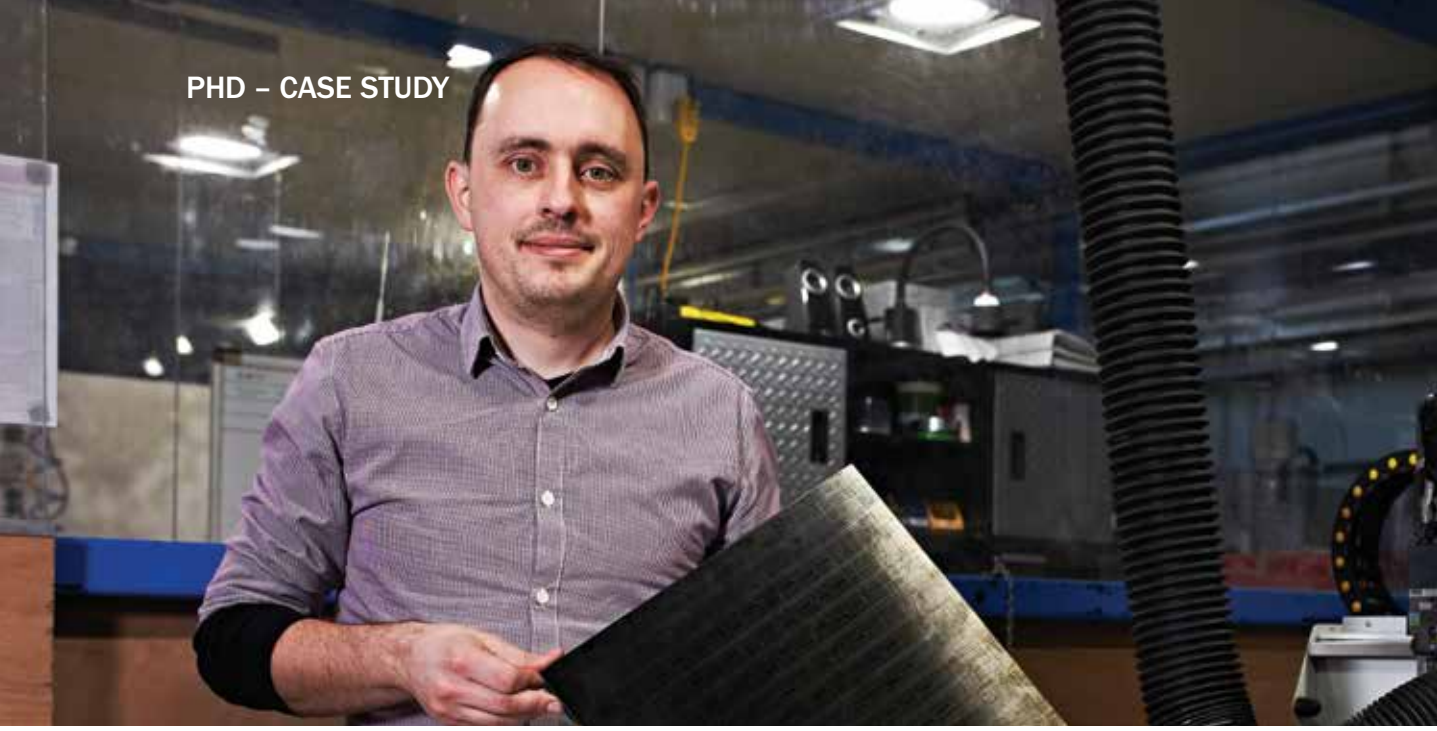
AN INVESTIGATION OF THE WELDABILITY OF HIGH HARDNESS ARMOUR STEELS, UNIVERSITY OF WOLLONGONG

Dr Lenka Kuzmikova was DMTC's first PhD graduate completing her research project at the University of Wollongong. Dr Kuzmikova's doctorate thesis investigated the development of alternative welding techniques in steel hulled military vehicles. Dr Kuzmikova's research focused on optimisation of current welding procedures following lean manufacturing concepts. She also researched the feasibility of hybrid laser-gas metal arc welding (GMAW) for future replacement of the current flux-cored process and developed welding procedures for a typical joint of a tank or armoured personnel carrier. Dr Kuzmikova was officially awarded her degree in 2013.

