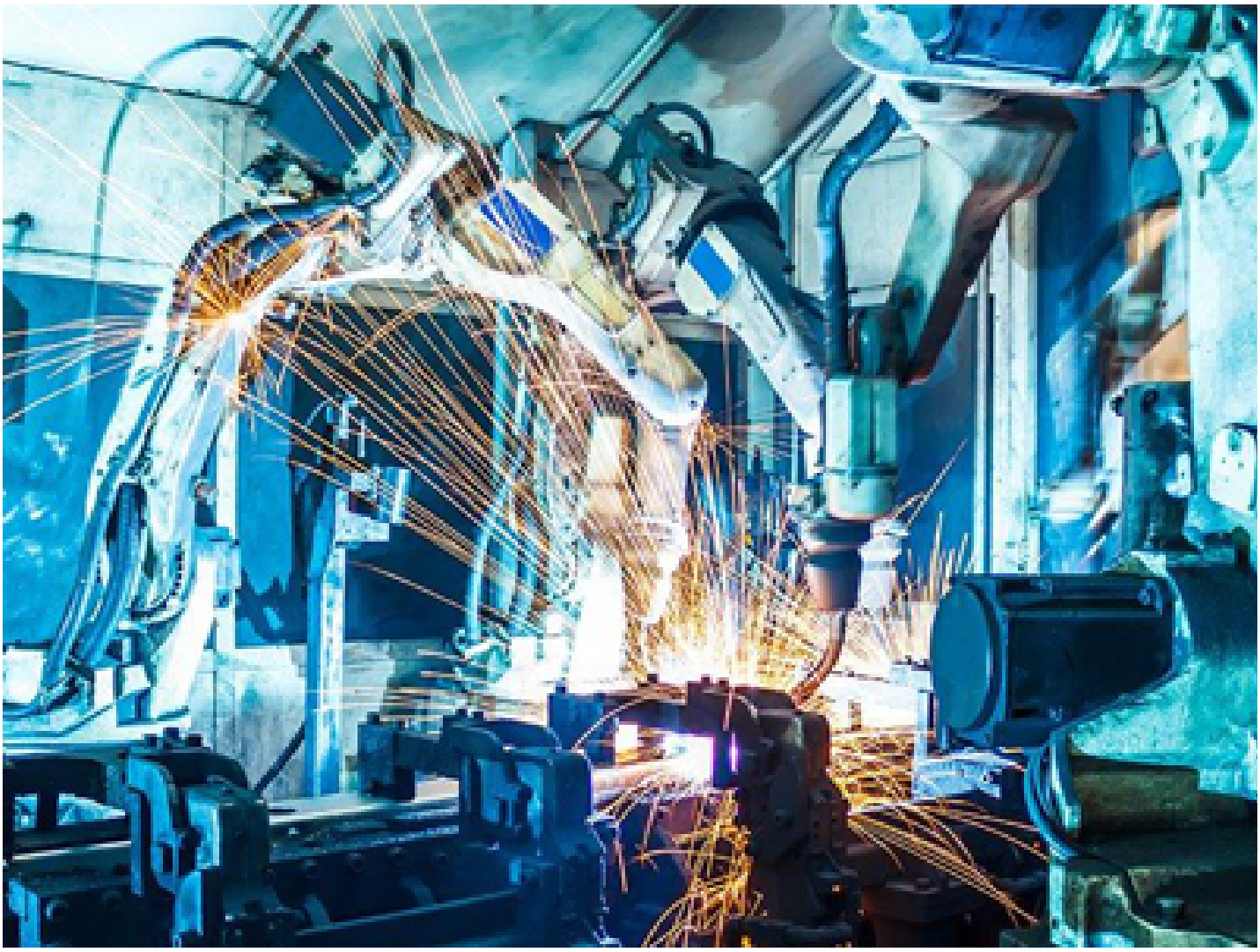
A JOINT EFFORT - INTEGRATING ADVANCED MATERIALS ONTO MILITARY PLATFORMS (STAGE 2)



