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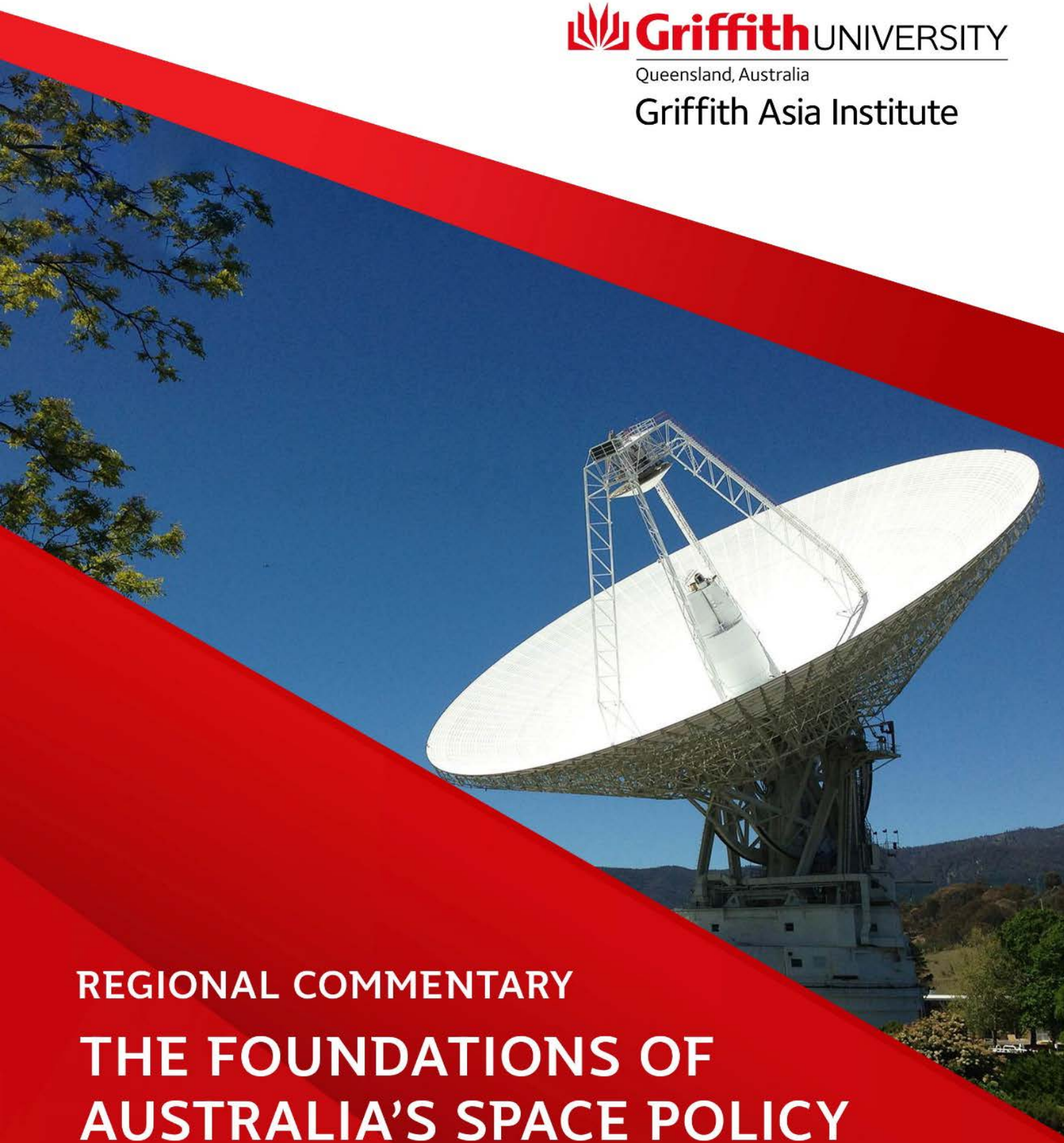

REGIONAL COMMENTARY

THE FOUNDATIONS OF AUSTRALIA'S SPACE POLICY

Edited by Tristan Moss

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About this Publication

Commentaries in this document are informed by discussions at the Griffith Asia Institute 'The foundations of Australia's space policy' workshop held in Brisbane in November 2022. The opinions and views expressed in this publication are those of the authors and do not necessarily reflect the views of the Griffith Asia Institute.

'The foundations of Australia's space policy'.

Compiled and edited by Dr Tristan Moss, University of New South Wales, Canberra.

Griffith UNIVERSITY
Queensland, Australia

About the authors

Dr Brett Biddington AM is the founder of Biddington Research Pty Ltd, a consulting company specialising in space and cyber security policy development and advocacy. He previously worked for Cisco Systems and before that served in the Royal Australian Air Force in intelligence, security and capability development roles, including in space. He is a member of the National Committee for Space and Radio Science of the Australian Academy of Science and Chair of the Advisory Committee of the Victorian Space Science Education Centre (VSSEC). He is also a board member of the Australian Defence Information and Electronic Systems Association (ADIESA) and the Australian Chapter of the Association of Old Crows (an electronic warfare education and advocacy organisation). He holds an Adjunct Professorship in the Security Research Institute at Edith Cowan University in Perth.

Dr Malcolm Davis joined the Australian Strategic Policy Institute as a Senior Analyst in Defence Strategy and Capability in January 2016. Prior to this, he was a Post-Doctoral Research Fellow in China-Western Relations with the Faculty of Society and Design at Bond University from March 2012 to January 2016, and he currently retains an Honorary Assistant Professor position in the faculty. He has worked with the Department of Defence, both in Navy Headquarters in the Strategy and Force Structure area and with Strategic Policy Division in the Strategic Policy Guidance and Strategic External Relations and Education sections from November 2007 to March 2012. Prior to this appointment, he was a Lecturer in Defence Studies with Kings College London at the Joint Services Command and Staff College, in Shrivenham, UK, from June 2000 to October 2007. He holds a PhD in Strategic Studies from the University of Hull as well as two Masters degrees in Strategic Studies, including from the Australian National University's Strategic and Defence Studies Centre. His main research focus is on defence strategy and capability development, military technology, and the future of warfare.

Professor Melissa de Zwart is Professor (Digital Technology, Security and Governance) at Jeff Bleich Centre for the US Alliance in Digital Technology, Security and Governance, Flinders University. Professor de Zwart is a thought leader in the area of law and technology and has a strong international profile in the fields of internet law and the regulation of access to and uses of outer space. She previously served as Dean of the Adelaide Law School, University of Adelaide (2017-2021), and Chair of the Council of Australian Law Deans. She is currently the Deputy Chair of the Space Industry Association of Australia, a Board Member of the Australian Academy of Law and a Lieutenant in the Royal Australian Navy (Reserve).

Dr Annie Handmer is an Associate Lecturer for the University of Sydney's Faculty of Science, in the School of History and Philosophy of Science. She researches and writes about space policy, space law, and space debris. In addition, she is on the Advisory Council for the Space Industry Association of Australia and will serve as the IPC Co-Chair for the International Astronautical Congress 2025, to be held in Sydney. Annie has experience working in finance, central government, and the private sector. Her most recent roles include working as a product manager with a startup which used satellites to do in-space imaging, and contracting to NSW Government conducting futures and foresight analysis for how technology will impact society in the next decade.

Dr Danielle Ireland-Piper is Associate Professor at the National Security College, Australian National University and Honorary Adjunct Associate Professor at the Faculty of Law, Bond University. She has a PhD from the University of Queensland and an LLM from the University of Cambridge, where she was a Chevening Scholar. Danielle is the author of *Extraterritoriality in East Asia: Extraterritorial Criminal Jurisdiction in China, Japan, and South Korea* (Edward Elgar, 2021) and *Accountability in Extraterritoriality: A Comparative and International Law Perspective* (Edward Elgar, 2017) as well as publications on public international law, space law, human rights law, transnational criminal law, national security law, and comparative constitutional law. Danielle also has experience in policy and government roles, as well as in private legal practice. She was Associate to the Hon. Chief Justice Susan Kiefel during her Honour's time on the Federal Court.

Dr Tristan Moss is a senior lecturer at the University of New South Wales, Canberra. He is a historian researching Australian space history and the history of the ADF with a focus on its culture and policy. His current research focuses on a history of Australian space activities, 1957–2020, and he is also working on a history of sex in the Australian military. He is the author of *Guarding the Periphery: The Australian Army in Papua New Guinea, 1951–75* (Cambridge University Press, 2017), and co-editor of *Beyond Combat: Australian military activity away from the battlefields* (New South Books, 2018) and *Fighting Australia's Cold War: The Nexus of Strategy and Operations in a Multipolar Asia, 1945–1965* (Australian National University Press). Tristan has worked on the Official History of Australian operations in Afghanistan, Iraq and East Timor at the Australian War Memorial and on the Official History of peacekeeping. Tristan is a Fulbright Senior Scholar, (Fulbright Professional Scholarship in Australian- US Alliance Studies, sponsored by DFAT) and winner of a Discovery Early Career Researcher Award, titled 'Australia and Space: Government policy and public imagination, 1957–2021'.

