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DSTO Maritime Platforms
Division: External Interactions

Phillip Box

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DSTO Maritime Platforms Division: External Interactions

Phillip Box

Maritime Platforms Division
Platforms Sciences Laboratory

DSTO-GD-0345

ABSTRACT

DSTO Maritime Platforms Division's interactions with industry and academia have been recorded analysed and are reported. The interactions are numerous and significant in scope and complexity. International interactions are also extensive covering a broad range of research areas across the Division.

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*DSTO Platforms Sciences Laboratory
506 Lorimer St
Fishermans Bend, Victoria 3207 Australia*

Telephone: (03) 9626 7000

Fax: (03) 9626 7999

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DSTO Maritime Platforms Division: External Interactions

Executive Summary

External interactions, for the fiscal year 2001 – 2002, of Maritime Platforms Division have been collated and are reported. The level and breadth of interactions is extensive with industry, academia and overseas research organisations. Interactions with over 120 industries, the majority of which were small to medium enterprises, 27 universities, and numerous government and non-government research organisations were identified.

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1. Introduction

Defence policy encourages defence–industry interactions with the aim for ‘Defence and Industry to work together as partners to maintain national security and a truly sustainable, efficient and innovative defence industry base.’(1) DSTO interacts extensively with Australian Industry with the objective ‘to work with industry to enhance Australia’s defence capabilities, and to contribute to national wealth creation, including through the support of exports’ (2)

Interactions with industry and academia are not only encouraged for the reasons above but with the increasing pressure to achieve more from available resources, alternatives have been sought by most task managers in Maritime Platforms Division (MPD).

Through the fiscal year of 2001/2002 MPD implemented a concerted effort, including the significant commitment of a full time Industry Interaction Officer, to analyse the breadth and depth of industry interactions across the Division. This report details the results of this effort.

2. Interaction Agreements

MPD task managers were interviewed regarding their interactions with industry and academia. Through these interviews and the reporting of interactions in the annual task reports and task reviews, a collation of interactions across the Division was possible. The task managers were able to describe the agreements using their own terminology. However the analysis and reporting of the interactions were done using generic terms. Some of these descriptors are interchangeable but the essence of the interactions is captured in the descriptors.

The agreement types used in this process are listed in Appendix A: Interaction Agreements.

There were only a small number of task managers that could not identify any interactions with industry or academia that contributed to their research in a manner more than just through the provision of products or services.

The collated interactions are included as Appendix B: External Interactions.

3. Industry Interaction

Industry, for the most part, is willing to carry out work for Defence for reasonable compensation. In a lot of cases industry and in particular Small to Medium Enterprises (SME) undertake work with DSTO on the basis of the possibility of opening up defence markets to their business. Due to this two-fold reason, SMEs will sometimes work

collaboratively with DSTO researchers for very little cost in developing techniques and materials.

Early involvement of industry in a research program can establish crucial links for the eventual development of products for defence and other markets. It can align research with engineering development and hence limit or even eliminate re-engineering a prototype for production. Re-engineering is generally required when research in a possible product is conducted without consultation with industry or production engineering through the development of the prototype regarding production issues.

Of possibly more importance to Australian industry, is the development of a culture where specific industries look favourably towards the Australia Defence Organisation as a market for their products. As a result, the companies will be able to take advantage of the defence market and contribute to Australia's self-reliance.

An example of this is MPD's interactions with Mackay Consolidated Industries and their success in marketing their tracked vehicle products to the Australian, and overseas, defence organisations. Mackay's track links use an MPD rubber formulation under licence. These links have approximately double the life compared with previous links used in the ADF. Prior to their interaction with MPD, Mackay industries had no connection with Defence. The defence market is now close to a third of their business.

Analysis of the interactions indicates that the marine engineering companies of Australian Defence Industries (ADI), Tenix and Australian Submarine Corporation (ASC) have numerous interactions under a number of arrangements across the breadth of MPD.

There are a large number of companies with which MPD researchers interact in progressing their tasks. A significant number of these have been identified as informal collaborations. This may be a concern with respect to intellectual property protection in some cases.

4. Interactions with Academia

MPD has extensive interactions with universities throughout Australia and a small number overseas. These interactions are undertaken directly with the universities or with research organisations integrated with universities. The majority of these interactions are carried out under the auspices of formal agreements, although there are a significant number that have been classified as informal collaborations, which are based around less formal associations between MPD researchers and university researchers.

Universities interact with DSTO for numerous reasons including: the additional funding directly from DSTO, and in some cases through successful cooperative grant applications; the kudos of collaboration with the DSTO; the increase in applied research work for their undergraduate and graduate students; and in some cases the improvement in their research facilities and capabilities as a result of collaborative work.

MPD gains access to diverse expertise by interacting with universities across Australia, and in a small number of cases overseas. This has enabled MPD to rapidly enter into new fields of research required to support RAN requirements, where the indigenous capability was limited. One example is the research on human factors relating to fatigue and cognisance of RAN ship crews.

By contracting a university and utilising the skills and enthusiasm of undergraduate, and postgraduate students, research can be progressed at considerably reduced costs compared to employing staff within DSTO to conduct the work. Utilising students can also assist in meeting short-term research requirements where the personnel within DSTO, with the necessary skills, are limited or otherwise occupied.

Some universities have research capabilities that are not available in DSTO, such as the Australian Maritime College in Tasmania with their Australian Maritime Hydrodynamics Research Centre. MPD, together with the University of Tasmania, and the Australian Maritime College, has recently been successful in gaining a Commonwealth grant under the Commonwealth initiative for major national research facilities, to dramatically improve this facility. This is to the mutual benefit of all three organisations.

A longer-term benefit for MPD in interaction with universities is the exposure and focus of undergraduate and graduate students to research programs in DSTO. This demonstrates the possibilities and range of defence research to possible future employees.

A minor disadvantage to these interactions can be that the work carried out by students sometimes doesn't meet deadlines, as students don't always complete their studies, and in most cases the work is dependent on the individual as a part of their undergraduate or post graduate project work.

5. Intellectual Property Protection

Working with industry and academia on defence research leads to concerns regarding the security of information from the perspective of both national security and intellectual property. There are well-established mechanisms for the protection of both, but perhaps the protection of intellectual property is not as well entrenched throughout the organisation as national security.

Methods of protecting intellectual property fundamentally entail the signing of agreements by both parties, i.e. representatives of the Commonwealth and the industry or university. These agreements can have a number of titles dependent on the scope of the agreement and they usually contain an intellectual property agreement clause.

6. Financial Implications

In collaborating with industry and academia, under the various agreements, resources are consumed both in personnel terms and financial terms. In the 2001/02 fiscal year MPD expended 2.2 million dollars on payments to other organisations to conduct research on behalf or in collaboration with the Division. This equates to approximately one third of non-salary dollars of MPD's budget.

Staff time spent in collaborative efforts and with negotiating and management of contracts for research conducted by external organisations was tracked and indicated that 6350 personnel hours and \$178,000 salary dollars were expended in these activities. However it is the view of the author that the personnel time and the equivalent salary dollars recorded were not accurate and would be a significant underestimate of the actual effort.