A Joint Effort – Integrating Advanced Materials onto Military Platforms

1 INTRODUCTION

Stage 1 of the "A Joint Effort" research topic was launched in November 2018 in parallel by Australia and the United Kingdom. The call sought innovative joining technologies to enable the use of advanced materials and/or designs on military platforms in land, sea and air environments. Over 70 proposals were received from industry and academia, which resulted in 14 projects being funded for Stage 1 split evenly between the Australian and British competitions. Now in Stage 2 the campaign is seeking to increase collaboration between the two nations, build on innovations from Stage 1 and develop entirely new concepts that have emerged from collaboration.

Stage 2, "A Joint Effort", is looking for innovative joining technologies that enable the use of advanced materials and/or designs on military platforms in land, sea and air environments. It is being run collaboratively as part of ongoing partnership in Science and Technology within Defence. In Australia, participation is being led by Defence Science and Technology Group (DST Group) and the Small Business Innovation Research for Defence (SBIRD), part of the Next Generation Technologies Fund . In the UK, participation is led by Defence Science and Technology Laboratory (DSTL). The competition will be managed by the UK's Defence and Security Accelerator (DASA) and funded collaboratively by both nations. Stage 2 will be looking for developed proposals beginning at a TRL 2-3 to test the technology / innovation in a laboratory setting against an application.

This document outlines the requirements for Australian-led Stage 2 applicants only. If uncertain, joint bids between Australian organisations and other nations (including the United Kingdom) should contact DASA to determine the best route.

The technical scope remains unchanged from Stage 1. We are seeking innovative technologies that will help to expedite the insertion of advanced materials into platforms, through innovations in joining technologies. SBIRD and DASA are seeking proposals that will deliver innovations in joining technology to enable the use of advanced materials on military

platforms. Innovations should address the challenging demands of the defence environment and must therefore:

- Improve the durability of structures and joints to reduce failure and maintainability issues;
- Enable new design choices to be made for future military platforms to maintain a capability advantage;
- Provide new routes to create and manage joints across the life-cycle of a military platform.

There is total funding of up to A$1m available in Stage 2 of the topic within Australia, applications from other nations should refer to the UK documentation on the DASA website.

The topic closes at 2300 (Eastern Daylight Savings Time), 1200 (Midday) Greenwich Mean Time on Friday 31st January 2020.

2 TOPIC SCOPE

2.1 Background

Advanced materials offer significant benefits to military capability, for example through increased functionality, improved survivability, enhanced maintainability and reduced through-life cost. Military platforms across all operating domains (land, sea and air) need to incorporate an increasingly diverse range of materials to meet the complex and demanding requirements of the armed forces.

In order to exploit these benefits advanced materials often need to be accommodated within existing designs or retro-fitted onto an existing platform, leading to a combination of materials and sub-systems on a single platform. Consequently, joints and interfaces will often have challenging characteristics such as sharp changes in mechanical and mechanical properties, stress raisers, reduced structural integrity or susceptibility to environmental degradation.

These issues are exacerbated by the diverse and intense operating environments that a military platform will be exposed to during a typical operational lifetime, including environments that were not considered during manufacture. Therefore joining techniques must be robust, reliable and ideally tailorable to a range of operating scenarios. We are interested in creating and maintaining joints and interfaces not just during manufacture, but throughout the platform life-cycle. Repair processes, whether emergency repairs on the front line or part of planned maintenance, must also keep up with advances in the manufacturing techniques used for the original structure. Innovations could either reduce the complexity or cost of repair processes or allow greater flexibility in the materials/components being repaired.

2.2 Scope

This topic is seeking innovations and new approaches that will accelerate the integration of advanced materials onto military platforms. These materials may be monolithic, composite or functionally graded depending on the application. They may have been manufactured using conventional or advanced manufacture techniques, including additive manufacture.

Developments of particular interest for this topic include:

- enabling new material combinations;
- novel approaches to the integration of advanced or novel materials;
- increasing joints durability in military operating conditions;
- joints that allow easier modification/replacement of components or sub-systems on a platform;
- health and usage monitoring of joints.