Dr Kathryn Robison Hasani is a Lecturer in Politics and Public Policy at the Flinders University's College of Business, Government and Law. She is a political scientist specialising in the role of political communication in the formation and dissemination of space policy at both the domestic and international level. She is the Vice Chair of Career Development for the International Astronautical Federation's Workforce Development/Young Professionals Programme Committee and serves on its Space Education and Outreach Committee. Dr Robison previously worked with the Space Generation Advisory Council as a member of its Executive Committee and is also a member of the UN's Space4Women Network, the Launchpad Mentorship Programme at IAF, and was nominated by NASA to receive recognition as an IAF Young Space Leader in 2021. Her current research interests include public opinion on government spending on space, legislative processes which affect national and international space policies, and equitable and just access to space and space resources.

Dr Cassandra Steer is a is Deputy Director of the Australian National University Institute for Space (InSpace), with a focus on Mission Specialists. Globally recognised for her expertise in space governance, space law, and space security, she has published widely on these topics, including the application of the law of armed conflict and use of force in outer space. She has consulted to the Australian, Canadian and US Departments of Defence, the Australian Space Agency and Australian Department of Foreign Affairs and Trade on these issues. She has taught space law and space security at McGill university, the ANU College of Law, the National Security College and the Australian Defence College. Dr Steer is multilingual, and has lived and worked in five countries across four continents. She has degrees in philosophy, civil law, international law, international criminal law, and training in common law, comparative law and space law. Dr Steer is a member of the Australian Space Agency's Technical Advisory Group for Space Situational Awareness, an Associate Expert on the Woomera Manual on the International Law of Military Space Operations, a member of the Space Traffic Management Committee of the International Academy of Astronautics, and a member of the International Institute of Space Law.


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INTRODUCTION

Dr Tristan Moss

Australia is at an inflection point in its thinking about space. Wherever the country might go in its space efforts, it is safe to say that the way in which space is discussed and the way in which space activities are managed has changed in the last decade. In the past few years, government funding has significantly increased, an Australian Space Agency and an Australian Defence Force Space Command have been created, and industry and defence space policies have begun to be developed. This has occurred in a broader regional context, in which countries of the Asia-Pacific have also embarked on their own space trajectories alongside, independent of and in competition with Australia. In industry, new means of accessing space more easily and with less expense have opened up space to a wider range of actors, and increased competition and congestion in earth orbit. However, significant questions remain in relation to Australia's place in space. What does Australia want in space, and how can it get there?

Australia's future in space is a question of policy and politics as much as it is one of launch vehicles and satellites. Space policy is composed of a balance of discrete but interconnected policy areas: science and research, industry and commerce, national security and resilience, values and inspiration, governance and regulation, and international cooperation. In turn, these are shaped by culture, history and particular national institutions, as well as wider events both in space and on the ground.

In this way, getting to space is not a just technical problem, although advances in technology and science are fundamental to access to space. Rather, what a country does in space is the product of policymaking, and by extension public opinion and politics. It is not merely enough for an actor to be capable of reaching and using space: it must secure the financial, technical and political means to do so. The enablers for space activities are not just funding, but also include regulation and governance structures, the orientation of government-funded institutions, such as universities, towards space, and the mobilisation of popular support for the expenditure of these resources.

Australia's space future will be written—or not—because of government decision making, because of public support or its absence, because of governance and legislation, because of industry involvement and because of the fostering of research at universities. Humanity is in space: the extent to which Australia wants to join others is a question of national priorities, which are, in turn, the product of Australia's values, politics, resources and context.

This collection of essays aims to bring together experts in the different areas of space policy in a discussion to explore the challenges and opportunities in creating an Australian approach to space. This collection is the result of a workshop held jointly by the Griffith Asia Institute

and the Griffith School of Information and Communications Technology in November 2022, bringing together the humanities and the sciences. Particular thanks go to Professor Paulo de Souza for providing the bulk of the funding, and Professors Caitlin Byrne and Ian Henry who supported the project as heads of GAI. Meegan Thorley was instrumental in managing the event, and Jill Moriarty did a fantastic job with the production of this collection.

The papers here represent a concentration of academics working on space from a policy—or rather a humanities and social sciences—perspective. There are a range of arguments made about Australia's space future, and a range of different lenses applied to answering the questions surrounding Australia's space future. Rather than being a departure from the main focus of Australia's space efforts—the capabilities and the groups that use them—these different approaches are at the core of how Australia discusses space, and how it should think about it going forward. Both advocates and sceptics would be wise to note the issues raised.

Backdropped against Australia's Shark Bay, this panoramic scene of the Space Shuttle Endeavour in Earth-orbit was recorded during the mission's second Extravehicular Activity (EVA-2) on January 17, 1996. (NASA)

The collection is divided into four parts, reflecting the interconnected elements of Australia's space endeavour: context, law and governance, science and industry and national security. Dr Tristan Moss begins the collection by examining the history of Australia's space activities, and in particular the way in which the country's participation in space was rationalised. By doing so, he contributes to a better understanding of the types of arguments have been used, and accepted, by policymakers and the public. Associate Professor Danielle Ireland-Piper examines the broader regional context, which must be understood though question of resourcing, partnership building and human security.

Dr Cassandra Steer asks who Australia is in space, examining Australia's two space strategies, defence and civil. She argues that Australia lacks an overarching national space policy, and is therefore unable to match what it does in space with its national values. While difficult questions would need to be answered about what approach Australia should take to space, the creation of a centralised space policy would allow the country to position itself as middle power in space.

Public opinion is key to what countries do in space, with public belief in the prestige, security, moral, commercial or personal benefits in space a key factor in space policy making. Equally, a lack of public enthusiasm for space, as has often been the case in Australia, can limit space

activities. Dr Kathryn Robison-Hasani gives an overview of the landscape of public opinion and offers proposals for how the space sector might engage with the public on space.

Similarly, research is synonymous with space exploration. Dr Annie Handmer focuses particularly on the Space Environment Research Centre (SERC) with the ultimate goal of demonstrating how social theory frameworks might lead to better understanding and outcomes for stakeholders in the Australian space sector. Industry puts research into practice, but while industry is often at the centre of Australian discussions of space industry, policy has been haphazard. Dr Brett Biddington offers a clear-eyed analysis of Australia's approach to building a space industry. The fundamental question of whether Australia needs a space industry, and if so, what shape it should take, has yet to be examined, and Biddington offers a challenge to both industry and government to cogently articulate what trajectory Australia should take.

No discussion of space in Australia is complete without the security element. Space is crucial to Australia's security, and the Department of Defence and Australian Defence Force have been at the heart of decision making and action on space since the 1950s. Dr Malcolm Davis explores how the ADF perceives the space domain, particularly through the new Defence Space Command. Australia's push for greater sovereignty in space capabilities, Davis argues, marks a significant shift in its approach to this domain, and opens new avenues for both local capability and engagement with key allies.

Finally, a key part of Australia's space experience is how enmeshed the country is with its partners; security is no exception. Professor Melissa de Zwart considers space in the context of Australia's AUKUS partnership. While the partnership does not mention space specifically, it is a natural fit, but to ensure Australia makes the most of this relationship, De Zwart argues, it must embrace its position as a space actor.

CONTEXT

1. History and Australia's space policy | *Tristan Moss*
2. Outer space and the Asia-Pacific region | *Danielle Ireland-Piper*

1. History and Australia's space policy

Dr Tristan Moss
University of New South Wales

Australia has been involved in space since the space age dawned in the 1950s. It has participated in cooperative space exploration and research, particularly with the United States, and had a series of early successes in space. At the same time, the country has experienced periods of relatively little new space activity, in which Australia as a nation was a passive consumer of space.

The Department of Defence Wideband Global Satellite 6 (WGS6) satellite as its being connected to the launch vehici in preparation for take-off. Image courtesy of Boeing. (Department of Defence)

The difficulty and expense of space means that any country wishing to use space for its national needs must justify these activities to the public. In short, a nation wishing to go to space must explain to its taxpayers why their money should be spent on that activity, and not on another. The rationales a country chooses in support of space efforts reflect the particular political and strategic context, the way it remembers its space history, and that country's self-perception and values. The United States, seen as the archetype of a space power and the example with which many will be familiar, justifies space to its citizens in a variety of ways. At its core, space is tied to the sense of American identity, while space is sold to the American public for reasons of human destiny, geopolitics and national pride, national security, economic competitiveness, and scientific discovery.[1]

A country such as Australia, with a smaller economy, large landmass in the southern hemisphere, reliance on great powers for national security, and with a less strident sense of its role on the global stage has approached its place in space in a different way. This paper argues that there are four readily identifiable rationales used by the Australian government, or in arguments to it, for or against Australian space activities. These are: national security, technical and commercial benefits, inspiration and values and expense.

By identifying the broad categories into which justifications for space in Australia fall, we can gain a better understanding of the types of arguments that ring true with policymakers and, potentially, the public. In this way, history and space are not mutually exclusive, with one 'old' and the other 'new'. Rather, the country's current space activities are shaped by its past efforts. It follows, too, that misreading Australia's history creates the conditions for future policy failures. Looking at Australia's space past allows us to ask the right questions when identifying national need in space, and in turn developing policy. It also helps uncover a path to political and public support for particular space directions.

