An Australian DARPA to turbocharge universities’ national security research
Securely managed Defence-funded research partnerships in Five-Eyes universities

Dr Robert Clark AO and Peter Jennings
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About the authors

Dr Robert Clark AO was formerly an officer in the Royal Australian Navy, a lecturer and Fellow of The Queen’s College at the University of Oxford, and Scientia Professor and Chair Professor of Experimental Physics at the University of NSW. As an Australian Government Federation Fellow, he was the founding Director of the ARC Centre of Excellence for Quantum Computer Technology over its first decade. More recently, he was Chief Defence Scientist in the Australian Department of Defence, CEO of the Defence Science and Technology Organisation and a member of Australia’s Defence Committee. He is a Fellow of the Australian Academy of Science, Distinguished Fellow of the Royal Society of New South Wales and a Senior Fellow at the Australian Strategic Policy Institute.

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Cover image: Ghost Robotics quadruped robot on a reconnaissance task at Mount Pleasant, Canberra. Source: Defence image library, online.
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More than at any time since World War II, science and technology (S&T) breakthroughs are dramatically redesigning the global security outlook. Australia’s university sector now has a vital role to play in strengthening Australia’s defence.

In this paper, we propose establishing a formal partnership between the Defence Department, defence industry and Australian universities. There’s a significant opportunity to boost international defence S&T research cooperation with our Five-Eyes partners: the US, UK, Canada and New Zealand. We outline how this can be done.

Central to this partnership proposal is the need to restructure current arrangements for Defence funding of Australian universities via the creation of an Australian Defence Advanced Research Projects Agency (DARPA)—based on the highly successful American model, which the UK plans to emulate in 2022.1 In Australia, implementing these initiatives will contribute significantly to a vital restructuring of the university sector’s research funding model. An Australian DARPA, with robustly managed security, will enhance research ‘cut-through’ in the defence sector and the wider economy.

We think it’s also vital that this work, underpinned by a DARPA-like culture of urgency and innovation and with potential to affect several portfolios beyond Defence, needs to be championed at the government level. In the modern Australian system of government, that means the Prime Minister needs to be directly involved. Urgent means urgent. At least for the first few years of its life, an Australian DARPA should, in our view, report through Defence to the Prime Minister and the National Security Committee of Cabinet.
The significant financial and security risks of our universities becoming overdependent on funding sources from the People’s Republic of China (PRC) has become painfully obvious because of the Covid-19 pandemic’s restrictions on international students. That’s led to major university job losses, with more to come, and recent foreign interference investigations of researchers’ links to schemes such as the PRC’s Thousand Talents Plan recruitment program. Those risks and their consequences are further amplified by geopolitical tensions that show no sign of abatement.

We clarify at the outset that the central issue isn’t about international students per se. International students, particularly from our ASEAN neighbours, have rightly been welcomed by our university sector dating back to the 1950 Colombo Plan. The problem is that what was once a diverse and proportionate international student cohort has grown to be significantly dominated by the PRC and universities have locked their funding model on to that dominance to cross-subsidise research.

Further, our universities have pursued substantial and direct research funding from China. According to the peak body, Universities Australia, in 2018 there were 10,392 international agreements with our 39 tertiary institutions. The source of most agreements was China, with 1,741 agreements—nearly a fourfold increase in a decade. The US was a distant second, with 1,110 agreements.

In response to these risks, the Australian Parliament has passed Australia’s Foreign Relations (State and Territory Arrangements) Act 2020 to protect Australian sovereignty and counter foreign interference. The Act extends to universities and provides for the review of any agreements between Australian public institutions and foreign governments that may give rise to security or foreign policy concerns. Wide-ranging calls to strengthen Australia’s sovereign capabilities, from producing medical protective gear to fuel refining and the production of complex munitions, all point to the need for changed approaches to strengthening our national security. The inquiry into national security risks affecting the Australian higher education and research sector now being undertaken by the Parliamentary Joint Committee on Intelligence and Security, and due to report in July 2021, shows that universities have become part of the national reconsideration about strengthening Australian sovereignty.

Calls for change have cited the need for a greater focus on domestic students and an improved student experience, including better equipping students for jobs in a rapidly changing technology landscape. Our universities need to:
• rebalance the teaching and research nexus to counter an upward trend in research-only positions and a decoupling of teaching from research
• do more to differentiate between universities and establish distinct offerings
• find a more diversified and proportionate international student cohort
• push back against the pursuit of higher rankings on international measures of university standing via continuous growth strategies.