7. International Interactions

As well as the identification of interactions with industry and academia, strategic international interactions were also identified. These interactions centre primarily on formal international agreements to further research and share results between allied countries. These interactions occur under NATO, AAMOUR, TTCP, DEA, MOU and IEA agreements. These interactions are crucial for the leveraging of research within Australia and to maintain our role at the leading edge of defence research. These interactions, totalling over 70, are tabulated in Annex C.

8. Discussion

The motivation to increase interaction with industry throughout the Defence Department and in particular within DSTO is primarily to foster a defence industry in Australia in an endeavour to improve Australia's self-reliance. The inclusion of new industries in the defence environment and to better utilise industry already involved in defence is better for defence and Australia as a whole in the long term. The level of involvement required and the amount of resources, from DSTO, to be directed to these industries has not been benchmarked and subsequently questions remain as to what the required level should be. MPD has expended a third of its non-salary dollars with such organisations. Any action taken to increase the DSTO interactions with industry across the whole organisation must be done with the knowledge of the current level of interaction. In MPD, significant time and expense is expended in these interactions.

There are a large number of interactions described by task managers as informal. This is an issue, as intellectual property (IP) may not be protected in all these cases. The level of awareness of intellectual property protection across the Division is varied and the attitude towards taking the precaution is, as a consequence, also varied. Some task

managers essentially don't talk to external organisations until an agreement on IP has been signed yet others collaborate for long periods of time, over years, sharing information with no agreement in place.

9. Conclusion

The level of interaction across MPD with both industry and academia is extensive and appears to be normal operating practice for the majority of tasks across MPD. The resources expended in these activities is also significant.

The involvement of industry in the early stages of a research program, especially in the development of techniques and/or materials appears to provide for better outcomes for the research and possible opportunities for the industry.

The involvement with academia appears to be, in the majority of cases, of mutual benefit to both MPD and the academic institution. Some research can be progressed at reduced cost by utilising students, a defence focus can be nurtured in academia, and facilities not available within DSTO can be accessed through universities.

The protection of Intellectual Property probably requires more attention by some task managers but at the same time this shouldn't be seen as a reason to limit involvement with external organisations. The mechanisms for this protection are readily available through the DSTO Business Office. It should be recognised that virtually all the agreements including the formal agreements were initiated informally and relationships have developed. The informal interactions with industry and academia should be encouraged and task managers and all researchers made aware of intellectual property issues and mechanism available to protect both the Commonwealth's interests and that of the relevant industry.

1 Defence and Industry Strategic Policy Statement 1998

2 DSTO _ Industry Interaction Paper , June 2000

Appendix A: Interaction Agreements

The descriptors of the agreements across the division were characterised into the following:

Ad hoc advice: MPD researchers provide advice on a small scale usually over the phone.

Alliance: Interactions under a strategic alliance agreement.

Boeing Contract: The contract with Boeing for engineering support has often lead to collaborative work on projects where engineering is a crucial element of the research program.

Collaboration: As the name implies where MPD and the external organisation collaborate on a research program, most often under the auspices of a 'Collaborative Agreement'

Consultancy: These interactions are when MPD conducts research for financial compensation at the direction of the external organisation. There were only a small number of these but are considered significant because it recognises unique capabilities within MPD

CRC: Participant in a Collaborative Research Centre

Informal Collaboration: Collaborative work with external organisations without any formal agreement.

Interactive Project Agreement: An agreement between MPD and the organisation on a particular project.

Licence Agreement: An agreement for an organisation to use technology developed either wholly or partially within MPD in a commercial manner for which MPD receives royalties on any sales. Sales to the Australian Defence Organisation do not carry the royalty and are therefore cheaper for the ADO to purchase.

Non-Disclosure Agreement:

A formal agreement where the external organisation is privy to information or technology and agrees not to convey this to third parties.

Placement: The placement of MPD personnel in the external organisation for a short period of time.

Research Agreement:

An agreement for a program of research to be collaboratively conducted. These are usually with Universities or other research organisations.

Support through Project Offices:

Significant interaction with industry occurs at the request of Defence project offices to assist industry with issues.

TSS Contracts: A means with which external organisations are remunerated for their research assisting the progression of MPD's research programs.

Intellectual Property Agreement:

An agreement clarifying who has ownership of intellectual property developed as part of research programs.

MOU: Memoranda of Understanding, where the two parties agree to share information for mutual benefit.

Appendix B: External Interactions

Interaction Type	Organisation	Project	Description
Alliance	Preston Consulting	Wayamba	design & construction of power supply
Alliance	Hydro Cable	Wayamba	design & construction of power cable
Boeing Contract	Boeing	Wayamba	Collaborative design & construction of Wayamba
CRC	CRC Welded Structures		Continued collaboration on welding technology applicable to thick section weldments
Collaboration	IRIS Swinburne	Laser Machining	Minaturisation of vacuum sensor channels using laser machining
Consultancy	FCA Australia (Peter Ford)	FE modelling & stress analysis	Thick section weldment residual stress finite element model development
TSS Contract	Weldtronics	Weld repair procedure development	Submarine penetrator insitu weld repair
TSS Contract	Fronius	Weld repair procedure development	Submarine penetrator insitu weld repair
TSS Contract	PHP Welding	Weld repair procedure development	Submarine penetrator insitu weld repair
Collaboration	SMS Pty LTd	Vacuum Sensor Development	Adaptation of vacuum sensor technology for insitu weld monitoring
License agreement	ASC	Inspection of Anechoic Tiles	Techniques developed and possibly marketable
TSS contract	PLTS	Weld repair procedure development	Insitu weld cladding of Submarine penetrators
TSS contract	SAF	Weld repair procedure development	Insitu weld cladding of Submarine penetrators
Research Agreement	Victorian University of Technology	Fire & smoke modelling	
Non-Disclosure Agreement	Victorian University of Technology	Gas analysis system	Gas monitoring system to measure gas concentrations in 30 simultaneously. Used to evaluate Fixed fire fighting systems
Informal Collaboration	SSL	Fire & smoke	
Informal Collaboration	CSIRO	Fire & smoke	
Non-Disclosure Agreement	Catalyst Interactive Pty Ltd	Merlin S/W	
Non-Disclosure Agreement	Click Craft Pty Ltd	Merlin S/W	
Non-Disclosure Agreement	Macromedia Inc	Merlin S/W	