3. TOPIC ASPECTS

Stage 2 intends to fund different proof-of-concepts / ideas / projects /developments that address at least one of the aspects outlined below. This topic is being run in parallel with the Ministry of Defence in the UK, who are also seeking innovations in joining technologies; however at this stage there is not a requirement to directly collaborate with establishments in the United Kingdom. Stage 2 encourages collaboration with other Australian or United Kingdom partners.

Key requirements that apply across all the aspects for creating and managing joints on military platforms are:

- creating effective joints in real-world conditions (surface contamination, repairs on damaged material.
- techniques that are cost effective (whether this is the manufacture cost or through-life savings).
- considering the fire, smoke and toxicity performance of materials and interfaces.

joining approaches that are light weight compared to current methods.

3.1 Aspect 1 – Integration of Composites

Composites offer significant benefits including being lightweight, wear resistant and corrosion resistant. Composites have already been utilised on some military platforms in areas where they were sought for specific performance requirements; however there remain significant blockers to composites being considered to other materials with equal weighting.

The requirement for reliable, cost-effective methods for joining composites to other materials is an important example. We are interested in developing a range of composite integration methods that address key performance criteria: specifically managing mismatches in properties (especially coefficient of thermal expansion) and having rapid methods to repair composite joints and interfaces. Currently the use of pre-impregnated composites for fast composite builds and repairs is common practice; however these materials require specific storage conditions which are burdensome during operations, so alternatives are sought.

As additive manufacture processes mature it is anticipated that they will be increasingly used to produce composite and metallic structures (including parts with graded surfaces and structures). We are interested in developing methods to attach a mixture of composite and metallic structures that will be manufactured by a combination of conventional and AM techniques. As it is anticipated that these joints and interfaces may be particularly susceptible to failure, we are also interested in developing techniques to understand the reliability of these joints.

3.2 Aspect 2 – Adhesives for Structural Joining

Adhesives are of increasing interest for military platforms due to benefits including weight savings, fatigue performance and the ability to join a range of materials. The rate of adoption has varied across the armed forces based on specific usage cases and design considerations; however key developments must be made in order to accelerate their usage for defence applications.

Military platforms operate in a diverse range of challenging environments within their service lives, and require adhesives that perform beyond the requirements of many civil industries. We are interested in forming bonds which are effective in the environments commonly found during build, maintenance and operation. This will include the presence of contaminants and less than ideal surface preparation, varied exposure conditions (including UV, salt, humidity, operating temperatures), and dissimilar material combinations.

Reliability of platforms is critical for the Australian Defence Force (ADF), military users must be confident in the quality of adhesive bonds. This could be through the design of novel bonded joints which are not reliant on a fully bonded interface, or by developing robust methods for inspecting and monitoring adhesives bonds.

Disrupting adhesive bonds on demand without use of excessive force or harsh chemicals is also of interest for the opportunities in inspection, modular designs and temporary repairs and equipment attachment. Techniques should behave consistently and be practical within current manufacture and maintenance procedures.

3.2 Aspect 3 – Joining High Temperature Structures

High-speed weapons and future air-platforms place an increasing demand on materials and structures, in particular the temperatures at which they must operate. Refractory metals may be pushed to their thermal and structural limits for example, and may be joined to even hotter ceramic or ceramic-matrix-composite (CMC) components such as radomes or leading edges. Ceramics and CMCs are also of interest for major structural components or thermal protection system (TPS) skins, potentially replacing metals.

Interfaces between parts within the airframe, within high-pressure duct structures, or between the airframe and TPS, may be subjected to significant out of plane loading, generating 3-dimensional stress states, and this can be a challenge for both metallic and ceramic components. Parts within the propulsion system, such as combustion chambers, pipes and nozzles may be subjected to temperatures approaching that of the combusting gases (circa 2000°C), and may have complex geometry and joints. Other significant sources of loading include thermal expansion, shock, and vibration loading.