Additionally, our judgement is that more careful assessment and stronger direction by university management are needed to ensure that key ‘dual-use’ research areas (that is, areas with potential military and civil applications) can make stronger contributions to Australia’s national and economic security.
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How we’ve got to this point has been well aired. What’s less clear is how to shape a pathway out of this dilemma for Australia’s universities. Importantly, in reshaping a sustainable and de-risked Australian higher education strategy that squarely serves the nation, we need a partnership rather than a, frankly, hostile stand-off between government and the university sector. The alignment of the university sector with the Australian Government’s essentially bipartisan international priorities and initiatives, including Australia’s key security alliances, will be an important step in improving universities’ engagement with the government.

Many complex factors are in play, not least the articulation of an appropriate set of national core values to guide university policy development. To go to the heart of the matter, the central issue for the university sector is financial: all roads lead back to sourcing necessary levels of research funding. Significant cross-subsidisation of research predominantly by international student fees from the PRC and direct research funds from PRC sources and programs has produced rivers of gold that have grown Australian universities and, to a limited extent, increased their world rankings.

For that financial dance, the music has stopped. We judge that, for strategic reasons, there will be no easy or quick return to that business model. Even if a return to easy cooperation with the PRC were possible, it wouldn’t be desirable for our universities to reinforce our dependence after we’ve seen Beijing’s willingness to use such dependence as a coercive instrument to ‘punish’ Australian policy independence. There are also significant negative collateral impacts of a PRC-dependency strategy on the quality of undergraduate education and the priority it receives. While this must be dealt with, addressing the research funding issue is the key to freeing our universities from PRC-dependence and reclaiming a sustainable baseline for broader reform. That’s our focus in this paper.

It’s time to set aside a view of the problem that variously cites the oversimplification of a historic decline of government research investment on the one hand, and an acquired addiction of universities to the PRC market in pursuit of higher rankings through its funding of ever-increasing research programs on the other. We can’t lose sight of the necessity to maintain a strong and sovereign university research base with the capacity to support industry, the community and national security. This is clearly important for Australia’s future and can’t be allowed to fail.

In framing the problem, we further draw attention to the fact that the PRC-dependency problem is soon to become even more problematic. A recent US Studies Centre paper, Tech wars: US–China technology competition and what it means for Australia, sets out the impact on Australia of key steps taken by the US Government (and pending), with increasing bipartisan support, to strengthen the regulatory framework for the US’s technological industrial base. Those impacts are consequential for Australian universities and need to be understood.

The integrated list of US steps is complex and extensive, spanning the Pentagon’s Third Offset Strategy, a redefined and reinforced National Security Innovation Base, a Foreign Investment Risk Review Modernisation Act, an Export Control Reform Act, a Department of Justice China Initiative, a National Defense Authorization Act, a crackdown on non-traditional intelligence gatherers and a pending China Technology Transfer Control Act, among others.

The sharp message from the list is that, in this new US framework, universities are being redefined by the US Government (both the Trump and Biden administrations) to be an important part of the national security enterprise and subject to stronger regulation and oversight. We judge that this approach will increasingly inform thinking among governments in developed democracies around the world. In this hardened reality, the current largely open approach of Australian research universities to their international links is significantly exposed.

Australian university research funding from the US and the collaborative arrangements that come with it for both dual-use foundational and emerging technology areas will be subject to the new regulation and will bring a requirement to limit S&T interaction with the PRC in critical fields. Notwithstanding legislated developments in the US, the Australian Government is also rightly taking its own steps to protect national security through a similar stance.
An important component of a solution: Defence funding of university research

No one policy approach will solve the university research funding issue. That will require the integration of a hierarchy of initiatives. In these difficult economic times for government, calls to simply double the government funding of agencies such as the Australian Research Council (ARC) get the necessary financial magnitude right but arguably don’t identify the right mechanism or governance structure.

We need more creative and lateral thinking that considers new research translation funds, a revisitation of the R&D tax incentive (RDTI) collaboration premium put forward some years ago in the Ferris, Fraser and Finkel review of the RDTI scheme, which leverages and drives business investment in its own and universities’ R&D, and other linkage proposals that would better connect universities and industry.

There’s some discussion that the problem might be temporary, and that international students will return in numbers, particularly from China. In any scenario, it’s unlikely that this will occur before a significant restructure of the university sector is required to meet the substantial projected funding shortfalls for 2021 and 2022. Even if that were the case, does the Australian Government, the Australian public or the sector want to continue to carry the inherent financial and sovereignty risks of a return to the status quo ante, in which the impact of a pandemic could so easily be replicated by a future geopolitical incident? In our view, we’re in a ‘call to action’ situation, in which the PRC-dependency of our university sector needs to be unlocked.