Interaction Type	Organisation	Project	Description
Non-Disclosure Agreement	Eden Technologies	Merlin S/W	
Non-Disclosure Agreement	Barry & Associates	Merlin S/W	
Non-Disclosure Agreement	ASC	Merlin S/W	
Non-Disclosure Agreement	Macromedia Inc	Phoenix S/W	
Non-Disclosure Agreement	Pains Wessex	Torpedo Decoys	Enabling in-country design & manufacture of Light Weight Hull Mounted Launchers
Non-Disclosure Agreement	ADI	Torpedo Decoys	Enabling in-country design & manufacture of Light Weight Hull Mounted Launchers
Non-Disclosure Agreement	Pacific Composites	Torpedo Decoys	Enabling in-country design & manufacture of Light Weight Hull Mounted Launchers
Research Agreement	Melbourne University	Submarine Hydrodynamics	Research Cadet
Research Agreement	Australian Maritime College	Submarine Hydrodynamics	PhD project
TSS Contract	CSIRO	Submarine Hydrodynamics	Measurement and analysis of turbulence using lasers
TSS Contract	NUWC	Submarine Hydrodynamics	Modelling of Collins hydrodynamics
Research Agreement	Australian Maritime College	Submarine Hydrodynamics	Development of automated traverse system and pressure probe system for cavitation tunnel
TSS Contract	Lorenz Drack	Submarine Hydrodynamics	Modelling of propellers
Consultancy	Melbourne University	Submarine Hydrodynamics	Consultancy services by Peter Joubert
Joint Venture	Australian Maritime College	Australian Maritime Hydrodynamics Research Centre.	successfully applied to the Commonwealth of Australia for a grant of financial assistance under the Commonwealth initiative of a Major National Research Facility
Joint Venture	University of Tasmania	Australian Maritime Hydrodynamics Research Centre.	successfully applied to the Commonwealth of Australia for a grant of financial assistance under the Commonwealth initiative of a Major National Research Facility
Consultancy	ASC	Shock Testing	Calibration of instrumentation for shock studies
Adhoc Advice	Australian Explosives Technologies		Advice on moulds, explosives packaging and transport
Support through Project Offices	ADI	Australian Acoustic generator	shock testing of AAG
Support through Project Offices	ADI	MHC Shock Testing	Instrumentation specific locations for ADI to shock qualify the MHC

Interaction Type	Organisation	Project	Description
Support through Project Offices	ADI	MHC Shock Testing	Provided additional instrumentation and analysis to determine failure mechanism of EOSS system
Consultancy	Pains Wessex	Torpedo Decoys	Providing trials support and instrumentation for tests on concept demonstrators
Consultancy	ADI	Dyads	Shock testing of Dyads to determine structural integrity of flotation gussets
Consultancy	ADI	Australian Acoustic generator	shock testing of AAG
Consultancy	ADI	AAG & TBG	Shock testing of AAGs and TBGs
Consultancy	DMS Glass	Blast testing of glass	Blast Testing glass
Non-Disclosure Agreement	Regina Fibreglass	RAM	Production of radar absorbing composite materials
TSS Contract	Australian Urethane & Styrene	Phenolic Foam RAM material	Production of samples of phenolic foam with active RAM components
Informal Collaboration	Hedemora	Collins Diesels	Improving performance of Collins Diesel engines
Informal Collaboration	GTSA	Collins Diesels	Improving performance of Collins Diesel engines
Informal Collaboration	ASC	Collins Diesels	Improving performance of Collins Diesel engines
Informal Collaboration	Westrac	Collins Diesels	Improving performance of Collins Diesel engines
TSS Contract	Ballarat University	Collins Diesels	Torsiometer Hire
TSS Contract	Curtin University of Technology	Collins Diesels	Torsiometer Hire
TSS Contract	Digitec	Collins Diesels	Engine Performance Monitoring
Support through Project Offices	MTU	ANZAC	Failure Investigations
Support through Project Offices	Tenix	ANZAC	Failure Investigations
Support through Project Offices	Detroit Diesel	FFG & LCH	Engine investigations
License Agreement	MacKay Consolidated Industries Pty Ltd	Leopard Tank, M113 Upgrade	Applique Armour for track skirts for the leopard Tank and possibly the M113AS3
Adhoc Advice	MacKay Consolidated Industries Pty Ltd	Leopard Tank	To support Appliqué Armour license
MOU	Armour Solutions	Ceramic Armour	development of a unique family of low cost ceramic armour materials

Interaction Type	Organisation	Project	Description
License Agreement	ADI	Bushranger	License of armour design to ADI through DMO project Office
MOU	Modern Ceramic	Ceramic Armour	development of a unique family of low cost ceramic armour materials
Non-Disclosure Agreement	Rosebank Engineering	Armour development	Rosebank are the local representative of the German armour manufacturer Verseidag-Indutux
Boeing Contract	Boeing	FOCUS/Virtual Ship	Consultancy to integrate FOCUS into virtual ship (Peter Beckwith)
Interactive Project Agreement	BAe Systems	Maritime Human Factors	
TSS Contract	University Of Sydney	Crane Automation	Development of simulation model
TSS Contract	RMIT	Wing in Ground Effect	Fee for service consultancy on Wing in Ground effect technology
TSS Contract	University of South Australia	Fatigue in Submarines	Centre for Applied Behavioural Sciences: Analysis of Activity Data
Informal Collaboration	University of South Australia	Fatigue in Submarines	David Darwent will analyse and report on the submarine sleep data collected during Lungfish 2000 and use the data for his PhD thesis and provide DSTO with a full report.
Informal Collaboration	University of Ballarat	HLA Distributed Simulation	Developed two week summer school and consequently established research capability at University of Ballarat
Research Agreement	University of Ballarat	HLA Distributed Simulation	Research program funded by RAN
Research Agreement	Calytrax	HLA Distributed Simulation	Simplicity: Rapid Development environment for distributed simulation
Research Agreement	Victorian University of Technology	Survivable Networks	
Alliance	Tenix	Virtual Ship	Talks, Presentation on Virtual Ship aspects
Collaboration	NATO	NIREUS	NATO Interoperability and Reusable Study. Collaborative modelling work through NATO study group
Boeing Contract	Boeing	Distributed Simulation	Development of HLA compliant models (Peter Beckwith)
Research Agreement	University of Western Australia	Maritime Human Factors	Research program with Dept. of Organisational Psychology
Centre of Expertise Agreement	University of Queensland	Martime Human Factors	ARC key Centre for Human Factors & Cognitive Psychology

Interaction Type	Organisation	Project	Description
Centre of Expertise Agreement	University of South Australia	Martime Human Factors	ARC key Centre for Human Factors & Cognitive Psychology
Centre of Expertise Agreement	University of Adelaide	Martime Human Factors	ARC key Centre for Human Factors & Cognitive Psychology
Centre of Expertise Agreement	University of Newcastle (Aust.)	Martime Human Factors	ARC key Centre for Human Factors & Cognitive Psychology
Centre of Expertise Agreement	Monash University	Martime Human Factors	ARC key Centre for Human Factors & Cognitive Psychology
Centre of Expertise Agreement	University of Western Australia	Martime Human Factors	ARC key Centre for Human Factors & Cognitive Psychology
Informal Collaboration	Akzo Nobel	Anti Fouling coating technology	Collaboration with paint companies and their R&D personnel.
Informal Collaboration	Jotun	Anti Fouling coating technology	Collaboration with paint companies and their R&D personnel.
Informal Collaboration	Hempels	Anti Fouling coating technology	Collaboration with paint companies and their R&D personnel.
Informal Collaboration	Kansai	Anti Fouling coating technology	Collaboration with paint companies and their R&D personnel.
Informal Collaboration	Chogoku	Anti Fouling coating technology	Collaboration with paint companies and their R&D personnel.
Informal Collaboration	Wattyl	Anti Fouling coating technology	Collaboration with paint companies and their R&D personnel.
Informal Collaboration	Australian Paint Industries	Anti Fouling coating technology	Collaboration with paint companies and their R&D personnel.
Informal Collaboration	Sealcoat	Anti Fouling coating technology	Collaboration with paint companies and their R&D personnel.
Informal Collaboration	Tenix	Anti fouling	Provide advice and investigations into anti fouling issues
Informal Collaboration	ASC	Anti fouling	Provide advice and investigations into anti fouling issues
Informal Collaboration	ADI	Anti fouling	Provide advice and investigations into anti fouling issues
Informal Collaboration	NQEA	Anti fouling	Provide advice and investigations into anti fouling issues
Informal Collaboration	Incat	Anti fouling	Provide advice and investigations into anti fouling issues