Findings from Dr Kuzmikova research project directly benefited DMTC Project 3.1 - Evolution of Vehicle Armour and Improved Manufacturing. This project confirmed that the opportunity to eliminate the time consuming and costly pre-heating of large armour plates prior to welding, which could in combination with increased inter-pass temperature, double the production rates whilst maintaining performance. The low pre-heat welding procedures developed within this project are now being validated for commercialisation in a new project. Dr Kuzmikova and her team from University of Wollongong, Thales and DSTO are working to ensure the new welding process is widely accepted via inclusion in the relevant welding and defence standards.

Having displayed outstanding leadership qualities during her thesis research and the high quality of her work, Dr Kuzmikova was hired into the University of Wollongong as a Post-Doctoral Researcher and subsequently given a Project Leaders position for the follow-on optimised welding process project mentioned above. Dr Kuzmikova was also awarded DMTC's Early Career Award in 2012. Lenka is also involved in materials and welding related research for the oil and gas industry through the Energy Pipelines Cooperative Research Centre. Dr Kuzmikova continues to improve her knowledge and practical "hands-on" skills to be able to assist Australian industry to remain competitive and up-front in the tough global market.

DR KUZMIKOVA WITH THE 2013 EUREKA PRIZE WON BY DMTC'S ARMOUR APPLICATIONS PROGRAM TEAM



DR KELVIN NICHOLSON

TUNABLE METAMATERIALS FOR THE SLOTTED WAVEGUIDE ANTENNA STIFFENED STRUCTURE, RMIT UNIVERSITY

Dr Kelvin Nicholson was awarded his PhD degree in 2014. The Slotted Waveguide Antennas Stiffened Structure (SWASS) concept is a conformal load bearing antenna structure designed by a joint DSTO and Air Force Research Laboratory team. In SWASS, the top-hat cross-section stiffeners commonly used to reinforce thin aircraft skins double as microwave waveguides and can therefore be integrated into airframes with little weight and drag penalties compared to conventional protruding aircraft antennas. This work has investigated electromagnetic metamaterials as one approach to overcome the structural impact of the slot and the required orientation of the stiffeners.

Dr Nicholson's work was directly related to DMTC Project 2.3 – Technology Development for Multifunctional Composite Structures. This project investigated vehicle structures that incorporate functional systems such as antennas. By integrating structure and functionality, and simultaneously optimising both, there is tremendous potential to substantially enhance vehicle capability. Significant gains are expected by better integration of existing structures, materials and systems. However, potential transformative gains could be made by the integration of new advanced materials such as metamaterials. Dr Nicholson's research investigated electronically tunable metamaterials for the slotted waveguide antenna stiffened structure concept. The research revealed a novel method to reduce the physical size of the antenna while also achieving electronic beam steering. This enables the integration of antennas into load bearing structures to achieve enhanced aircraft performance.

Dr Nicholson joined DSTO in 2006 as part of the Advanced Composites Technology group within the Aerospace Division. As part of this group, Dr Nicholson is involved in the development of microwave Doppler tomography imaging techniques for the assessment of damaged and repaired composite structures. Dr Nicholson hopes to apply his knowledge of metamaterials to the development of new repair techniques for advanced composite structures typically found on next generation military platforms. Dr Nicholson also plans to pursue an overseas research posting with DSTO support.