In an article published in The Australian’s Higher Education section, we outlined a proposal for a formalised research partnership funded by Defence and defence industry and involving Australian universities and counterpart institutions of our Five-Eyes allies and other close security partners. In particular, there’s exceptional promise in partnering with US universities, building on our bilateral treaty-level agreement with the US on S&T and funded appropriately by both the Australian and US governments to achieve leverage, scale and depth. Initiated first with the US, this scheme could subsequently extend to other Five-Eyes nations, some key European friends and our Quadrilateral Security Dialogue partners Japan and India.

This initiative would greatly assist the mission-oriented research carried out by our government agencies—Defence Science and Technology Group (DSTG), CSIRO, Geoscience Australia, the Australian Nuclear Science and Technology Organisation and others. On their own, those agencies can’t cover all the work that needs to be done in an era of escalating technological disruption.

Essentially, what we’re proposing is a university analogue of the Technical Cooperation Program that formalises the longstanding collaboration between the defence R&D agencies of the Five Eyes. It would add a new dimension to both strengthen our alliances, particularly with the US via the addition of a university-alliance component to the AUSMIN framework, and contribute to Australia’s defence and national security capability edge and to the economy.

To make this tangible, consider the example of Australian Group of Eight universities forming a formalised linkage with counterpart research-intensive universities within the publicly funded US University of California system in key priority research areas. Such a connection would be immensely valuable, but we expect that, with appropriate Defence and defence industry support, similar research linkages would develop to involve other, smaller groupings of willing Australian and US universities, driven by joint expertise in prioritised research fields.
There are practicalities to this proposal involving government formalities, funding, governance and, most importantly, security.

On government formalities, under the in-place treaty-level S&T framework, a US–Australia Joint Commission Meeting on S&T is held every two years—the last meeting being held virtually in August 2020. The framework’s impact would be significantly elevated by initiating a coordinated, defence-focused, collaborative program formally linking our universities as proposed and funded appropriately by the Australian and US governments.

At the Australian end, current funding sources referenced in the 2020 Defence Strategic Update, first introduced through the Defence Industry Policy Statement in 2016, are most notably the Next Generation Technologies Fund (NGTF—research focus—$1.2 billion to 2030) and the Defence Innovation Hub (DIH—development focus, including prototypes—$800 million to 2030). The update cites a total investment of $3 billion in Defence innovation, science and technology over the coming decade. Defence budget line items such as ‘Information technology’ ($5 billion to 2030) could also presumably allocate further R&D components as future developments require. The NGTF comes under the oversight of Australia’s Chief Defence Scientist and the management of the Defence Department’s DSTG, while the DIH is overseen by the Centre for Defence Industry Capability (CDIC) board, which is co-chaired by senior industry and Defence representatives from the department’s Capability, Acquisition and Sustainment Group and managed by the CDIC.

Very significant Defence Department counterpart funding mechanisms exist at the US end. They come under the oversight of the Pentagon’s Under Secretary of Defense for Research and Engineering, who heads both the Directorate of Defense Research and Engineering’s research and technology branch and, for accelerated prototyping and technology transition, its advanced capabilities branch. The directorate also spans agencies that, importantly for our proposal, include DARPA (see the appendix to this report for a summary). The US intelligence community also has its own R&D funding agencies that include DARPA’s intelligence counterpart, the Intelligence Advanced Research Projects Activity.
Governance and security arrangements: transition to a US DARPA model

The implementation of our proposal will require a strong but simple security framework, for which longstanding arrangements in the US for defence-related research carried out by US universities provide best-practice guidance. Most relevant to the Australian context are the arrangements by which DARPA securely harnesses the resources and cutting-edge research of forefront US universities. That relevance has been sharply outlined in a 2017 US Studies Centre paper titled Next steps for Australia’s defence innovation: lessons from DARPA. As summarised in the appendix, DARPA works more broadly within an innovation ecosystem that includes academic, corporate and government partners spanning from open-domain to classified research. Most importantly, DARPA recruits full-time program managers from this ecosystem for limited periods of three to five years, who ‘define their programs, set milestones, meet with their performers and assiduously track progress’ and are also ‘constantly probing for the next big thing in their fields, communicating with leaders in the scientific and engineering community to identify new challenges and potential solutions’.