Interaction Type	Organisation	Project	Description
Informal Collaboration	Forgacs-Cairncross	Washdown waters	DSTO method of treating washdown waters
Informal Collaboration	ADI	Washdown waters	DSTO method of treating washdown waters
Informal Collaboration	Australian Paint Manufacturers Federation (APMF)	Maritime Environmental Issues	Collaboration with paint companies and their R&D personnel.
Informal Collaboration	CSR	Maritime Environmental Issues	Provide advice and investigations into anti fouling issues
Informal Collaboration	BHP Billiton	Maritime Environmental Issues	Provide advice and investigations into anti fouling issues
Informal Collaboration	TT-Line	Maritime Environmental Issues	Provide advice and investigations into anti fouling issues
Informal Collaboration	Adsteam	Maritime Environmental Issues	Provide advice and investigations into anti fouling issues
Informal Collaboration	Aust. Ship Owners Association	Biofouling Control on Ships	Collaboration with ship owners on anti-fouling issues and particularly on anti-fouling patch experiment. John is the Technical Advisor to ASOA with this experiment.
Informal Collaboration	AMSA	Environmental Issues	Interactions on environmental issues
Informal Collaboration	NRA	Environmental Issues	Interactions on environmental issues
Informal Collaboration	EA	Environmental Issues	Interactions on environmental issues
Informal Collaboration	AFFA	Environmental Issues	Interactions on environmental issues
Informal Collaboration	AQIS	Environmental Issues	Interactions on environmental issues
Informal Collaboration	EPA(Vic.)	Environmental Issues	Interactions on environmental issues
Informal Collaboration	EPA(WA)	Environmental Issues	Interactions on environmental issues
Informal Collaboration	DEP(WA)	Environmental Issues	Interactions on environmental issues
Informal Collaboration	NIMPCG	Environmental Issues	Interactions on environmental issues
Informal Collaboration	CCIMPE	Environmental Issues	Interactions on environmental issues
Informal Collaboration	Cairns Port Authority (CPA)	Environmental Issues	Interactions on environmental issues

Interaction Type	Organisation	Project	Description
Informal Collaboration	Marine & Freshwater Research Institute (MAFRI)	Environmental Issues	Interactions on environmental issues
Informal Collaboration	GBRMPA	Environmental Issues	Interactions on environmental issues
Informal Collaboration	CSIRO	Environmental Issues	Interactions on environmental issues
Informal Collaboration	Halliburton	Environmental Issues	Environmental Consultants: Interactions on environmental issues
Informal Collaboration	URS Consulting	Environmental Issues	Environmental Consultants: Interactions on environmental issues
Informal Collaboration	PPK	Environmental Issues	Environmental Consultants: Interactions on environmental issues
Informal Collaboration	Thompson Clarke	Environmental Issues	Environmental Consultants: Interactions on environmental issues
Informal Collaboration	University of NSW	Hydrophobic coatings	Superhydrophobic coatings as fouling release coatings
Informal Collaboration	University of the Sunshine Coast	Anti Fouling coating technology	Short term indicators of antifouling coating performance
Collaboration	Australian Water Technologies	Treatment of waste water	Collaboration in adopting an existing technique to the treatment of waste wash water containing TBT.
TSS Contract	University of Newcastle (Aust.)	Corrosion Modelling and environmental degradation	
Placement	Monash University		MPD personnel an Associate at Monash, Civil Engineering
Placement	University of Newcastle (Aust.)		MPD personnel doing a Masters at University of Newcastle.
Informal Collaboration	Austal Ships	Ship Seakeeping	Seakeeping on Austal Ships catamaran
Informal Collaboration	North West Bay Ships	Ship Seakeeping	Seakeeping on new trimaran
Informal Collaboration	Lloyds Register of ships	Ship classification issues	MPD personnel on the technical committee of Lloyds
TSS Contract	Proteus Engineering	Development of modelling software	
CRC	Monash University	Sea sickness measuring	Under the AME CRC a sea sickness measuring device was developed. It is now being used on a patrol boat and on some commercial boat during seakeeping trials.

Interaction Type	Organisation	Project	Description
TSS Contract	Ancaro Pty Ltd	Prototype capability/costing tool development	Force (Tool A), Tool B, Tool C & Tool D
TSS Contract	Aspect Computing	Cost of ownership & operations	DSTO BHAG (MS01-3) – Reducing ADF Cost of Ownership and Operations.
TSS Contract	MERCADIER	Prototype capability / costing tool development	Development of capability costing applications
CRC	Centre for integrated Asset management CRC	Industry capability assessment & measurement	Exploratory Task/BHAG work
Support through Project Offices	Price Waterhouse Coopers	FEG Management	Support to the FEG management model as a Technical Advisor to the consultants
Informal Collaboration	Kleine Associates Inc	Minewarfare	
Informal Collaboration	Australian Maritime College	Towed Array Modelling & tank testing	Supervision of 4th year student projects
Interactive Project Agreement	Nautronix	Navsong	Cooperative work under Alliance umbrella
Research Agreement	Curtin University of Technology	UUV	PhD program on Control of Piloted UUVs
Non-Disclosure Agreement	ECA (France)	UUV power supply	ECA has shown interest in the UUV power supply. Hopeful to obtain an engineer from ECA through collaboration to further improve power supply
Informal Collaboration	Monash University	PhD Student studying Navigation of UUVs	Project would investigate minimum requirements for an effective SLAM navigation system.
Informal Collaboration	ADFA		3rd year student project. Path planning human-computer interface for semi autonomous UUVs
TSS Contract	MacKay Consolidated Industries Pty Ltd	RAM Materials	Manufacturer of sheet RAM rubber with repeatable properties
License Agreement	MacKay Consolidated Industries Pty Ltd	Army Track Vehicle components	Manufacture of superior track components with royalties coming to DSTO or being foregone for ADO
License Agreement	Baron Rubber Pty Ltd	Army Track Vehicle components	Manufacture of superior track components with royalties coming to DSTO or being foregone for ADO
Collaboration	MacKay Consolidated Industries Pty Ltd	submarine anechoic tiles	manufacture and adhesion enhancement treatment of anechoic tiles
TSS Contract	Bell Computing	FOCUS	SW development
TSS Contract	Darteks	FOCUS	SW & H/W development
TSS Contract	Siemens	FOCUS	Modifications to S/W to be compatible with FOCUS