Australia's space history

Australia's space history at the national, policy level is one characterised by a pragmatic approach to space as a medium in which to achieve other policy ends, primarily security and diplomacy related. It is also profoundly shaped by Australia's geographic position, which made it a desirable place to conduct certain space activities, particularly those of the United States and the United Kingdom. In this way, Australia's first foray into space was alongside the British at the Weapons Research Establishment in Woomera. While useful rocket research was conducted there, access to Australia's traditional source of great power support constituted Australia's main interest in Woomera. The existence of the defence facility at Woomera, with its extensive range and excellent tracking facilities, already set up for British missile testing, opened the door for cooperative efforts.

A sounding rocket at Woomera. (Department of Defence)

It was through Woomera that Australia became involved in the European Launch Development Organisation (ELDO), which sought to launch a cooperatively built rocket, the Europa. Australia's reluctant participation in this program is a good encapsulation of its involvement in space.[2] Menzies summed up his government's approach in a letter to the British Government in 1961, stating unequivocally that 'There are many other things more important to us than space research', citing national infrastructure and universities among the government's priorities.[3] Menzies' statement set the tone for government approaches to space into the 1970s.

It was the desire to use space as a tool in achieving Australia's alliance ends that shaped the long-lasting relationship with the United States in space. Here Australia's geographic position in the Southern Hemisphere, and its strategic, political and cultural alignment with the west made it an attractive place to host tracking and data relay stations. The most well-known and important of these were outside Canberra at Tidbinbilla and Honeysuckle Creek. Similarly,

Australia's commitment to the Joint Facility at Pine Gap, which was agreed to in 1966, has been described as the linchpin of the alliance.

In 1967, Australia became the third country on earth to launch its own satellite from its own soil. The satellite was a joint venture between the University of Adelaide and the Weapons Research Establishment; the satellite was named after the latter. Taking advantage of a spare rocket left over from upper atmosphere research with the United States and Britain being conducted at Woomera, the satellite was designed and built in just eleven months. While a significant achievement, WRESAT was a reflection of Australia's relationship with other space powers. The rocket that launched the payload was provided, for free, by the United States; Australia had no rocket of its own. The satellite also did not engender the creation of an Australian space program or industry; there was no convincing argument for this to occur, and the Australian government was understandably unwilling to spend money on prestige projects without identifiable national need.

The 1970s to 1990s period have been seen as fallow years in Australia's space history, as headline grabbing activities at Woomera and through NASA dried up. However, in many ways, this period represented a continuation of Australia's approach to space, which saw the country meet its limited needs through selective engagement with external commercial and nation state space providers. In this way when the government commissioned its first national communications satellite system in 1979, Aussat, it was to meet specific Australian communication needs. Launched in 1985 on a space shuttle, the satellite filled an important capability gap; it did not form the beginning of any Australian space program.[4]

There were, of course, inefficiencies in Australia's approach to space, such as the lack of policy direction and fragmented responsibilities for space within government. In 1985 Sir Russell Madigan of the Australian Academy of Technological Sciences published a government-commission report on Australia's space policy needs. Finding that a comprehensive policy was urgently required, Madigan called for a coherent set of government structures, guided by government direction, to oversee Australia's space efforts. These resulted in the Australian Space Office and the Australian Space Board. These organisations suffered from under-funding and by the mid-1990s had been disbanded by the Howard Government. Despite claims that Australia's space efforts were undermined by political neglect driven by a misunderstanding of space, a key barrier to government support was the lack of an acceptable rationale for spending significant additional public funds on space beyond that allocated to CSIRO, Defence and other agencies.

Only in the last 10 to 15 years have we seen attitudes begin to change, culminating in the creation of the Australian Space Agency (ASA) in 2018 and the recognition within Defence of space as a vital part of Australia's security. However, in the case of the ASA, while it marks a departure from Australia's previous approach to space in the establishment of a central and publicly facing body, it is small, non-statutory and overwhelmingly focused on industry, rather than space as a whole.

How space is seen in Australia

How have we discussed this history, and what relevance does this have for policy? Popular understanding of Australia's space history is perhaps superficial. Most Australians would be aware of Australia's participation in American spaceflight during the 1960s, not least through the movie *The Dish*. References are also made by advocates and politicians in particular to the launch of Australia's first satellite, WRESAT, in 1967 as an example of Australia's significant early achievements in space. At times, as with much of Australian history, recounting of Australia's space past can range from celebratory to triumphalist and jingoistic, focusing narrowly on national achievement over context.

Space is also seen as new, with a subsequent desire to focus on the exciting future, rather than the institutions, structures and preconceptions that might take us there. At the same time, Australia's space history is often seen through the lens of American experience. In many ways the access that Pine Gap or Tidbinbilla gave us to American systems and security also gave us access to American myths and narratives.

Astronomer Allan Duffy for instance stated on the anniversary of WRESAT in 2017: 'This marks 50 years since Australia built and launched its first satellite, putting us third in the world at the time behind the US and the USSR.'[5] While an extreme example, claims like Duffy's of Australia's heady space days set up another powerful narrative of Australian spaceflight: the missed opportunity. This idea holds that after the heyday of the 1960s, Australian governments neglected space, ignoring opportunities and setting the country back after the dizzying heights of WRESAT and the moon landings. Alice Gorman, in her book *Dr Spacejunk versus the Universe*, describes the WRESAT experience thus: "after one satellite, we retired hurt. Space became a dirty word to politicians." Nonetheless, both the overly celebratory and the 'missed opportunity' narratives, suffer from a misreading of the geopolitical, domestic and financial context that led Australia to participate in its most famous space activities in the first place.

The Parkes Observatory is a radio telescope observatory was one of several radio antennas used to receive images of the Apollo 11 moon landing in July 1969. (Wikimedia Commons)

This may be acceptable when explaining some of Australia's past to someone in the street, but when applied to policy, the result can be a mismatch between expectations and reality. To say that Australia has missed a series of opportunities, for instance, can run the risk of seeing a country's space experience as a linear path, to be deviated from, rather than the response to particular contexts. More useful is looking at the reasons to go to space the Australian government has either accepted or offered the Australian public. By doing so, we can

understand the paths to space involvement in Australia and understand the drivers of space policy in Australia.

Justifying space activities in Australia

National security

National security is at the forefront of Australia's activities in space and is perhaps the most important of the four rationales for Australian spaceflight. National security considerations, more than scientific or commercial interests, informed Australia's decision making around space from the 1950s. By leveraging Australia's unique geographical position, space was seen as means by which to strengthen Australia's relationship with two nations, the United States and United Kingdom, and access the technological, military and diplomatic benefits that might accrue. In this way, space was a medium through which to achieve Australian policy goals.

The argument that Australia should be in space for national security reasons has changed in its character since the 1950s. For much of the Cold War the national security space argument centred on the relationship with the United States. Internal government documents were clear about the utility of space to the alliance. Publicly, too Prime Ministers enthusiastically referred to the alliance.

Joint Defence Facility Pine Gap. (Wikimedia Commons)

In 1966, the ministers for Defence and External Affairs spelt out the overwhelming national security reason for involvement with the United States in space out in a draft cabinet submission, stating that United States interest was to be encouraged 'irrespective of their potential benefit to the Commonwealth'.[6] In 1971, one government report bluntly stated that 'our participation in space affairs has been determined largely on the basis of our overall national relationships with the various countries concerned and not from our interest in such affairs in their own right.'[7] Of all Australia's space activities, those related to national security have been the most enduring. Equally, the Australian government has seen even civilian space activities through the lens of security. In this way, the Joint Defence Facility Pine Gap and the Deep Space Network facility at Tidbinbilla have seen Australia and the United States continue to operate as cooperative endeavours.

Technological and commercial benefits

The second rationale that has shaped how Governments agree to space activities, and in turn justify them to the public, has been the technological and commercial benefits that might arise from space. Early on in the space age, advocates for space argued that space would bring great technological benefits to Australia, thereby improving society. Prime Minister

Harold Holt's speech at the opening of the Honeysuckle Creek tracking station emphasised technology. In the context of the 1960s space race, Holt pointed out the importance of weather prediction, geographic survey, materials development and technical experience for Australians as examples. Finally, Sir Russell Madigan, in his foreword to his 1985 report on Australian space efforts commissioned by the Government, framed his report around the question 'will we recognise and take advantage of the new opportunities which the space age offers?'[8]

In terms of the benefits to the economy and individuals, there has been a marked shift away from an emphasis on technological benefits for society of the 1960s and 70s, towards a government focus on the industrial benefits of space today. The current Australian civil space policy is explicitly aimed at jobs and growth, for instance, and this rationale is at the centre of all current government communication on space. Megan Clark, first head of the ASA suggested that because the funding was so small, the ASA had to focus on building space another way, though industry. 'Ours will be one of the most industry-focused agencies in the world.' Clark sat on the boards of Rio Tinto and CSL.[9] Similarly, in his address at the Australian Space Forum, 2020, Prime Minister Morrison stated that 'But here I am today launching the Australian Space Agency and it says a lot about where Australia is today and where we're going as a country and at the end of the day, it means this, it's a plan for jobs.'[10]

Inspiration and values

At the same time, advocates of space activities in Australia—or in some cases advocates of the benefits that space might bring to the bottom line—nonetheless are quick to emphasise that space is exciting, transformative or simply 'cool'. The broader search for the meaning of spaceflight, as Geppert points out, is 'socioculturally embedded'.[11] As such, a nation's activities in space can be justified as according with its values, such as a commitment to improving human life or better understanding the universe. Similarly, the inspiration derived from space might be an end in itself or used to further other goals. Importantly, while space advocates around the world are quick to point to broad public interest in space in support of their arguments. However, in most cases interest does not necessarily equate to a public willingness to see taxes spent on space.[12] In Australia, compared with the United States, there is little research on public opinion on space.