For universities that carry out published open-domain research, the program managers provide a buffer and air gap, but also a connection, between that necessarily open precursor activity and the classified programs carried out within defence agencies and defence industry. Often recruited from the university sector, the carefully selected and security-cleared program managers are at the leading edge of developments, and their fixed term tenure and turnover ‘fuels the signature DARPA urgency to achieve success in less time than might be considered reasonable in a conventional setting’.

Australia’s NGTF is the first significant funding initiative by which Defence has formally engaged with universities and serves as a useful example of the restructuring that we propose. The fund’s nine priority areas are integrated intelligence, surveillance and reconnaissance; space; enhanced human performance; medical countermeasures; multidisciplinary material sciences; quantum technologies; trusted autonomous systems; cyber and advanced sensors; and hypersonics and directed energy. Those are excellent choices.

Under current arrangements, Australian universities make applications for funding in those areas. Their applications are triaged and selected by DSTG staff for partnership with DSTG in a direct interface between university researchers working in the open domain and DSTG researchers separately working in a classified environment. While this can be carefully managed, in our view it isn’t ideal. DARPA’s dedicated program manager buffer would more robustly address security issues while bringing more focused expertise to the research cutting edge.

Our proposal would incentivise Australian university groups to partner with US university counterparts in those key areas at a more significant scale (as opposed to applying for funds alone), and with increased urgency made possible by the combined Australian and US funding leverage. The rapid development of intellectual property and know-how, created collaboratively via Australian and US universities and then transmitted to the classified domain by program managers, would then allow take-up by government agencies as required—keeping the unclassified and classified systems connected but appropriately separated.
As an example of funding leverage that pre-dates the NGTF, the ARC Centre of Excellence for Quantum Computer Technology, operating and publishing in the open domain, by the end of its first decade involved a partnership of six Australian, five US, four UK and two Canadian universities. Funding from the Australian and US defence departments and the intelligence community effectively doubled the centre’s research budget. Reporting to government agencies via the US Quantum Computing Program Review and the ARC, and with Australian Government agency representation on its advisory board, the centre exposed Australian researchers and students to the best-of-the-best in the field, driving progress in this joint venture in both nations.

Our proposal provides a formal framework in which this example would become the norm rather than the exception.

Downscaling (by a factor of 10) the DARPA statistics in the appendix back to the Australian NGTF, and rounding up the nine NGTF priority areas to ten (taking advanced sensors and hypersonics/directed energy as two separate areas), 10 dedicated program managers, running some 25 research programs across the priority areas, supported by 10 expert staff covering security, legal and contracting issues, finance, human resources and communications, would form the nucleus of an Australian DARPA that could very effectively interact with its US counterpart in the partnership we propose, thereby standardising governance and security.

We envisage that an Australian DARPA headed by an SES Band 2 director and an SES Band 1 deputy director (who, like the program managers, could be externally recruited for three to five year appointments) would fall under the oversight of Australia’s Chief Defence Scientist, whose US equivalent is the Under Secretary of Defense for Research and Engineering. The Australian system would effectively match the American approach, facilitating easier cooperation.

In short, reflecting counterpart arrangements in the US, in this restructure the Chief Defence Scientist would oversee both DSTG, which carries out classified mission-oriented defence research, and the Australian DARPA, which would ‘pull through’ relevant precursor cutting-edge research in the open domain from universities and open-domain and classified research from industry and other government agencies (such as CSIRO).

Similar considerations could be applied to the Australian Defence Innovation Hub and its engagement with the US Directorate of Defense Research and Engineering’s advanced capabilities branch.

We think it’s also vital that this work, underpinned by a DARPA-like culture of urgency and innovation and with potential to affect several portfolios beyond Defence, needs to be championed at the government level. In the modern Australian system of government, that means the Prime Minister needs to be directly involved. At least for the first few years of its life, an Australian DARPA should, in our view, through its proposed Defence chain of command (DARPA Director—Chief Defence Scientist—Secretary of Defence / Chief of the Defence Force) report to the Prime Minister and the National Security Committee of Cabinet.

As the US DARPA has shown us, cutting-edge innovation carries increased risk of some projects hitting dead ends, while other projects—think of the internet, GPS and drones—will change the world. The Australian Government and Parliament will need to rethink how they manage and evaluate risk to rapidly deliver enhanced security and strengthened economic performance. Our strategic circumstances demand nothing less than a fundamental rethink of our approach if we’re to be able to meet potential risks at relatively short notice, and well inside the now-discarded ‘10-year warning time’ to prepare for a major conflict. As Paul Dibb and Richard Brabin-Smith have written: ‘Because potential warning times are now much shorter, the new framework for strategic risk management by Defence and the wider government will have to be very different from that of the past.’ An Australian DARPA is one logical step to help overcome this risk.
Conclusion: Defence funding impact on the scale of the problem

Some broad arithmetic and assumptions about combined financial leverage that could flow from a formalised Australia–US university collaboration can be made in order to estimate the extent to which defence funding channels coordinated across both nations could replace Australian university research funds currently sourced from international students. We suggest that this could be in the range of 20%–25% of the total requirement—a significant proportion.