Interaction Type	Organisation	Project	Description
License Agreement	Eden Technologies	FOCUS	
License Agreement	Focus Systems (NZ)	FOCUS	
Alliance	Tenix	Blast resistant water tight doors and bulkheads	Tenix provided materials for our assessment under alliance umbrella
Non-Disclosure Agreement	Vandam B.V.	Water tight door design	Vandam have evaluated the DSTO designed blast resistant, water tight door
TSS Contract	University of Waterloo (Canada)	Hopkinson Bar experiments	provide high strain rate material property data for mild steel to validate finite element modelling
Alliance	ADI	Emergency underwater patch technology	ADI provided samples of GRP for testing of emergency patching technology
Alliance	ADI	GRP Blast resistance of bulkheads	Collaboration on design of GRP bulkheads for blast resistance testing
Informal Collaboration	RAMSET	Emergency underwater patch technology	Collaboration on improvements to underwater Ramset charges and provision of material for Manual for RAN
Alliance	Tenix	FE modelling	collaboration on the conversion of CAD drawings to be compatible for XVAM
TSS Contract	CONCENTRIC	NEWXVAM	Development of XVAM code to interface with Cad/Cam drawings
TSS Contract	Bell Computing	ShockVAM	Development of graphical output for ShockVAM
Non-Disclosure Agreement	CONCENTRIC	NEWXVAM	Development of XVAM code to interface with Cad/Cam drawings
Alliance	Tenix	NEWXVAM	ANZAC class electronic Product Models, Amour Solutions
Informal Collaboration	AUSDEC		Monitoring of developments in exchange protocols including STEP
Non-Disclosure Agreement	Tenix	NEWXVAM	Limits disclosure of Tenix IP to third parties
Research Agreement	RMIT	FE Modelling	possibly a scholarship arrangement with RMIT/ Masters Student
Informal Collaboration	Pacific Noise & Vibration	UDT Paper	Acoustic Holography development
Consultancy	Pacific Noise & Vibration	Acoustic Holography	
Support through Project Offices	ADI	MHC Self Noise Monitoring System	
Research Agreement	University of Adelaide	Active Noise Control	

Interaction Type	Organisation	Project	Description
Collaboration	Townsville University	Active Noise radiation Control	Under government Research Grant for research with University /Industry DSTO involved as third party
Informal Collaboration	Victorian University of Technology		Sabbatical leave for VUT staff member
TSS Contract	Victorian University of Technology		Sabbatical leave for VUT staff member
Support through Project Offices	NSWC	Collins Noise measurements	Collaboration between DSTO/NSWC but through project office
Informal Collaboration	BAe Systems	Active damping for Collins propeller	
Informal Collaboration	Michelle Bearings (Sp??)	Active damping for Collins propeller	
Informal Collaboration	Tenix	Paints, coatings & corrosion investigations	AMRL (Paints) acted as the arbitrator in a dispute between Tenix and International Paints over the cause of pinholing over the hull of HMAS Parramatta
Informal Collaboration	Lockheed	Paints, coatings & corrosion investigations	Identified defects and their causes on the new C130L aircraft. RAAF approached Lockheed to rectify these defects using the information provided by DSTO. Lockheed agrees.
Informal Collaboration	Jotun International	Paints, coatings & corrosion investigations	Assisted Jotun International in the development of LSA (Low Solar Absorbing) paints for RAN vessels
Informal Collaboration	Boeing	Paints, coatings & corrosion investigations	Interacted with Boeing on paint schemes for Project Wedgetail
Informal Collaboration	NQEA	Paints, coatings & corrosion investigations	Provided NQEA with a suite of new paint schemes for RAN patrol boats.
Consultancy	Delft University of Technology (Netherlands)	Glare exposure program	Glare exposure program
CRC	CRC Advanced Composite Structures		
Informal Collaboration	Huntsman Chemicals	Fire Resistance Resins	Long running relationship on material-fire research
Informal Collaboration	ADI	Qualifying Fire resistance of composites	
TSS Contract	CFA	GRP Fire Resistance	
Informal Collaboration	Wharington Fire research	GRP Fire Resistance	
Informal Collaboration	CSIRO	GRP Fire Resistance	

Interaction Type	Organisation	Project	Description
License Agreement	ADI	Composite repair	Resin infusion technology for the repair of composite materials
Informal Collaboration	ADI	NDE inspection of composites	methods for the inspection of thick composite materials
TSS Contract	Composites Fabricator	Composites manufacture	manufacture of composite specimens for experimentation
Informal Collaboration	Australian National University	Composite materials	demonstration & training of composite fabrication and experimentation techniques
Informal Collaboration	Monash University	Composite materials	demonstration & training of composite fabrication and experimentation techniques
Informal Collaboration	RMIT	Fire testing of composites	demonstration & training of composite fabrication and experimentation techniques
Informal Collaboration	Montpellier University (France)	Vinyl Ester Resins	Informal discussions & possible joint paper
Informal Collaboration	Soniclean	Oxygen & gas Lines	Provided advice on the methods for maintaining air/oxygen lines. Conducted some tests of seals & gears for soniclean
Adhoc Advice	H.I Fraser	Oxygen & gas Lines	Provided advice on the methods for maintaining air/oxygen lines for the RAN @ HMAS Penguin
TSS Contract	Fiomarine	SSP DAMDIC	Design electronics (own IP)
TSS Contract	Gascon	SSP DAMDIC	Design & build regulators (own IP)
TSS Contract	FloatPac	SSP DAMDIC	Develop & build bladders
Boeing Contract	Boeing	SSP DAMDIC	Design and build SSPD (DSTO IP)
TSS Contract	Underwater Video Systems	SSP DAMDIC	Develop underwater seals and connections. Pressure testing of fittings and seals.
Boeing Contract	Boeing	Human-computer interface for ROVs	Write software for the operation console for a mine clearance ROV
TSS Contract	People Bank	Human-computer interface for ROVs	Write software for the operation console for a mine clearance ROV
Research Agreement	RMIT	ROV Tethers	Computer tools for the prediction/tracking of ROV tether cables
Informal Collaboration	Australian Maritime College	ROV Tethers	Student project: Modelling of ROV tether behaviour
Collaboration	Australian Maritime Hydrodynamics Research Centre	Hydrodynamics of Adjunct Sensors and Systems for underwater surveillance and intervention tasks.	Research Agreement Proposal to jointly sponsor and supervise a postgraduate student project.
Consultancy	Czigledy Consulting	ROV Power supplies	Review of electrical safety of Wayamba Decktop System

Interaction Type	Organisation	Project	Description
Consultancy	W.S. Curry	ROV Power supplies	Review of electrical safety of Wayamba Decktop System
TSS Contract	Advanced Technical Systems Australia	ROV information systems	Possibly developing a means of capturing information from double eagle
Non-Disclosure Agreement	Fiomarine	Acoustic Activated Mine Lifting Bag	Development of an acoustically trigger mine lifting bag
Non-Disclosure Agreement	Liferaft Systems Australia	Acoustic Activated Mine Lifting Bag	Development of an acoustically trigger mine lifting bag
Non-Disclosure Agreement	ADI	Acoustic Activated Mine Lifting Bag	Development of an acoustically trigger mine lifting bag
Informal Collaboration	ADI	Mine Actuation Simulator System	Possible Concept Technology Demonstrator, MPD introduction, MOD to sponsor
Support through Project Offices	ASC	Submarine Air Quality	Ongoing discussions and meetings regarding air quality issues on board Collins class
TSS Contract	University of NSW	Submarine Air Quality	Manufacture of experimental rigs for membranes
TSS Contract	University of NSW	Submarine Air Quality	Conduct literature reviews
TSS Contract	CSIRO	Submarine Air Quality	Performed gas analysis
TSS Contract	Grasby Dynamics	Submarine Air Quality	Built equipment, to DSTO specification, for the detection of particular substances in air.
TSS Contract	Scottish Anglo	Submarine Air Quality	In collaboration built a hyperbaric instrument/testing system for air quality
Research Agreement	University of W.A.	Collins Noise & vibration	Initial project has two phases: Characterise the thrust block system using FE modelling. Conduct experiments to validate models
Informal Collaboration	ASC	Collins Noise & vibration	Collaboration in arranging experiments
Support through Project Offices	ASC	Collins Noise & vibration	Numerous issues with respect noise & vibration
Alliance	Nautronix	Collins Noise	Data collection and analysis from sound ranges
Alliance	Nautronix	Collins Noise	Seafac experiment conducted in Alaska
Informal Collaboration	Navy Research Laboratory	Collins Condition Monitoring	Development and testing of oil examination equipment
Research Agreement	Monash University	Motor Noise	PhD project: Reducing motor noise through mechanical design
Research Agreement	Monash University	Motor Noise	PhD project: Reducing motor noise by control strategies
Non-Disclosure Agreement	Pacific Main Batteries	Battery Charging	Pacific Main batteries using pulse charger system developed by DSTO