Menzies spoke of the 'great step forward' that space research had engendered when opening the Tidibinbilla Deep Space Tracking Centre in 1965.[13] Harold Holt suggested that Australians should 'feel gratified and take some pride, indeed satisfaction' in their involvement in 'one of the great historic events of man's exploration of his universe'.[14] Prime Minister John Gorton's message, left on the moon as part of Apollo 11, stated that the landing (an Australia's support of it) were a 'dramatic fulfillment of man's urge to go "always a little further"'.[15] Equally, Australia's values have also seen it closely involved in United Nations discussions of space, and the various space treaties of the past six decades.

Internal government discussion of the 'inspirational' value of space was rare in discussions of space from the 1960s onwards. Rather, government policy tended to see space instrumentally. Inspiration, however, is used to sell space, with the Space Agency leaning into

the public relations side of its role. Indeed, its charter includes 'inspiration' as one of its goals. For the government, and the ASA, as well as many advocates, the inspiration value of space is purely in the number of students it will inspire to get technical and engineering jobs. The Australian Space Agency's charter argues that space has the power to lead Australia's children to STEM subjects at university, and then to jobs in those fields, linking it closely to the rationale of commercial benefits. It is, of course, easy to overplay the degree to which space actually inspires, or whether spending money on space is the best way to achieve the outcomes to which inspiration is said to lead.

Expense

The arguments made against spaceflight are as illuminating as those made for it when assessing Australia's approach to space. The argument that space is expensive is seen the world over, and is at play in almost every government discussion of space in Australia or elsewhere. We should solve our problems on earth, so the argument goes, before spending money on space.

In this way, Menzies argued in 1961 against significant Australian space activities because he wanted to fund universities and infrastructure and could readily meet modest Australian needs through working with allies or buying off the shelf. In the 1970s, Australia turned down a part in the European Space Agency and in NASA's Post-Apollo programme, because the significant costs involved saw the government assess that Australia could make little meaningful contribution, despite spending what was, for it, large sums of money.[16] Better, so the argument went, to spend the money in policy areas that were of more direct interest to Australia.

US Secretary of Commerce Wilbur Ross and Australian Prime Minister Scott Morrison witness the signing of a letter of intent between NASA and the Australian Space Agency by NASA Deputy Administrator Jim Morhard and Dr Megan Clark AC, Head of the Australian Space Agency. (NASA)

This view was a powerful one throughout Australia's space history, and as late as 2003, for instance, the Howard government's *Space Engagement Statement* saw no need to pursue self-sufficiency in space in the face of adequate cooperative arrangements with other nations, the availability of commercial space capabilities and a market-driven space industry. Even today, the arguments about space as a zero-sum game play out. In 2019 the Courier Mail followed Prime Minister Morrison's commitment of $150 million to cooperation with NASA with the headline 'Littleproud defends space spend in the midst of drought'.

Conclusion

A significant lesson here is the sheer pragmatism of the Australian government when it comes to space. Unlike, say, the United States, for whom space is a key part of national identity, space has little prestige cachet in Australian policy thinking. Instead, space is seen as a means by which to serve other policy ends, most notability national security and more recently commercial interests. It is this pragmatic approach to space, interested in national security, commercial benefits, the cost and to some degree Australia's values, that any future policy must address. Space is not yet an end in and of itself in Australia: instead, the key question, asked throughout Australia's space history, is 'how does space achieve national ends, and does it do so better than other alternatives?'

Members from the Japan Aerospace Exploration Agency (JAXA) retrieve a sample from the returned capsule during the Hayabusa2 mission at the Woomera Test Range. (Department of Defence)

In 1972, the Minister for Supply wrote to the Administrator of NASA, in reply to the American invitation for Australian participation in the Post-Apollo Programme, which included the still unbuilt space shuttle. Australia declined. In his letter, the minister stated:

> *It is well recognised by Australia that space activities will become an important facet of civilisation and that advances of the next decade will find significant and growing relevance in the life of man in his earth environment. Thus we, as a technologically advanced community in the South West Pacific region, regard it as important to maintain contact with space developments in all fields. At the same time, it is necessary for us to consider carefully the best use of our limited resources, and to restrict our actual participation in space activities to those that have direct relevance to our particular scientific, technical, commercial or national security interests.'*[17]

Putting aside outdated references to 'man' and 'civilisation', much of this response could just as well be written today. The only change is the broader space context, not the drivers of Australian space policy.

Notes

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2. Outer space and the Asia-Pacific region

Associate Professor
Danielle Ireland-Piper
Australian National University

Australia's geography and relative stability and wealth lends itself to space excellence. Space is growing in the Indo-Pacific, with access to space now essential as a means to services such as telecommunications, navigation, transport, education, climate monitoring, and aid. The demography of space has changed rapidly since the Cold War. It is no longer a US-Russia-China trichotomy. There is now an expanding kaleidoscope of space activity worldwide and this is certainly true in the Indo-Pacific. This presents Australia with an opportunity for meaningful "space diplomacy," both as a good international citizen, capable middle power, and in terms of strategic partnerships to balance and manage regional geopolitics. Access to space matters also matters to national and global security, not least because of the significance of access to remote sensing technologies in gathering intelligence and other useful data.[1] In that context, this article first provides a general overview of space in the Indo-Pacific, and then assesses that overview through a security lens in the specific context of access, resources, and human security. This article urges Australia to expand the public face of space, both domestically and internationally, through vision, strategy and policy.

Space activity in the Indo-Pacific: An overview

By way of background, the term "Indo-Pacific" has become 'common parlance'[2] in government, not least between diplomats, bureaucrats, and politicians,[3] with reference to the term appearing in the defence and foreign policy white papers. The boundaries are not fixed, but generally speaking, 'by Australia's reckoning, the Indo-Pacific ranges from the eastern Indian Ocean to the Pacific, connected by south-east Asia, home to nine of Australia's top 10 trading partners'.[4] As Rory Medcalf, head of the National Security College at Australian National Security College, has observed, the geopolitical notion of the Indo-Pacific is much more than an attempt to counter-balance Chinese power: 'it is also about drawing strength from vast space, and from solidarity among its many and

The aft section of the docked space shuttle Discovery and the station's robotic Canadarm2 are featured in this image photographed by an Expedition 23 crew member on the International Space Station. The north western coast of Australia and the Indian Ocean. (NASA)

diverse nations'[5] and recognising 'both economic ties and strategic competition now encompass an expansive two-ocean region'. In short, it matters for middle power diplomacy and for conceptualising the breadth of the "table" and who gets to have a seat at it. To that end, examples of space activity in the Indo-Pacific are introduced: from Southeast Asia, East Asia, and the Indian subcontinent.

Southeast Asia and East Asia are geographically, economically, and politically significant regions. Back in 2000, East and South-East Asia were home to at least one-third of the world's population.[6] East Asian institutions, in particular, are 'highly integrated into the global political economy',[7] regional tensions have consequences world-wide, and regionally produced technologies are pervasive. In Asia more generally, rapid economic development has seen 'a seminal turning point in history'.[8] A 2011 report by the Asian Development Bank suggested that 'Asia is in the middle of a historic transformation'[9] and if the trajectory maintains, 'by 2050 its per capita income could rise sixfold in purchasing power parity (PPP) terms to reach Europe's levels today'.[10] Another source has Asian PPP-per capita beating the rest of the world as early as just after 2030.[11] Further, while per-capita measures still have Asian incomes well below that of the EU and the US, results from the ICP 2017 Global Report suggest the size of the Asian economy has grown significantly larger than any of its "competitors".[12] In turn, this would mean 'Asia would regain the dominant economic position it held some 300 years ago, before the industrial revolution'.[13] Examples of space activity from these regions are now considered.