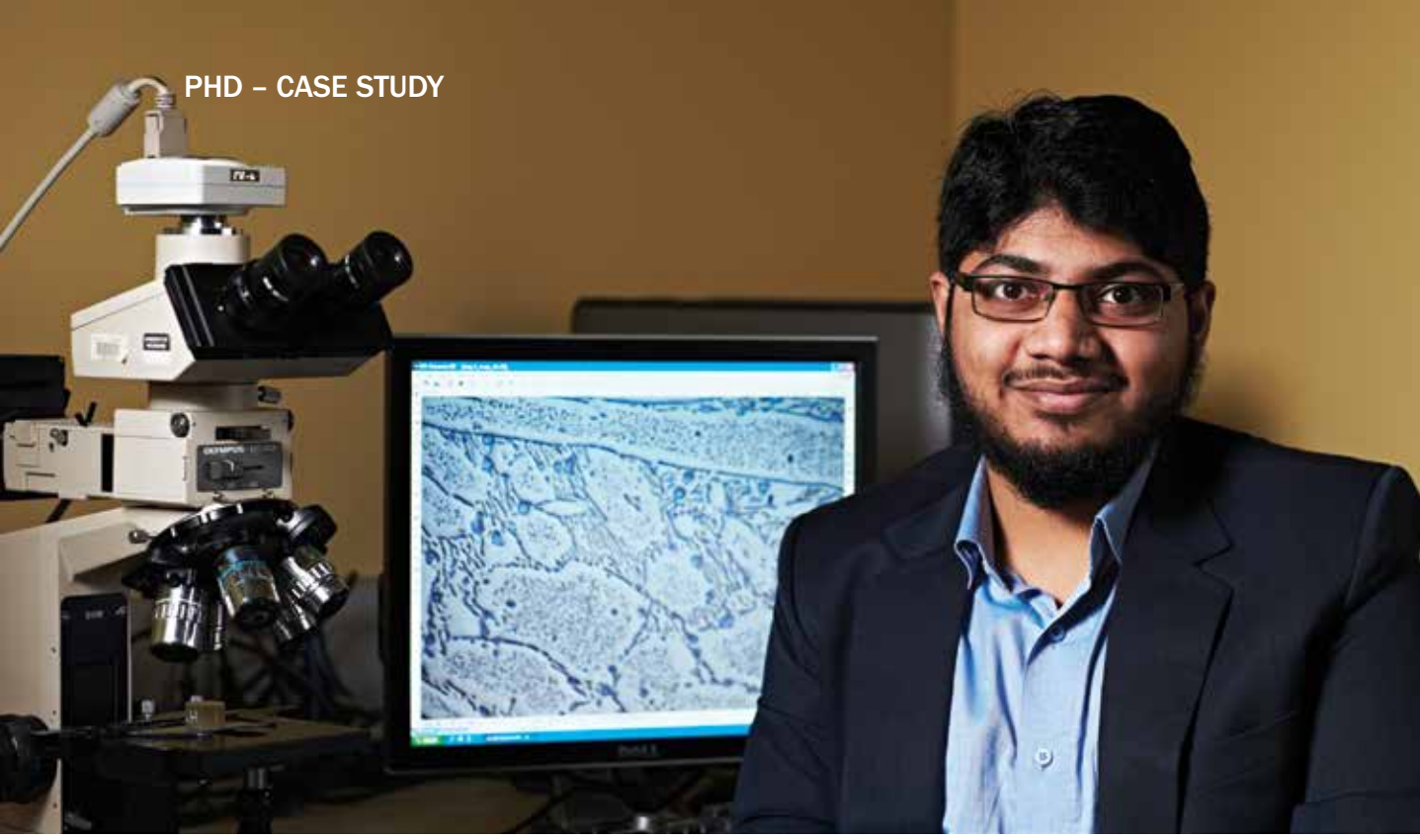
DR TONY PILKINGTON

DEVELOPMENT AND EVALUATION OF PLASMA-ASSISTED ALUMINA BASED COATINGS, UNIVERSITY OF SHEFFIELD

Dr Tony Pilkington was awarded his PhD in March 2014. Dr Pilkington is a DMTC Research Fellow at RMIT University working with industrial partner Sutton Tools in DMTC Project 1.1.1b – Next Generation Cutting Tool Development. Dr Pilkington's thesis was concerned with the development of wear resistant alumina based Physical Vapour Deposition (PVD) coatings to increase the productivity of round shank tooling for difficult to machine materials. The cutting tool design, manufacture, PVD development and tool life testing was carried out with DMTC industrial partner Sutton Tools.