Interaction Type	Organisation	Project	Description
Informal Collaboration	Pacific Main Batteries	Battery Charging	Together with DMO/DSTO develop specifications for tender.
Informal Collaboration	Pacific Main Batteries	Battery Charging	PMB have provided test cell for validating tests of pulse charger model
Support through Project Offices	CSIRO	Battery Charging	CSIRO have been contracted by DMO to be consultants to DSTO on charging algorithms
TSS Contract	Intellectual Property & Technology Consultants	Land Based Test Facility	Scoping exercise for the LBTF
TSS Contract	BAe Systems	Land Based Test Facility	Project Definition Study for the LBTF
Consultancy	BAe Systems	Anti Corrosion coatings	Assessment of coatings for Aluminium Alloys
Consultancy	BAe Systems	Corrosion Modelling	Develop Software to predict corrosion
Collaboration	BAe Systems	Corrosion on aircraft	4 areas of work: Fatigue cracking of thin paint films Condition based monitoring sensors non-chromate corrosion coatings On-board aircraft corrosion tests
Research Agreement	S&K Technologies (US)	Corrosion on aircraft	Atmospheric Corrosion Testing Assessment of corrosion Protective Compounds RRA - Heat treatment of alloys to limit corrosion Mechanical Breakdown of paint films
Research Agreement	Monash University	Sensors for the detection of corrosion	
Research Agreement	ADFA	Corrosion on aircraft	Corrosion damage & Fatigue of aircraft joints
Research Agreement	Monash University	Corrosion on aircraft	Non-chromate corrosion inhibitors
Research Agreement	Monash University		Fibre optic sensors for the detection of corrosion on aircraft
Placement	Monash University		MPD personnel doing Masters at Monash
Informal Collaboration	Queensland University of Technology	Corrosion Studies	PhD students do research during university vacations
Intellectual Property Agreement	Delft University of Technology (Netherlands)	Corrosion Studies	PhD students do research on filiform corrosion
Informal Collaboration	Royal Military College of Canada	Corrosion Studies	They model atmospheric corrosion. DSTO provide empirical data in exchange for the models
MOU	CSIRO	Corrosion Studies	Collaborative work on atmospheric corrosion

Interaction Type	Organisation	Project	Description
Collaboration	USAF	Corrosion Prevention & Control	Collaborative effort on the manufacture and testing of corrosion sensors
Collaboration	USN	Corrosion Prevention & Control	Collaborative effort on the manufacture and testing of corrosion sensors
Informal Collaboration	Rockwell	Corrosion Studies	Corrosion Resistance of friction stir welded areas
CRC	BHP	X-80 Steel	X-80 steel development project
CRC	University of Adelaide	X-80 Steel	X-80 steel development project
CRC	University of Wollongong	X-80 Steel	X-80 steel development project
CRC	Tenix	X-80 Steel	X-80 steel development project
Alliance	Tenix	X-80 Steel into new ship builds	Project aims to get X-80 steel into new ship builds
CRC	University of Adelaide	Friction welding	Joint project between MPD/AED/Uni of Ade. For the friction welding in refurbishment of high strength Aluminium Alloys
CRC	IRIS Swinburne	Laser Cladding	Developing laser cladding technologies for high strength Aluminium Alloys
Informal Collaboration	University of Adelaide	Hydrogen Cracking	
Informal Collaboration	RMIT	IR Inks	Application of active printing ink
Alliance	Tenix	Ship Signature Management	strategies to present technology to the customer
License Agreement	ADI	RAM	License to manufacture & sell RAM
TSS Contract	MacKay Consolidated Industries Pty Ltd	RF Signature management	manufacture of foam rubber tiles
TSS Contract	Wattle	RF Signature management	manufacture of paint for RF signature management
Non-Disclosure Agreement	Australian Hi-Tech Fabric	RF Signature management	coating of textiles for RF signature management
TSS Contract	Australian Hi-Tech Fabric	RF Signature management	develop processes for coating fabrics with RF paints
TSS Contract	Netmakers Australia	RF Signature management	manufacture RF signature management netting
TSS Contract	Numerous plastics/polymer manufacturers	Optical Signatures	Manufacture of components for investigation of Optical Freq. Signature management properties
MOU	RMIT		Collaborative Agreement for Research Cooperation between Materials Research Laboratory (MRL) and RMIT

Interaction Type	Organisation	Project	Description
License Agreement	Analatom Inc.	Adhesive Bond Degradation Sensor	Analatom Inc have a licence to market the sensor
License Agreement	Analatom Inc.	Linear Polarisation Corrosion Sensor	Analatom Inc have a licence to market the sensor
Informal Collaboration	Analatom Inc.	Adhesive Bond Degradation & Linear Polarisation Corrosion Sensors & Silicone MEMS Strain gauge	Continued Development and trialing of sensors
MOU	CSIRO	Nanoparticle films	MOU with CSIRO Telecommunication & Industry Physics
CRC	CRC Microtechnologies		Member of the Users Technical Panel.
TSS Contract	IRIS Swinburne	Laser Micro Fabrication facilities	10 weeks per annum access to microfabrication facilities for 3 years
Collaboration	IRIS Swinburne	Minifab	Collaborative effort by Swinburn Uni., DSTO, Wilkore Inc. and the CRC in applying for a state government STI grant for the establishment of a microfabricating facility
Collaboration	Wilkore	Minifab	Collaborative effort by Swinburn Uni., DSTO, Wilkore Inc. and the CRC in applying for a state government STI grant for the establishment of a microfabricating facility
Collaboration	CRC Microtechnologies	Minifab	Collaborative effort by Swinburn Uni., DSTO, Wilkore Inc. and the CRC in applying for a state government STI grant for the establishment of a microfabricating facility
Informal Collaboration	Swinburn University of Technology	micro fabrication	Ongoing collaboration with issues of micro fabrication technologies
Informal Collaboration	Melbourne University	nano technology	Small ongoing collaboration with issues of nano technologies
TSS Contract	The Laser Experts	Linear Polarisation Corrosion Sensor	Numerous contracts for development of laser fabrication of micro sensors
License Agreement	Analatom Inc.	Silicone MEMS Strain gauge	Analatom have a licence to market the sensor
Collaboration	Monash University	Fundamental studies of Fracture	Supervision of two 4th year students in materials science
Collaboration	University of NSW	Fundamental studies of Fracture	Supervision of 4th year project
Collaboration	University of NSW	Fundamental studies of Fracture and deformation	ARC Grant application submitted and to be re-submitted