Southeast Asia

As at 2019, only six countries in Asia (including China and India) could launch satellites into orbit. However, Indonesia has strongly held plans to build a (non-military) spaceport in Biak, an island in the northern part of Papua.[1] Reportedly, Indonesia's president, Joko Widodo, has personally pitched the plan to SpaceX's founder, Elon Musk (whose other interests in Indonesia may relate to the country's nickel-rich resources, useful to producing batteries and electronic vehicles).[14] Indonesia's geographical position on the Earth's Equator make it an attractive space launch location because the Earth's axis can provide Equatorial space launches with an additional 1609.3 kilometres-per-hour launch velocity using the same fuel as a higher latitude launch.[15] The satellites from these kinds of launches are also particularly suitable for data transmission and weather research.[16] Currently there are only two equatorial launch sites: Europe's Guiana Space Centre in French Guiana is about 5 degrees above the equator, and Brazil's Alcantara Space Centre about 2 degrees below it.[17]

Indonesian delegation visited Goddard on May 21, 2018. (NASA)

However—and herein lies an example of the many links between human activity in space and human rights—the island of Biak is home to Indigenous West Papuans with concerns about the fairness of land acquisition processes and environmental management. The *New York Times* reports as follows:

> *Biak island is everything to them [Indigenous West Papuans]: their identity, the source of their livelihood and the link to their forebears. But now the tiny clan fears it will lose its place in the world as Indonesia pursues its longstanding quest to join the space age.*
>
> *The Indonesian government claims to have acquired 250 acres of the clan's ancestral land decades ago and has planned since 2017 to build a small-scale spaceport there to launch rockets. Clan leaders say the project would force them from their homes.*[18]

Notwithstanding the legitimate concerns of Indigenous peoples about the manner of acquisition, if the site is to be viable, Indonesia—or another neighbour with parallel ambitions—would also likely need international partnerships. Indonesia's National Institute of Aeronautics and Space director Thomas Djamaluddin has observed, 'The spaceport wouldn't be efficient if only used for our own activities', and 'international partnerships are needed for its operation.'[19] However, if these partnerships were secured, the spaceport may, in turn, also boost Indonesia's own space activities. Indonesia's keen interest in space is no doubt in part linked with its need for reliable telecommunications and security by virtue of it being an archipelagic state with more than 17,000 islands.[20] Notably, it is one of very few Asian states to have established a space program as far back as the 1960s, with the launch of Kartika-I rocket and the establishment of the National Institute of Aeronautics and Space (LAPAN).[21] During this time, the Indonesian government sent Indonesians students to study overseas to learn about space technology—an early example of the fusion between education and space diplomacy.[22] Indonesia's 2013 space legislation identifies the use of outer space for national interests through five main activities: space research, remote sensing, space technology development, launches, and commercial space activities.[23] The likelihood of the latter of these being achieved would increase if an Indonesian spaceport goes ahead and remains viable.

There is, then, potential for strategic cooperation between Australia and Indonesia in the context of space: space diplomacy in action. Australia and the rest of the world should not underestimate the strategic significance and importance of Indonesia. It is the edge of the south-west Pacific Ocean to the east. To the north east, Indonesia sits at the edge of the Philippines and the northern pacific. To the north, it is on edge of South China Sea, and to the west, on the edge of Indian Ocean. It is the world's largest democracy and a geographically close and strategically significant neighbour.

Moving across the region to Malaysia, the Malaysian Space Agency (MYSA)—*Agensi Angkasa Malaysia*—was established in 2019.[24] According to the Deputy Minister of the Malaysian Ministry of Science, Technology and Innovation, the focus of MYSA is intended to be on technology, infrastructure and strategic space application development.[25] It is tasked with 'gathering comprehensive satellite data and information systems to assist various public

agencies effectively in terms of environment, natural resources, food security, disaster management and climate change management'.[26] The collected data and information can be shared with the private sector. In September 2022, Malaysia signed a Memorandum of Understanding with China on digital communications and cyber security.[27] This has obvious connections to remote sensing technologies and access to and management of geostrategic interests in space. In a 2020 statement submitted to the United Nations, Malaysia expressed its hope that its space sector would contribute 0.3 percent of GDP and employ 500 knowledge workers by 2030.[28] Elsewhere in the south-east Asian region, Thai start-up 'mu-Space' opened Thailand's first spaceship factory in late 2020. The factory will be used to produce and assemble Thailand's first spaceship, as well as satellite parts, locally-made GPS systems, and a space data centre.[29] Further, Theo-2, Thailand's first satellite for earth exploration is being prepared for a launch in early 2023.[30] Theos-2 was assembled in the United Kingdom, which is small but significant illustration of the interconnectedness of the space industry, but also the importance of international partnerships in space.

East Asia

To say that China is both a key pillar in space relations and geopolitical realities is to state the obvious. By way of overview of China's space ambitions, China released a 2021 white paper on its space program declaring its mission to 'explore the vast cosmos, develop the space industry and build China into a space power' to be an 'eternal dream' to be pursued,

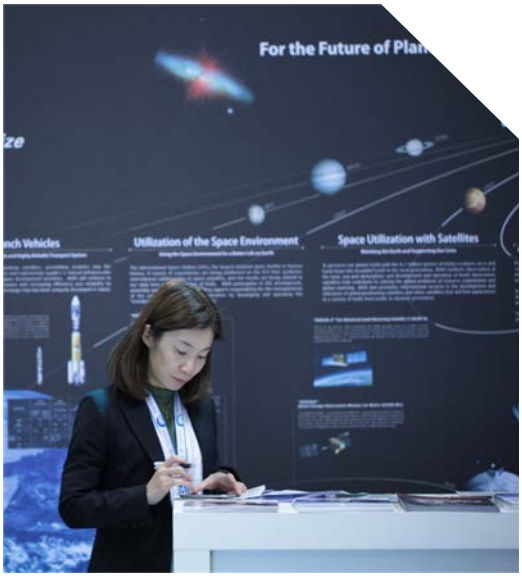
> *For the benefit of all humanity; to meet the demands of economic, scientific and technological development, national security and social progress; and to raise the scientific and cultural levels of the Chinese people, protect China's national rights and interests, and build up its overall strength.*[31]

That same year, China signed a memorandum of understanding with Russia to establish a research station on the moon within the next two decades and, reportedly, 'China's lead space scientists … have articulated aspirations of an annual US$10 trillion Earth-Moon economy by 2050'.[32] To further illustrate China's place in Asian space relations, the *Asia Pacific Space Cooperation Organisation* (APSCO), whose member states are Bangladesh, China, Iran, Mongolia, Pakistan, Peru, Thailand, and Turkey, is headquartered in Beijing. The APSCO development strategy forum in 2015 was themed 'The belt and road initiative for facilitating space capabilities building on the Asia Pacific countries'. APSCO built a satellite data sharing service platform. As at 2018, 200,000 data satellite images had been shared on that platform.

Other than obvious links with China,[33] Taiwan, 'as a small island in the Pacific Ocean with a population of 23.5 million, is not the first place that comes to mind when thinking of space powers'.[34] However, despite what has historically been a limited domestic space sector, the selection of Taiwanese electronics manufacturers as SpaceX suppliers for example, may enable Taiwan to move up the 'global space industrial chain'.[35] Taiwan also passed its first major consolidated space law, the *Space Development Act,* in May 2021.[36] While development of a robust launch industry in Taiwan is likely to be limited by political tensions with China, as Aurélie Gillet, a space industry analyst with Orbital Gateway Consulting in Hong Kong, has observed:

> *Taiwan does have the potential to become a key player in the space supply chain—and definitely has the political will to do so. At her second term's inaugural speech in May 2020, Tsai Ing-wen indeed defined the space industry as one of the Six Core Strategic Industries, before asserting that "Taiwan should use its advantages in the semiconductor sector to occupy a spot in the space industry supply chain" in September 2021. The adoption of Taiwan's first space law by the Legislative Yuan on May 31 proves the island's determination to put increasing effort and resources into industrializing space technology.*[37]

In other parts of East Asia, Japan was the first program on Earth to launch a mission that returned samples from an asteroid.[38] Operated by the Japan Aerospace Exploration Agency (JAXA), the 7 year long Hayabusa2 mission provided vital data on the history and development of the solar system.[39] The program also resulted in a collaboration effort between JAXA and NASA to study the retrieved asteroid samples.[40] In 2021, Japan signed an agreement with NASA and the American Government on the Lunar Gateway (an orbiting outpost with both commercial and government partners).[41] Under this agreement, Japan will provide several capabilities for the Gateway's International Habitation module (I-Hab), which will provide the heart of Gateway life support capabilities and additional space where crew will live, work, and conduct research during Artemis missions. The Japan Aerospace Exploration Agency's (JAXA) planned contributions include I-Hab's environmental control and life support system, batteries, thermal control, and imagery components.[42] Nearby, in June 2022, neighbour South Korea launched satellites into orbit using its own rocket for the first time. Notably, in 2022, South Korea is one of 8 countries to have pledged not to conduct direct-ascent anti-satellite (ASAT) missile testing. Japan and Australia are also one of these eight.[43] This is space diplomacy and cooperative space leadership in action.