Dr Pilkington's research work was aligned with a DMTC project that aims to develop and optimise cutting tools for the production of components made from the latest aerospace composites and alloy materials. Optimisation focuses on improving the performance and reliability of round shank tools for drilling, milling and thread making. This will support the development of internationally competitive (e.g. high speed machining) technology for the advanced manufacture of aerospace components from difficult-to-machine materials (such as β annealed – titanium alloys and high nickel alloys). The outcomes of Dr Pilkington's research are the improved understanding of the role of tool surface integrity, reliability improvements in cutting tool life through reduced edge brittleness and new production ready AlCr oxy-nitride tool coatings for round shank tooling developed specifically by Sutton Tools for difficult to machine materials. A major objective achieved in this thesis was to develop a large scale PVD process for alumina based coatings offering high performance and a stable repeatable process with a commercially useful deposition rate of 2-3μm/hour. The use of pulsed plasmas in the state of the art INNOVA deposition system was the key to success for the alumina based coatings.

Dr Pilkington is continuing his research work in DMTC at RMIT University through involvement in PVD coating development, tribology and improvement in tooling manufacturing technology.



DR RIZWAN ABDUL RAHMAN RASHID

LASER ASSISTED MACHINING OF BETA TITANIUM ALLOYS, THE UNIVERSITY OF QUEENSLAND

Dr Rizwan Abdul Rahman Rashid was awarded his PhD in 2014. Beta (β) titanium alloys are attractive for a number of high-value applications due to their unique range of properties. However, these properties also make these materials difficult to machine. Laser Assisted Machining (LAM) aims to improve the machinability of such materials. In LAM, a laser beam locally heats and softens the workpiece material ahead of the advancing cutting tool. Machining trials were carried out under both laser assisted and unassisted conditions on two particular β titanium alloys using a broad range of cutting parameters such as cutting speeds, feed rates and laser power. The results indicate that there is an optimum range of parameters which can maximise material removal rate and subsequently enhance productivity.

Dr Rahman Rashid's work supported DMTC Project 1.1.1a – Development of New Titanium Fabrication Technology. The project aimed to increase the competitiveness of Australian manufacturers through new manufacturing technologies to provide cost effective domestic supply solutions to the Australian Defence Force. Dr Rahman Rashid's thesis provided important information into DMTC Project 1.1.1a by examining the properties of β titanium alloys after LAM and whether LAM would have potential application in high-value added components such as aircraft landing gears.

Dr Rahman Rashid will be continuing his work with Dr Suresh Palanisamy (DMTC Air Program Leader) at Swinburne University. Dr Rahman Rashid will be looking to supplement his work by studying tool wear and chip formation utilising LAM on titanium alloys. Dr Rahman Rashid is looking to develop his technical skills in learning to use advanced experimental equipment complemented by research software. He is also interested in developing leadership, managerial and supervisory skills. In the short-term, Dr Rahman Rashid is aspiring to take on R&D roles in an industry and/or academic environment which in turn will be a foundation for his career goal of becoming a Professor at one of the leading educational institutions in the world.

MANAGEMENT

DMTC maintains an efficient operational structure with a low overhead cost to the business. The management team are committed to the business's objectives and ensure maximum funding and resources are directed to our research and technology development activities.

MARK HODGE
CHIEF EXECUTIVE OFFICER

SUGANTHINI ATHITHTHAN
ASSISTANT ACCOUNTANT

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

There was a change in Directors this year with Professor David StJohn retiring in November and Michael Grogan appointed shortly thereafter. The rest of the Board remained the same, with Tony Quick, Dr John Best and Professor John Norrish re-elected at the Annual General Meeting.