Interaction Type	Organisation	Project	Description
Collaboration	Queensland University of Technology	Fundamental studies of Fracture (LME)	ARC Grant application to be submitted
Collaboration	Monash University	Fundamental studies of Interfaces & Fracture	ARC Grant application to be submitted
CRC	CRC Advanced Composite Structures	Materials Characterisation	Provision of materials characterisation infrastructure
Informal Collaboration	Monash University	Materials Characterisation	Microscopy time
Informal Collaboration	University of NSW	Materials Characterisation	
Informal Collaboration	University Of Sydney	Materials Characterisation	
Informal Collaboration	CSIRO	Materials Characterisation	
Informal Collaboration	ANSTO	Materials Characterisation	
Informal Collaboration	Hawker DeHavilland	Materials Characterisation	Collaboration on microanalysis technologies
CRC	CRC Welded Structures	Hydrogen Cracking	MPD personnel is a member of the working group on Hydrogen Cracking
Support through Project Offices	ASC	Hydrogen Cracking	
Support through Project Offices	ASC	Component Failure Analysis	
Support through Project Offices	ASC	Bearing Failure	
Support through Project Offices	SKF Australia	Bearing Failure	
Support through Project Offices	Kockums	Propellers	propeller investigations
TSS Contract	Fortburn	Strain Gauge Application	Application of strain gauges to propellers
TSS Contract	Hartwood Pty Ltd	FE analysis of ACPD	
TSS Contract	Lorenz Drack	Hydrodynamics	
Informal Collaboration	Tenix	Hull Cathodic Protection	Measurement of hull potential due to cathodic protection systems
Support through Project Offices	Tenix	Auxiliary sea water piping system corrosion	Measurement of SW flow rates during contractor sea trials
Consultancy	Tenix	A-bracket bearing wear	Investigation of wear on propeller shaft & bearing
Consultancy	ADI	AAG corrosion	Investigation of corrosion on the AAG

Interaction Type	Organisation	Project	Description
Consultancy	Resonance Technology	AAG corrosion	Investigation of corrosion on the AAG
Support through Project Offices	ADI	MHC	Investigation of corrosion issues
Support through Project Offices	ASC	Failure investigations	Investigation of corrosion issues. Member of Submarine Corrosion Working Group
Informal Collaboration	Rhocraft R&D (Canada)	Hull Potential measurements	Development and provision of commercial underwater dataloggers, DSTO feedback on product improvement
TSS Contract	Peter Quested	Electric Propulsion	Contract Management of Technology Study into Integrated Full Electric Propulsion (IFEP) systems for ships
Collaboration	Victorian University of Technology	GRP Piping	Shock assessment of metallic and GRP pipes
Collaboration	Australian Marine Technology	GRP Piping	Shock assessment of metallic and GRP pipes
Research Agreement	Victorian University of Technology	Capability management	Master student project
Alliance	Tenix	Capability management	Tenix have expressed interest in the application of SPAR s/w to capability management
Alliance	ADI	Capability management	Presentations of the SPAR s/w have been made to ADI
Informal Collaboration	Victorian University of Technology	Capability management	A continuing relationship exists through Alec Simcock.
Alliance	Tenix	Capability management	Development of predictive models for ANZAC systems
Collaboration	Aspect computing	Capability management	Development of predictive models for ANZAC systems
Alliance	ADI	Capability management	Modelling of critical MHC systems (focus here is on development of a large detailed model, not on addressing specific MHC issues).
Collaboration	Clockwork group	Capability management	Modelling of critical MHC systems (focus here is on development of a large detailed model, not on addressing specific MHC issues).
Collaboration	ASC	Capability management	ASC provision of ISCMMS data & presentation of knowledge discovery in databases research
TSS Contract	Direct Focus Consulting	Capability management	Investigation & assessment of current configuration management practises & policies
TSS Contract	Blumax	Capability management	Development of reliability/Availability block diagrams of the FFG

Interaction Type	Organisation	Project	Description
Research Agreement	Victorian University of Technology	Capability management	Success Trees Automated Reliability Blocks (STARB)
Research Agreement	Victorian University of Technology	Capability management	GUI for risk management Decision Tools
TSS Contract	PADJ Pty Ltd	Sustainability Assessment	Development of a user interface for Explosive Ordnance sustainability
Research Agreement	Victorian University of Technology	Capability management	Work Breakdown Structure (WBS) to SPAR input file generator software
Research Agreement	Victorian University of Technology	Capability management	SPAR Optimiser Software
TSS Contract	Douglas Beck		Provide professional support to the SEA4000 Emergent Technology Study
TSS Contract	Douglas Beck		Provide professional support to the DMO Commonality Study
TSS Contract	Kim Baddams		Provide professional support to the SEA4000 Emergent Technology Study
TSS Contract	Peter Quested	Electric Ship Study	Provide professional support to the Electric Shp Study for Maritime Development
TSS Contract	Intellectual Property & Technology Consultants	IFEP Technology Study	Contract Management of Technology Study into Integrated Full Electric Propulsion (IFEP) systems for ships
TSS Contract	BAE Systems (UK)	IFEP Technology Study	Technology Study in Integrated Full Electric Propulsion for various ship classes
Non-Disclosure Agreement	BAE Systems (UK)	IFEP Technology Study	Technology Study in Integrated Full Electric Propulsion for various ship classes
Placement	Monash University	Electromagneetic Nondestructive Evaluaiton	MPD personnel doing MSc at Monash
Informal Collaboration	Monash University		Supervision of MSc student
Informal Collaboration	Aristotle University of Thessaloniki	Eddy current NDE	theory of eddy-current NDE for generic applications (Dr T Theodolidis)

Appendix C: International Interactions

Strategic Interaction Type	Sub Group	Topic	Country	Laboratory (Organisation)
AAMOUR	Topic 140	Shipboard waste management	UK	SSA Foxhill Bath
DEA	N-97-5846	Shipboard environmental systems and technology	USA	NAVSEA Arlington
TTCP	WPN-TP-4	Energetic Materials & Propulsion Technology		
TTCP	MAT TP6	Ship Materials Technology - Paints	Canada	
			UK	
			USA	
			NZ	
TTCP	MAT TP6	Sealants	Canada	
			UK	
			USA	
			NZ	
TTCP	MAT TP6	Aircraft paints	Canada	
			UK	
			USA	
			NZ	
TTCP	MAT TP6	Polymers, Adhesives & Coatings	Canada	
			UK	
			USA	
			NZ	
TTCP	MAT TP6 OA	Environmentally Acceptable Fouling Release Coatings	Canada	EDRD Esquimalt
			USA	NRL Washington
TTCP	KTA 4-28	EM Contaminated Site Characterization	UK	DERA, Ft Halstead
			USA	AFRL, AFMC
			Canada	DREV Val-Belair
IEA	ABCANZ-97-07	Ship Materials Technology- Antifouling WG	Canada	DMSS Quebec
			UK	DPA Bristol
			USA	NAVSEA Arlington

Strategic Interaction Type	Sub Group	Topic	Country	Laboratory (Organisation)
			NZ	DOTSE Auckland
Collaboration		Anti-Fouling Acoustic Tiles	France	DCE Toulon
TTCP	MAT TP1	Aircraft Corrosion Sensors	UK	
			USA	
			NZ	
			Canada	
TTCP	MAT TP1	Corrosion and fatigue	UK	
			USA	
			NZ	
			Canada	
TTCP	MAT TP1	Thermal Barrier Coatings	UK	
			USA	
			NZ	
			Canada	
TTCP	MAT TP1	High Cycle Fatigue and Engine Components	UK	
			USA	
			NZ	
			Canada	
TTCP	MAT TP1	Friction Stir Welding and Stress Corrosion Cracking	UK	
			USA	
			NZ	
			Canada	
Commercial		Adhesive Bond Degradation Sensor	USA	Analaton Inc
Commercial		Linear Polarisation Resistance corrosion sensor	USA	Analaton Inc.
Commercial		Silicone MEMS Strain Gauge	USA	Analaton Inc.