3.2 Aspect 4 – Improving Armour Systems

Currently military platforms and body armour use a range of different materials to provide physical protection against ballistic threats. The way that these different armour components and armour systems are joined can have a significant impact on its protection effectiveness.

Research is required to join dissimilar materials, which can be either metallic, ceramic or polymeric, such that the armour system can withstand multi-hit ballistic impact. This has traditionally proved difficult using adhesives applied to surfaces, with materials de-bonding through-life or following initial ballistic impact. Advanced and novel approaches are being sought that improve the shear and tensile strength of interfaces, that does not add significant weight to the overall armour system.

Innovative multifunctional personnel protection concepts and solutions that integrate additional operational capability are of specific interest. Non-traditional joints and interfaces with new bonding methods are of interest, as are more layered or textured joining solutions.

3.4 Clarification of what we want

Your proposal should include:

Innovation;

novel ideas for defence and/or security;

a clear pathway to future exploitation;

a focus on solving key material problems rather than a focus on complex systems;

consideration of the operating environments experienced by in-service military equipment;

fundamental advances in material science and engineering;

clear demonstration of how the proposed work builds on existing published or open knowledge;

enhancement to or building of Defence capability;

a clear description of the benefit and advantages of your approach.

approaches which leverage expertise of both Australian and British organisations

3.5 Clarification of what we do not want

For this topic we are not interested in:

consultancy, paper-based studies or literature reviews;

solutions that do not offer significant benefit to Defence;

proposals that only offer a written report;

proposals that cannot demonstrate feasibility within the Stage 2 timescale;

minor improvements in existing high technology readiness level TRL (TRL 6+) technologies;

demonstrations of off-the-shelf products requiring no experimental development;

identical resubmission of a previous bid to Next Generation Technologies Fund / SBIRD or Defence Innovation Hub without modification;

incremental improvements on existing technology;

proposals which offer no real long-term prospect of integration into defence capabilities;

proposals with no real prospect of out-competing existing technological solutions;

solutions that require unreasonable volumes of training data;

proposals that are not compliant with extant legislation, e.g. health, safety and environmental;

duplicate or replicate of other Defence research and development efforts and collaborations;

work that may interfere with either existing or expected Defence procurement projects;

proposals that are classified;

4 PATH TO MARKET (PATH TO CAPABILITY)

It is important that over the lifetime of this topic, ideas are accelerated towards appropriate end-users, to enhance capability. How long this takes will be dependent on the nature and starting point of the innovation. Early identification and appropriate engagement with potential users during the competition topic and subsequent stages is essential.

All proposals to this parallel SBIRD / DASA topic should articulate the development in TRL of the output over the lifetime of the contract and how this relates to improved operational capability. For this topic it is envisaged that proposals will start at around TRL 2.The deliverables in your proposal (especially the final demonstration) should be designed to provide evidence that you have reached the intended TRL (around TRL 4-5) by the end of the contract. The final demonstration should evidence that full development of the solution would indeed provide improved operational capability to the user.

For applicants who were successful in Stage 1, evidence generated should support the development of the business case for Stage 2, with the aim of making it as easy as possible for potential collaborators to identify the innovative elements of your proposal in order to consider routes for exploitation.

It is important right from the start that SBIRD, DASA and end users understand how your idea will deliver longer term improvements to defence and/or security capability and how it could be integrated with other relevant capabilities (Centre for Defence Industry Capability (CDIC) are available to advise). Therefore, you may wish to include some of the following information, where known, to help the assessors understand your exploitation plans:

the intended Defence and/or security users of your final product and whether you have engaged with end-users or their procurement organisation

the current TRL of the innovation and where you realistically think it will be by the end of this stage

awareness of, and alignment to, any existing end user procurement programmes

the benefits (for example, in cost, time or improved capability) that your solution will provide to the user

whether it is likely to be a standalone product or integrated with other technologies or platforms

expected additional work required beyond the end of the contract to develop an operationally deployable commercial product (for example, 'scaling up' for manufacture, cyber security, integration with existing technologies or environmental operating conditions)