Japan Aerospace Exploration Agency employee. (Wikimedia Commons)

Indian subcontinent

The Indian Subcontinent, also often referred to as South Asia, includes countries such as India, Pakistan, and Bangladesh.[44] At times, Afghanistan, Bhutan, and Nepal are included in the term.[45] The Indian Subcontinent is among the most densely populated areas on Earth.[46] Economically, the region has experienced a recent surge in commercial growth, with India overtaking the United Kingdom and becoming the fifth largest economy in late 2022.[47] The region is expected to maintain strong economic growth over the next decade compared to other regions.[48] One in five people who are part of the world's working age population will reside on the Indian subcontinent by 2050.[49]

India has a significant presence in space activity. The Indian Space Research Organisation (ISRO) has a number of important upcoming missions planned for 2023 and onwards including Chandrayaan 3, successor to the failed Chandrayaan 2 moon landing, and more importantly, Gaganyaan, India's first human spaceflight mission.[50] Notably, November 2022 saw India's first commercial launch, with a successful pilot of a private rocket that 'heralds the entry of the private sector into the country's space activities and sets the stage for more such launches'. [51]

While India currently only accounts for roughly 2 per cent of the $440 billion global space trade,[52] recent space-sector reforms and largescale changes within the private sector show a clear effort by the Indian government to grow the domestic space industry.[53] Prime Minister Narendra Modi pronounced India to be a "space superpower" following a successful test-run of an Indian-made anti-satellite missile in 2019.[54] The test involved the destruction of a satellite in low-earth orbit, and resulted in India now becoming one of only four countries with anti-satellite capabilities. In addition to the recent uptick in activity by ISRO, there has also been movements within the Indian private sector with space-tech startup company Skyroot Aerospace recently launching the Vikram-S in November 2022.[55] This launch by Skyroot Aerospace marks the first Indian space program to be developed and launched by a non-government entity, following governmental approval in mid-2020 to allow partnerships between ISRO and the private sector.[56] This approval came with the establishment of the Indian National Space Promotion and Authorization Centre (IN-SPACe) to co-ordinate, guide, and promote private sector activity, and authorize the use of facilities owned by Department of Space.[57] The success of Skyroot Aerospace can be seen as the culmination of a steady year-on-year increase of investments into the Indian space-tech private sector.[58]

Launch Vehicle Mark-3 (LVM 3), previously known as GSLV Mk3, is the heaviest rocket in operational service with the Indian Space Research Organisation (ISRO). (Wikimedia Commons)

In neighbouring Pakistan, officials have express ambition on future Space and Upper Atmosphere Research Commission (SUPARCO) missions, such as a planned crewed space launch in 2022.[59] However, the crewed space launch was quietly put on hold in 2020,[60] and Pakistani satellites appear to rely on Chinese rocket launches to be put into space.[61] Again, this highlights the significance of partnerships

in securing access to space, something Australia can—and should—consider in its regional strategic planning.

Regional security—risk and consequences of space in the Indo-Pacific

The intrinsic value of space as both balm and stimulant to the human imagination is undeniable. However, the practical reality is that the most important feature of space to life on Earth is as means to other ends. Even setting aside the fact that space technologies regularly have other useful applications on Earth, access to space is now so ingrained in our everyday lives that it is critical to transport, logistics, weather monitoring—including the now critical monitoring of climate change, aid, education, medicine, and many other aspects of human security. This is complicated by the fact that space is a dual use environment used by both state and non-state actors and technologies with both civilian and military applications.[62] From a security perspective, this has consequences in terms of access to space, management of resources, human security and human rights.

Securing reliable access to space is essential to security. In turn, this presents opportunities for Australia to engage in meaningful regional partnerships and "space diplomacy", including through delivery of space education. Education is Australia's third largest export,[63] and, geographically, we are conveniently located and populated for space activity. This presents both risks and opportunities and should mean Australia actively engages in regional space diplomacy. As Steven Freeland and I have noted:

> *Human access to outer space has increased, and this trend will undoubtedly continue. However, this does not necessarily represent an equality of access. At present, of the 195 Member States of the United Nations, approximately 70–80 are engaged in space activities and thus involved in domestic capability development to allow them to participate actively in directly accessing space. Of course, viewed from another perspective, this also means that somewhere approaching two-thirds of the world's countries do not currently have any indigenous space capability whatsoever, placing them at an increasing comparative disadvantage over time and rendering them entirely dependent on others for access to space infrastructure and, indeed, access to space itself. If these 'taps' are turned off, this would have profound implications for the lives and livelihoods of the communities within those countries.*[64]

Further, the increasing problem of space debris,[65] and the rise of private actors in space means access needs to be managed on a number of fronts, Space itself is 'replete with resources such as the water, minerals, precious metals found on moons and asteroids',[66] and this is of both scientific and economic interest to public and private sectors. This has attracted interest from both scientists and entrepreneurs. While all peoples have an interest (and a human right) to enjoy and benefit from technological advancement, competition over resources is a security risk and needs to be managed accordingly, including through advocacy of international cooperation on sustainable and peaceful uses of space.

Finally, all of the above, as intimated at the outset, has consequences for human security and human rights. Space is not merely an end in itself, but its use in the modern world is now inextricably linked to rights relating to safety, life, communication, education, development, food, a healthy environment, and privacy. In short, if the premise of national security is to keep a society safe and its people able to enjoy inherent human rights, then regional space relationships and space diplomacy are also a national security priority.

Australia has yet to article a vision for space. A clearly articulated and inspiring vision can generate support from the body politic for more tangible strategies and policies. Situating itself as an essential space player would position Australia to fruitfully engage in space diplomacy and strategic regional partnerships, including in the development and application of space law principles.

Conclusion

By way of summary, Indonesia has plans to build a spaceport in Biak, an island in the northern part of Papua. In late 2020, Thai start-up 'mu-Space' opened Thailand's first spaceship factory. In June 2022, South Korea launched satellites into orbit using its own rocket for the first time. Japan was the first program on Earth to launch a mission that returned samples from an asteroid and in 2021, it signed an agreement with NASA on an orbiting outpost. China, a key player in international space relations, released a 2021 white paper on its space program declaring its mission' to 'explore the vast cosmos, develop the space industry and build China into a space power' to be an 'eternal dream'. India is a presence in space, and that is unlikely to change. Australia itself has a rapidly growing commercial space sector that includes launch capabilities. In 2022, Equatorial Launch Australia successfully completed its first and second commercial space launches for NASA from Nhulunbuy in the Northern Territory, which was also NASA's first launch from a fully commercial spaceport.[67] Space is burgeoning in the Indo-Pacific—strategically and practically. Australia should seek a key role in space diplomacy in the specific context of the Indo Pacific as a region. This is important more broadly because:

> *How leaders define regions can affect their allocation of resources and attention; the ranking of friends and foes; who is invited and who is overlooked at the top tables of diplomacy; what gets talked about, what gets done, and what gets forgotten. A sense of shared geography or 'regionalism' can shape international cooperation and institutions, privileging some nations and diminishing others.*[68]

In short, how we understand space in the region is an important question of resourcing, partnership building and human security. In this article, I have suggested that, in turn, this has consequences for security strategy in three key ways: access, resources, and human security and human rights. We—and our neighbours—need reliable access to space, not merely as an end in itself, but as means of securing human rights, intelligence, and important scientific information about our land and the Earth itself.

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LAW AND GOVERNANCE

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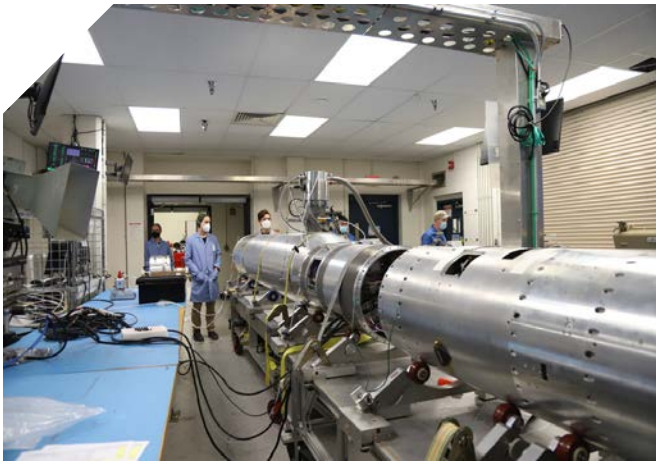
3. Who is Australia in space? The need for a national space policy

Dr Cassandra Steer
Australian National University

Australia could be considered a relatively new entrant to the global space sector, despite a long and ongoing history of Australian space technologies and expertise. In terms of federal and state government attention for the space sector, we are still very much in an infancy, yet there are many opportunities for us to position ourselves as a space middle power, as we aim to assert ourselves as a serious space nation. However, there is work to be done on clarifying our internal policies and strategies, all of which could better reflect who Australia is as a space actor, why we are "doing" space, and what we hope to achieve. Australia needs a national space policy to centralise the nation's values, commitments and aspirations in space, which will in turn guide investment decisions, regulations, and how effective we can be at participating in the global space sector.

In 2019 the Australian Space Agency's Civil Space Strategy was adopted, with a ten-year timeline to 2028.[1] In 2022 the Defence Space Strategy was made public, with a vision for 2040, but lines of effort spanning five years, which takes us to 2026.[2] Both of these documents focus on specific capabilities rather than guiding principles, are generally light on detail, do not engage with each other sufficiently, and do not represent a truly whole of government approach. Moreover, a *strategy* should be an expression of how to operationalise a guiding *policy*. Australia may have been going at this backwards, by developing two separate strategies before having a central, overarching national space policy to guide them both, guide the sector, and guide other government departments such as DFAT, Home Affairs, Education, Agriculture, NIAA, other sectors within Industry, and various other portfolios where space is integrated but still invisible.