Strategic Interaction Type	Sub Group	Topic	Country	Laboratory (Organisation)
TTCP	MAT TP5	Nondestructive Evaluation for Asset Life Extension and Integrity	UK	DSTL
			USA	NSWC
			Canada	DRDC
TTCP	MAT TP6-09	Acoustic noise reduction	UK	
			USA	
			NZ	
			Canada	DREA
MOU	SA 16	Vibration isolation materials	Canada	DREA
DEA	5845	Underwater Shock Loading	USA	NSWC
TTCP	MAT TP6	Polymers, Adhesives and Coatings	UK	
			USA	
			Canada	
Collaboration		Actively trimmed tow platform for sonar	USA	Klein Associates Inc.
NATO	NG3-WP#16	Specialist Team-Remote Controlled Mine Influence Minesweeping(ST-RCIMS) System-:Shock and Bubble Loads	NATO	
International Cooperation Agreement	Subsidiary Agreement No. 6	Shock Testing Scaled Hull Forms	Singapore	DSO National Laboratories
Collaboration		Hydrodynamics	USA	
AAMOUR	Topic 141	Submarine Platform Technologies	UK	
NATO	TG 16	EO Signature Management	NATO	ONR
NATO	TG 16	Naval Electromagnetic signature management	UK	DSTL Portsmouth West
NATO	TG 16	IR signature management	Canada	DREV
NATO	TG 16	EO signature modelling	USA	NRL
Collaboration		Submarine acoustic signatures	USA	NSWC-CD
Collaboration		DSTL Rosyth	UK	DSTL Rosyth
AAMOUR	Topic 113	Nondestructive Evaluation for Ageing Aircraft	UK	DSTL
Collaboration		NRL LaserNet Fines system for examination and classification of oils.	USA	
TTCP	MAT TP7	Composites Technology and Performance	UK	

Strategic Interaction Type	Sub Group	Topic	Country	Laboratory (Organisation)
			USA	
			Canada	
IEA	ABCANZ-97-12	Composite Ship Structures	UK	
			USA	
			NZ	
			Canada	
NATO	AC/301 Sub GroupB	Fire Assessment of Materials	FRCAUKCAN LGESWEIT	
DEA	A-92-AS-1336	Penetrators and Light Armour	USA	US Army Research Lab
MOU	A-99-0019	Light Armour and Penetrators	USA	US Army Research Lab
MOU	SA 10	Ballistic Protection and Armour Materials	Canada	DRDC Valcartier
TTCP	MAT TP1-O26	Nanomaterials for Projectile Applications	USA	US Army Research Lab
TTCP	MAT TP1-O26	Glassy Metals	USA	US Army Research Lab
TTCP	WTP-1	Kinetic Energy and Chemical Energy Warheads	USA	US Army Research Lab
TTCP	MAT TP7-O22	Modelling Composite Materials in Armour Applications	USA	US Army Research Lab
Collaboration		Submarine Diesel Engines	UK	
Collaboration		Diesel engine modelling	UK	Ricardo Consulting Engineers
Collaboration		Diesel engine reliability and performance development	Sweden	Hedemora Diesel
TTCP	HUM TP-9	Human Factors Integration for Naval Systems	UK	
			USA	
			Canada	
NATO	SG61	Virtual Ships	UK	
			USA	
			Germany	
			France	
			Italy	
			Sweden	

Strategic Interaction Type	Sub Group	Topic	Country	Laboratory (Organisation)
TTCP	MAT TP1	Operating Assignment O24: Alternate materials for seawater applications	USA	
			UK	
			Canada	
TTCP	MAT TP1	Operating Assignment 018: Low heat input welding of NAB (corrosion aspects)	UK	
			USA	
			Canada	
TTCP	MAT TP1	Operating assignment O-24 (Alternative Materials for seawater applications)	UK	Dstl
			USA	ONR
			NZ	
			Canada	DRDC
TTCP	MAT TP1	Operating assignment O-20 (Novel Hydrogen Storage Materials) To be replaced by O-34 (Hydrogen Storage in Carbon-based materials)	UK	Dstl
			USA	NRL
			NZ	
			Canada	RMC

Strategic Interaction Type	Sub Group	Topic	Country	Laboratory (Organisation)
IEA	ABCANZ-97-07	Ship Materials Technology: Cathodic protection Working Group	UK	Dstl?
			USA	NRL
			NZ	RNZN
			Canada	DRDC
AAMOUR	Topic 84	Ship electromagnetic signatures	UK	
IEA	ABCANZ-97-12	Progressive Failure	UK	
			USA	
			Canada	
IEA	ABCANZ-97-12	Structural Analysis methods	UK	
			USA	
			Canada	
IEA	ABCANZ-97-12	Project Office for ABCANZ97-12	UK	
			USA	
			NZ	
			Canada	
IEA	ABCANZ-97-12	Hydrodynamic loads	UK	
			USA	
			NZ	
			Canada	
TTCP	WTP-1	Sea Targets	UK	
			USA	
			Canada	
		Underwater Shock	USA	NSWC
NATO	SWG12	Maritime Environment Protection		
DEA	N-96-A-584	Submarine Structures	USA	
TTCP	MAT TP1	Proposed operating assignment on environmental factors affecting the corrosion performance of nickel aluminium bronze	UK	Dstl

Strategic Interaction Type	Sub Group	Topic	Country	Laboratory (Organisation)
			USA	
			NZ	
			Canada	DRDC
Collaboration		Target Strength Modelling Benchmarking Studies	Canada	DREA
			Germany	FWG
			Netherlands	TNO-TPD
			Sweden	FOI
			UK	QunetiQ
TTCP	KTA 1-36	Underwater Explosive Effects in the Littoral	UK	DSTL Fort Halstead
			USA	NSWC Indian Head
			Canada	DRES
TTCP	KTA 1-37	Simulation of Underwater Explosion Effects	UK	DSTL Fort Halstead
			USA	NSWC Indian Head
			Canada	DRES
MOU	SA 6	Blast & Shock Loading	Canada	DRES

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19. ABSTRACT Maritime Platforms Division's interactions with industry and academia have been recorded analysed and are reported. The interactions are numerous and significant in scope and complexity. International interactions are also extensive covering a broad range of research areas across the Division.					

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