More important than the dollar amount would be the development of a framework encouraging our universities to partner with their counterparts in the US, the broader Five-Eyes alliance, key European friends and Quad partners. If our university sector contributes a collaborative research capability to the security and economic wellbeing of Australia and our democratic allies, that would reflect a fundamental turning point in the sector, rebase the discussion between universities and government and offer a pathway out of destructive reliance on student fees and research funding from the PRC.

We judge that it’s timely, indeed urgently necessary, to restructure the management of Australian defence-related funds to universities by initiating a US DARPA model and forming an Australian DARPA unit as outlined, both to seamlessly engage with the US and to most optimally drive cutting-edge research with increased urgency and more robustly managed security. This would be at modest cost for maximum impact.
Appendix: The US Defense Advanced Research Projects Agency (DARPA)

Extract from the DARPA website, online.

For sixty years, DARPA has held to a singular and enduring mission: to make pivotal investments in breakthrough technologies for national security.

The genesis of that mission and of DARPA itself dates to the launch of Sputnik in 1957, and a commitment by the US that, from that time forward, it would be the initiator and not the victim of strategic technological surprises. Working with innovators inside and outside of government, DARPA has repeatedly delivered on that mission, transforming revolutionary concepts and even seeming impossibilities into practical capabilities. The ultimate results have included not only game-changing military capabilities such as precision weapons and stealth technology, but also such icons of modern civilian society such as the Internet, automated voice recognition and language translation, and Global Positioning System receivers small enough to embed in myriad consumer devices.

DARPA explicitly reaches for transformational change instead of incremental advances. But it does not perform its engineering alchemy in isolation. It works within an innovation ecosystem that includes academic, corporate and governmental partners, with a constant focus on the Nation's military Services, which work with DARPA to create new strategic opportunities and novel tactical options. For decades, this vibrant, interlocking ecosystem of diverse collaborators has proven to be a nurturing environment for the intense creativity that DARPA is designed to cultivate.

DARPA comprises approximately 220 government employees in six technical offices, including nearly 100 program managers, who together oversee about 250 R&D programs.

DARPA goes to great lengths to identify, recruit and support excellent program managers—extraordinary individuals who are at the top of their fields and are hungry for the opportunity to push the limits of their disciplines. These leaders, who are at the very heart of DARPA’s history of success, come from academia, industry and government agencies for limited stints, generally three to five years. That deadline fuels the signature DARPA urgency to achieve success in less time than might be considered reasonable in a conventional setting.

Program managers address challenges broadly, spanning the spectrum from deep science to systems to capabilities, but ultimately they are driven by the desire to make a difference. They define their programs, set milestones, meet with their performers and assiduously track progress. But they are also constantly probing for the next big thing in their fields, communicating with leaders in the scientific and engineering community to identify new challenges and potential solutions.

Program managers report to DARPA’s office directors and their deputies, who are responsible for charting their offices’ technical directions, hiring program managers and overseeing program execution. The technical staff is also supported by experts in security, legal and contracting issues, finance, human resources and communications. These are the people who make it possible for program managers to achieve big things during their relatively short tenures.
At the Agency level, the DARPA Director and Deputy Director approve each new program and review ongoing programs, while setting Agency-wide priorities and ensuring a balanced investment portfolio. DARPA benefits greatly from special statutory hiring authorities and alternative contracting vehicles that allow the Agency to take quick advantage of opportunities to advance its mission. These legislated capabilities have helped DARPA continue to execute its mission effectively.
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6 Bill Ferris, Alan Finkel, John Fraser, Review of the R&D tax incentive, 4 April 2016, online.

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9 Michael Biercuk, Next steps for Australia’s defence innovation: lessons from DARPA, US Studies Centre, University of Sydney, October 2017, online.

10 Paul Dibb, Richard Brabin-Smith, Deterrence through denial: a strategy for an era of reduced warning time, ASPI, Canberra, 22 May 2021, 4, online.
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<td>ARC</td>
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<td>CDIC</td>
<td>Centre for Defence Industry Capability</td>
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<td>CSIRO</td>
<td>Commonwealth Scientific and Industrial Research Organisation</td>
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