MR TONY QUICK, CHAIR

DEFENCE ADVISORY PANEL, PROGRAM DEVELOPMENT PANEL

Mr Tony Quick is executive Chair and a director of Quickstep Holdings Ltd. Mr Quick was the director of the Enterprise Connect Defence Industry Innovation Centre 2009 to 2011, director and general manager of GKN Aerospace Engineering Services (now Quest Global Engineering) from 2001 to 2009. Mr Quick is the former Chair of the Design Victoria Advisory Board and former Textiles, Clothing and Footwear Supplier Advocate from 2011 to June 2014. Mr Quick is an Adjunct Professor in the School of Aerospace, Mechanical and Manufacturing Engineering at RMIT University.

Meetings attended: 6/6

DR ROGER LOUGH AM, DEPUTY CHAIR

AUDIT RISK AND REMUNERATION COMMITTEE CHAIR, DEFENCE ADVISORY PANEL

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 appointed Chief Defence Scientist and CEO of DSTO in 2003. He retired from the Public Service in 2008. Dr Lough is Chair of the Defence Science Institute, a member of the Defence Council of Victoria and consults to the RAND Corporation of the US. 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: 5/6

DR JOHN BEST, DIRECTOR

AUDIT, RISK AND REMUNERATION COMMITTEE

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: 5/6

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

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 Colorpak Limited. She is a former independent director of the Melbourne Market Authority, Plantic Technologies Limited, The Just Group Limited and the CRC for Advanced Automotive Technology.

Meetings attended: 5/6

MR MICHAEL GROGAN, DIRECTOR
AUDIT, RISK AND REMUNERATION COMMITTEE

Michael Grogan is the CEO of Sutton Tools Pty Ltd, an Engineering Manufacturer producing and exporting a full range of Cutting Tools out of its three Australian facilities as well as one in New Zealand. Michael sits on the Board of Manufacturing Skills Australia and the Victorian Manufacturing Skills and Training Taskforce. Michael is heavily involved in the VET sector in Victoria and is on the School Committee of the Northern College of the Arts and Technology which has recently opened a $17 million dollar Technology Centre. Michael also Chairs the Inner Northern LLEN and is a member of the Northern Melbourne Regional Development Committee.

Meetings attended: 4/4

DR PETER JONSON, DIRECTOR
RESEARCH ADVISORY PANEL

Dr Peter Jonson is a 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 and Care CRC Ltd. He is an adjunct professor at RMIT University and principal research fellow at The University of Melbourne. Dr Jonson is a former Chair of the Australian Institute for Commercialisation, AADI Limited, Bionomics Limited and the Federal government's CRC Committee. Dr Jonson was an economist with the Reserve Bank of Australia for 17 years, Head of Research for 7 years, CEO of Norwich Financial Services Limited and managing director and Chair of ANZ Funds Management.

Meetings attended: 5/6

PROFESSOR JOHN NORRISH, DIRECTOR
RESEARCH ADVISORY PANEL

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 member of the steering committee of ITTC Naval Manufacture and Vice Chair of the International Institute of Welding Commission XII. Professor Norrish is Chair of the DMTC Ltd Research Advisory Panel.

Meetings attended: 6/6

GOVERNANCE

The DMTC Board is responsible for overseeing the management and strategic direction of the company. Each Director normally 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 7 November 2013. 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 Tony Quick, John Best and John Norrish each retired at the Annual General Meeting in accordance with constitutional requirement and were subsequently re-elected to the Board of Directors. Professor David StJohn announced his retirement from the Board subsequent to the meeting. Mr Michael Grogan was appointed by the Board to fill a casual vacancy on 5 December 2013.

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 John Best
- Mr Michael Grogan
- Dr Roger Lough

RESEARCH ADVISORY PANEL

The Research Advisory Panel provides advice 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
- Professor John Norrish (Chair)
- Dr Richard Chester (DSTO)
- Professor Ian Polmear (Independent)
- Dr Bruce Hinton (Independent)
- Professor Aleksandar Subic (RMIT University)
- Dr Michael Brennan (Defence nominee)

DEFENCE ADVISORY PANEL

The Defence Advisory Panel provides advice to the CEO in relation to Defence 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.

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