additional future applications and markets for exploitation

wider collaborations and networks you have already developed or any additional relationships you see as a requirement to support exploitation

requirements for access to external assets, including Government Furnished Materials, Equipment and Information (GFM) for example data, equipment, materials and facilities

how you intend to demonstrate the outputs at the end of this stage, what form the demonstration would take and whether it will require any special facilities (for example, outdoor space, specific venue)

how your product could be tested in a representative environment in later stages

any specific legal, commercial or regulatory considerations for exploitation

articulate existing links to Australia / UK partnerships.

5 HOW TO APPLY

Both Australian and UK proposals for funding to meet these aspects must be submitted by 1200 GMT (midday) 31st January 2020 via the Defence Innovation Portal which will direct you to the DASA submission service for which you will be required to register.

The initial funding pool of up to $1m is expected to fund 3 to 5 proposals. The cost to SBIRD per Australian proposal must be in the range of A$200k to A$350k. Proposers should consider these figures when costing a proposal, and note that the preference is to fund multiple projects (you may choose to use additional funds from elsewhere to meet the challenge). If successful, Stage 2 contracts will be awarded for a duration of between twelve to twenty four months.

Applications are not limited to successful Stage 1 projects. Applicants who were unsuccessful in Stage 1 may submit proposals, providing they are not identical to their initial Stage 1 proposal. New applicants who did not participate in the Stage 1 competition are also welcome to submit.

Further guidance on submitting a proposal can be found here .

5.1 What your proposal must include

The proposal should focus on this proof of concept stage but should also include a brief outline of the next stages of work required for exploitation.

When submitting a proposal, you must complete all sections of the online form, including an appropriate level of technical information to allow assessment of the bid and a completed finances section.

A project plan with clear milestones and deliverables must also be provided. Deliverables must be well defined and designed to provide evidence of progress against the project plan and the end-point for this stage.

For collaborative projects with partners within Australia, the collaborators should appoint a project lead. Similarly, for projects that involve contributions from both Australia and another nation, the collaborators should agree an organisation to act as the lead for the project and submit a single application to the relevant fund based on the location of the lead organisation. Projects with a lead organisation based in Australia should follow the guidelines set out in this document.

Projects led by UK or any other nation should consult the UK Ministry of Defence document . All proposals should clearly outline the nature of contributions of all participating organisations, including dependencies. IP should be managed within the team, with any agreements not impeding the ability of the team to meet the terms and conditions of the Next Generation Technologies Fund.

A resourcing plan should also be included that identifies, where possible, the names and nationalities of those that you intend working with on this stage and later stages. In the event of proposals being recommended for funding, SBIRD reserves the right to reject any proposed applications or applicants whom it considers unsuitable for any reason. The decision of SBIRD shall be final and it shall not be obliged to provide any reasons.

You must identify any ethical/legal/regulatory factors within your proposal and how the associated risks will be managed, including break points in the project if approvals are not received. Further details are available in the Australian Defence Human Research Ethics Committee .

In addition, requirements for access to external assets, including Government Furnished Materials, Equipment and Information (GFM) for example data, equipment, materials and facilities should be included in your proposal with information on availability and costs.

Completed proposals must comply with the financial range set for this topic which is between A$200k – A$350k per Australian proposal. Applications are likely to be rejected if they do not comply with this bracket.

5.2 Public facing information

A brief abstract will be requested if the proposal is funded. This will be used by SBIRD and DASA and other government departments across both nations as appropriate, to describe the project and its intended outcomes and benefits. It will be used for inclusion at SBIRD events in relation to this topic and placed on the SBIRD website, along with your company information and generic contact details. It may also be used by the Next Generation Technologies Fund in its various media and marketing-related activities.

5.3 How your proposal will be assessed

All proposals will undergo an initial screen and if the application does not meet certain minimum standards (for example, funding limits) it will not be taken forward to full assessment.