Technicians work at Wallops on the Suborbital Imaging Spectrograph for Transition region Irradiance from Nearby Exoplanet host stars, or SISTINE, payload before it ships to Australia. (NASA)

Having recently won the bid to host the 2025 International Astronautical Congress, the entire Australian space sector has an opportunity to show the world that we have matured as a space nation in a short time, but this requires the coming together of multiple stakeholders with a range of interests and commitments. The historical competitiveness between our federated states has been driving space innovation, with some great success, however the sense of one-upmanship underpinning this competition does not serve our potential as a space nation. How we present ourselves to the global space sector in 2025 will seal the role we play in the international space ecosystem as we enter the second quarter of the century. We have an opportunity to forge a coherent national story and present it to the global space sector. We need to come together in what some have termed a "Team Australia", to articulate our values as a space actor, what we see our potential role to be as a space middle power, and what significance we give to key issues of safety, security and sustainability of the space environment. What we need is a truly whole of government effort, with a commitment similar to the way cyber issues are now understood to touch all aspects of Australian's lives.

A mature space agency for a mature space nation

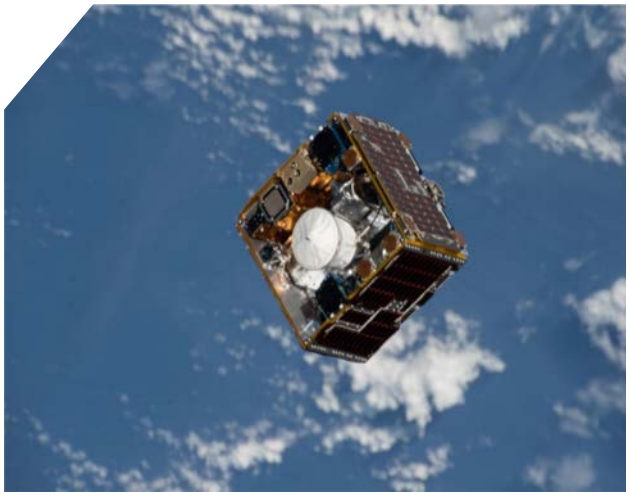
The Australian Space Agency (the Agency) was given a globally unique mandate when it was established in 2018, not to create a government space programme, but rather to grow Australia's private space industry. Specifically, to:

> *transform and grow a globally respected Australian space industry that lifts the broader economy, inspires and improves the lives of Australians—underpinned by strong international and national engagement [...] The Agency ensures that Australia's civil space activities contribute to productivity and employment across the Australian economy, secure new knowledge and capability, and inspire all Australians.*[3]

In no other country does a national space agency have an explicit and exclusive mandate to grow the private sector. All eyes were on Australia, and many commercial space entities around the world were excited to see what this would lead to. Unfortunately for Australia, the two short years before the beginning of the pandemic in 2020 were not enough for the Agency to produce any remarkable results. In fact, the Agency was crippled from the start with severe understaffing, lack of resources and funding, and an impossible Janus head of being both the funder and the regulator of an emerging industry. Across its early staffing, there was also a noticeable lack of sufficient space literacy. This was not a recipe for rapid success.

The purpose of the Agency is still not clear to the general public, who tend to expect something that resembles NASA. Nor is it clear across our federal government, where many still assume that space is a specific industry for Defence, or to be supported exclusively by the Agency. This picture is beginning to improve as members of the private space sector and educational sector have started to take up the cause of communicating why space matters across other sectors, but there is still work to be done.

The Charter of the Agency states that it "operates as the national priority setting mechanism for the civil space sector." There was an intention to give the Agency a coordinating role across whole of government, through leading the Australian Government Space Coordination Committee (SCC).[4] In practice, senior decision-makers have consistently delegated down such that attendees of the SCC are unable to make any decisions, and many portfolios do not send any delegates at all, as they do not see how space relates to their mandates.



Deployment of the NanoRacks-Remove Debris Satellite from the International Space Station (ISS). (NASA)

Though much smaller in scale, this coordinating role is somewhat akin to the US National Space Committee, which is chaired by the US Vice President, and ensures consistent national policy, regulatory, strategic and funding decisions across the US space sector, whether for a thriving commercial environment, for national security, or any international engagement of the nation. In order for it to fulfil this necessary coordinating role, the Agency needs to be made a statutory body, and funded appropriately by the federal government for its operations, so that it can grow its staff, and have more direct lines of decision-making on regulation and governance. This is quite apart from lines of funding for specific capabilities. A mature space nation needs a centralised, fully supported Space Agency, that is able to communicate with and guide senior decision-makers across the whole of government, regarding how we can leverage our space technology strengths to assist *all* government portfolios and priorities. It cannot remain embedded in a subordinate role within a Ministry that has so many priorities, and where its relevance to all other ministries and portfolios is restricted by size, mandate and authority.

Underpinning all of this, what our federal government needs to establish is a National Space Policy.

A national space policy

As the Charter of the Agency notes, "[t]he states and territories play a key role in the national space enterprise."[5] The Agency is therefore given the mandate to engage closely with states and territories, to "support national space policy and strategy, coordinate activities and provide one voice for Australia's civil space sector." What has made this task difficult, apart from under resourcing, is the tradition of competition between the states for federal funding, and for branding themselves as leaders in various industries. Instead of one voice for our civil space sector, we have seven, several of which claiming to be "the space to be", or the primary state for the space industry. This has led to confusion for foreign investors, to inconsistent messaging about what Australia's priorities or strengths are, and—perhaps most importantly—who Australia is as a space nation.

Australia has demonstrated true world leadership when it comes to cyber policy, both with respect to national policies and engagement across government and private sector, and with respect to international cyber security. It has achieved this by resourcing a thematic Cyber Ambassador, funded and mandated to work across whole of government, to engage across the sector domestically and to work with international equivalents. Where we were with cyber 8-10 years ago is where we are with space today. If we are serious about participating in the global space economy, and being able to use our strengths in space technologies to affect issues of global and regional climate, security and stability, then we need to be serious about centralising and coordinating our identity and our priorities as a space nation.

In 2022, the Agency had begun to undertake a Space Strategic Update (SSU), which was intended to clarify where the sector should go, how civil and defence interests could better intersect, and what the next steps should be after all seven Roadmaps are completed for the seven priority areas of funding.[6] When the Labor government came into power, expressing a range of values beyond jobs and economic growth, the Agency sagely took the opportunity to reconsider whether the focus on job growth and capability funding was the path to continue. Logically, this would lead to questioning whether those seven Roadmaps and those seven priority areas should remain at the centre of all efforts.

Under the Labor government, the SSU was rebranded as the National Space Plan. It should be acknowledged that the Space Agency shifted into a listening mode that it had not previously been in, and undertook a more active and inclusive engagement with stakeholders in all states and territories. It also began making explicit that it was engaging with Defence, which had previously been seen to be quite separate from the civil space sector.

Other themes which emerged included the need for greater diversity and inclusivity, the need for greater engagement with First Nations, the need for a coordinated national approach to space education—from primary through to graduate and postgraduate training—and including executive education for public servants and those in the private sector. These themes, as well as the need to prioritise space sustainability, have become pieces of a puzzle as the National Space Plan agenda has developed, with the Agency demonstrating increased engagement and leadership.

The National Space Plan would do well to culminate in a national space policy, and the federal government would do well fast track this process as a matter of priority, if we are to present ourselves as a matured space nation when we host the IAC in 2025.

Our current government expresses Australia's core values as including: responding to climate change including a net zero commitment and a focus on sustainability; connecting and supporting remote, rural and regional Australians; affordable housing and accessible education; improving health and aged care; contributing to regional security in the Indo-Pacific and relations with our Pacific nation neighbours; and an international rules-based order. Space based technologies are already integral to all of these issues, and are key to us living up to those values as a nation. A national space policy should be founded on these values, and express what we aim to achieve and why in the space sector.

What we have instead of a central, overarching policy statement, is two strategies. A policy identifies the "what" and "why", a strategy then articulates how to operationalise that policy. By working together on a National Space Policy, Defence and the Space Agency could stitch together the two parallel strategies we currently have, and potentially refine and update those strategies to speak to a single, national narrative. This will make future decisions easier, more salient and more coherent when it comes to responding to space threats, using space technologies to respond to threats on land, at sea and in the air, funding specific capability areas, interacting with our partners and neighbours on a range of issues, and ensuring we are maximising our potential as a space savvy middle power.

The question "why are we doing space" would then become clear: because it aligns with, and supports the fulfilment of, our national values.

Comparing Australia's civil and defence strategies

Aerial view of Arnhem Space Center. (Equatorial Launch Australia)

Our two current strategies do not fulfil all the things a National Space Policy would. They were developed with entirely different mandates, by two government bodies entirely asymmetrical in size, funding and authority. They were focused on different goals, with different restraints and concerns. Although personnel from both the Agency and the Department of Defence worked together on developing the Roadmaps, and on influencing each other's strategies, they did so from two different perspectives, and without any national narrative to glue them together.