Only those proposals that demonstrate their compliance against the competition scope and the SBIRD / DASA criteria will be taken forward to full assessment. Failure to achieve full compliance against the mandatory criteria will render your proposal non-compliant and will not be considered any further.

Mandatory Criteria

The proposal outlines how it meets the scope of the competition.	Within scope (Pass) / Out of scope (Fail)
The proposal fully explains in all three sections of the SBIRD / DASA proposal submission how it meets the SBIRD / DASA criteria	Pass / Fail
The proposal clearly details a financial plan, a project plan and a resourcing plan to complete the work proposed in Stage 2	Pass / Fail
The proposal identifies the need (or not) for Research Ethics approval	Pass / Fail
The proposal identifies any GFM required for Stage 2	Pass / Fail
Maximum value of proposal is $350k	Pass / Fail

Proposals will then be assessed against the SBIRD / DASA assessment criteria by subject matter experts from both Defence Science and Technology Group (DST Group) and ADF in Australia and Ministry Of Defence (MOD; including Dstl) in the UK. You will not have the opportunity to comment on assessors comments.

SBIRD and DASA reserves the right to disclose on a confidential basis any information it receives from bidders during the competition process (including information identified by the bidder as Commercially Sensitive Information in accordance with the provisions of this competition) to any third party engaged by SBIRD and/or DASA for the specific purpose of evaluating or assisting SBIRD and DASA in the evaluation of the bidder's proposal. In providing such information the bidder consents to such disclosure. Appropriate confidentiality agreements will be put in place.

Further guidance on how your proposal is assessed is available on the Defence Innovation Portal.

After assessment, proposals will be discussed internally at a Decision Conference where, based on the assessments, budget and wider strategic considerations, a decision will be made on the proposals that are recommended for funding. Representatives from the topic in both Australia and the United Kingdom will take part in the Decision Conference.

Proposals that are unsuccessful will receive brief feedback after the Decision Conference.

5.4 Things you should know about the Next Generation Technologies Fund Research contract

Please read the Next Generation Technologies Fund Research contract terms and conditions which contain important information for applicants. The Next Generation Technologies Fund Research Research Agreement will be used to contract successful applicants from industry and the Defence Science Partnerships Deed for the successful applicants for Academia.

Funded projects will be allocated a Technical Partner as a technical point of contact. In addition, the SBIRD / DASA team will work with you to support delivery and exploitation.

Deliverables from the parallel SBIRD and DASA contracts will be made available to ADF, MOD, other areas of Defence, and may be subject to review by relevant government departments across both nations.

The results of funded work will be exposed to international government partners. This is to promote international collaboration and to give projects the best chance of exposure to a larger audience and a greater scope of requirements. This will only be done under the protection of existing inter-governmental memoranda of understanding.

6 STAGE 2 DATES

Topic open	8th October 2019
Information Event*	Tuesday 8th October 2019
Pre bookable 1 – 1 telecom sessions	December 2019 – January 2020
Topic closes	2300 (Eastern Daylight Savings Time) (1200 GMT) 31st January 2020
Contracting	Aim to start by the start of Australian Financial Year 2020/2021

6.1 Supporting events

A series of 20 minute one-to-one teleconference sessions, giving you the opportunity to ask specific questions. If you would like to participate please discuss at the Information Event. For those not attending the event, questions can be directed to the SBIRD email address.

6.2 Collaborative Space

A private collaborative space using the LinkedIn platform has been created for potential applicants to identifty partners based on gaps in capaiblities and expertise. Membership to the space is managed by SBIRD & DASA; requests to join should be sent to SBIRD@dst.defence.gov.au or accelerator@dstl.gov.uk.

7 HELP

Topic queries including on process, application, technical, commercial and intellectual property aspects should be sent to SBIRD@dst.defence.gov.au quoting the topic title. Specific questions relating to the submission process should be directed to accelerator@dstl.gov.uk.

While all reasonable efforts will be made to answer queries, SBIRD & DASA reserves the right to impose management controls if volumes of queries restrict fair access of information to all potential suppliers.