This has led to unclear messaging both domestically and internationally about Australia's priorities and strengths. Meanwhile, some key issues of global space governance have been advancing rapidly, such as how to govern natural resource extraction and competition for property rights in space, arms control and the agenda of "responsible behaviours", space traffic management and space sustainability, and commercial human spaceflight. Australia has been participating in these advancements sometimes through DFAT, sometimes through Defence, sometimes through the Agency, sometimes through private actors, and sometimes through academic voices, but it has not clarified as a nation how it sees these issues interacting, nor how our stance on one might influence our stance on another.

Below, a critical comparison of the two strategies underscores their weaknesses, and doesn't speak to their strengths, which is not to say there aren't any. But there is value here in identifying room for improvement.

Advancing space: Australian civil space strategy

The "strategic vision" of the Civil Space Strategy is that Australia will have a "globally responsible and respected space sector that lifts the broader economy, and inspires and improves the lives of Australians".[7] While a laudable vision, it is never further explored what it is to be globally responsible and respected, how the space sector will lift the broader economy, nor how it will help improve the lives of Australians.

The strategy is built on four grammatically confusing strategic pillars (a mix of adjectives, nouns and a verb, making it a difficult read and an incoherent basis for a strategy). Moreover, the pillars are all defined according to jobs or workers, the economy, and a base level of compliance. This reflects the previous government's priorities, but does not speak to how these pillars will fulfil the articulated strategic vision. The four pillars could well remain the same in an updated strategy, but would be much stronger if there were defined according to overarching national values.

Currently they are defined thus:

- International: "**Open doors.** Leverage international bilateral and multilateral partnerships that, where consistent with our national interests, open the door for Australian innovators and grow a connected, respected, and globally competitive space industry in Australia."

Rather than focus only on opening doors for companies, there is an opportunity for Australia to have an international focus precisely because we are a middle power, with trade and financial interests in our region and across the globe that intersect with and sometimes challenge our commitments to regional stability and a rules-based order. Space technologies are at the crux of all of this, and could be leveraged and placed explicitly at the centre. This provides incredibly exciting opportunities for our commercial sector, in partnership with our federal government, rather than seeing the Agency only as a conduit for contracts.

- National: "**Increase capability.** From our areas of strength and addressing our challenges, transform and grow an Australian space sector that lifts the broader economy, and leaps into areas of future competitive advantage."

Having a "national" focus should mean much more than lifting the broader economy, though that is surely something the space sector does. It should include our national values, and articulate how Australian space technologies can support our nation through, for example, advanced communications linking remote, rural and regional communities; advanced secure communications for our Defence forces; Earth observation techniques specifically tailored to track, predict and respond to how eucalypt forests fuel bushfires, and integrate this with First Nations knowledge about preventive burning; Earth observation data for tracking and responding to climate change; space medicine research that can provide new techniques for remote health and aged care; ground-based systems and on-orbit sensors that can contribute to space sustainability, thus ensuring the longevity of being able to access and use space for all of these applications. This provides an enduring basis and justification for funding these companies and these technologies, including R&D.

- Responsible: Regulation, risk, and culture. Promote a space sector culture that is globally respected, ensures national safety and security under an appropriate regulatory framework, and meets international obligations and norms.

The definition reflects an unfortunate culture of focusing on compliance at a base level, rather than seeing safety and security regulations as essential for the sustainability of the space sector and the space domain in which they operate. If we are to have a "globally responsible and respected" space sector, we need to look to other space middle powers such as Canada, Japan, Korea, and the UK, who are leading the fray with space diplomacy, space sustainability initiatives, and updating their domestic policies and laws to foster these values. In particular, the work the Agency is doing to implement the UN Long-term Sustainability Guidelines,[8] and foster the culture of sustainability needs to be further highlighted.

Moreover, being "responsible" as a space nation has come to mean something more specific regarding the UN agenda to "reduce space threats through norms, rules and principles of responsible behaviour". This agenda is the current answer to decades of deadlock regarding space arms control, and Australia has been actively participating, including committing not to test direct-ascent anti-satellite weapons. Indeed, the joint statement announcing this commitment from Ministers Marles, Wong and Husic pointed to how much Australians rely on space, why it is in our interests to make this commitment and work towards greater space security, and how it serves our industry to do so.[9] More cross-government focus on space in this way would help clarify for all Australians why space matters, and what it is to be "responsible".

- Inspire: "Build future workforce. Partner in a vision to build an Australian space sector that inspires industry, researchers, government and the Australian community to grow the next generation of the space workforce."

This very definition of "inspire", with a sole focus on future workers, falls far short of the potential for inspiration. Young people are not *inspired* to join a workforce, and the Australian community is not *inspired* to grow a workforce. We are inspired by new technologies, being better connected, working towards solutions to the world's biggest problems, and seeking possibilities beyond what we already know. We are inspired by space and our relationship to it. We are inspired by potential, testing out ideas, exploring new realities. This entire pillar needs to be rethought, and aligned with Australia's values and the things that occupy multiple generations in the twenty-first century.

Upon these four pillars, rest seven priority areas, into which the Agency will provide funding:

- Position, Navigation and Timing
- Earth observation
- Communications
- Space Situational Awareness and debris monitoring
- Leapfrog Research & Development
- Robotics and automation
- Access to space (including, but not limited to, launch)

While the seven priority areas each have a certain value and logic to them when considered independently, and while space industry leaders contributed useful guidance on what should be the priority areas, there is no public clarity as to why there are seven instead of fewer or more. Nor why these were the priority areas settled upon rather than any others. Nor if there is any interrelationship between the seven with regards to what Australia considers to be national priorities—or considers to be the values and issues we wish to contribute to with space technologies. Is Australia becoming a space nation because space is exciting and cool? Are doing it because we think we might miss out? Are we doing it for economic reasons? Or are we seeking to increase our space capabilities and strengths because, much like cyber, space technologies permeate every part of our daily lives, our national interests, and our global concerns? If it's the latter, there is a core identification missing in all of our existing space regulation, policy and strategy, and it's this gap that a national space policy could fill.

Parkes telescope in Australia, part of the Commonwealth Scientific and Industrial Research Organisation. (NASA)

Throughout the entire strategy, there is not one mention of the word "sustainability". There is only one mention of the word "sustainable", with respect to ensuring the space industry is sustainable over time, rather than any focus on the space environment, or what kind of sustainability culture would be required for the space industry to continue—which is one of the central tenets of the UN Long-term sustainability guidelines.

There are ten mentions of the word "security", with respect to national security, cyber security, and ensuring regulation takes into consideration national security. No mention of how space capabilities contribute to international or regional security, and no mention of space security. This may be understandable given this is the civil space strategy, and the mandate of the ASA is not focused on security issues, however in the course of the state and territory consultations facilitated by the Agency, one of the key recurring themes was the need to better integrate Defence and security with civil priorities.

The word "value" is mentioned four times, only in relation to "high value jobs" and the value of the space economy. There are no clear values underpinning the strategy, and no alignment with any notion of national values.

The role of the Agency is described as advisory, regulatory, and brokering international relationships, but there is no identification of the role the Agency can play within the government as a whole. While there is a suggestion that the Agency can advise on the intersection between civil and military space, it is clear that the culture has been more the other way, and that Defence has been influencing more than receiving advice.[10] There is no

mention of whole of government approaches, responsibilities of different departments, nor of the importance of space for different government departments.

The only measures of success are to "triple the space sector's contribution to GDP to over $12 billion per annum and create up to an additional 20,000 jobs by 2030." Thus, aside from revenue and jobs, it is difficult to know how Australia seeks to place itself as a globally respected, responsible participant in the space sector, leaving the Agency with a very limited mandate and no clear guidance.

There is also no mention of the role of Indigenous Australians in the space sector, of their co-governance of ground-based infrastructure on traditional lands, or of the cultural heritage that relates to the skies. This is a looming gap. The Agency's logo represents the heritage of many different Australian First Nations, and the marketing video displays an Indigenous theme throughout.[11] There was concerted engagement and consultation with Indigenous communities around Australia on the part of some individuals who were building the Space Agency from the start, but this engagement was not publicly communicated, and there was no further explanation given about how the logo was designed and how. Until very recently, there was no concerted effort to recruit Indigenous Australians, and there is still no clear mandate for an Indigenous outreach officer or to incorporate requirements for Indigenous engagement when seeking funding or licences from the Agency. There was a wonderful opportunity to reach First Nations Australians at the launch of the Agency. Instead, there is an unfortunate potential for misunderstanding this branding as appropriation.

Defence space power eManual

Parallel to the Civil Space Strategy, the Defence space strategy was released in a public form in 2022 as the Space Power eManual. It articulates a vision of Australia as an integrated space power by 2040, however the lines of effort have a five-year horizon. This means that between the two strategies there are overlapping timelines to 2027, 2028 and 2040, making it hard to track our progress as a space nation.

The eManual was released concurrently with the public announcement of Defence Space Command. It is a prudent move for Australia to have joined many of our partner countries in establishing a central unit to coordinate space activities and decision-making across all three of the armed forces, at a time when we aim to assert ourselves as a serious space player across the civil, commercial, security and diplomatic spectrum.

The eManual states that the "immediate priority for Defence is to better integrate the many diverse elements of space capability within the Defence Force", which mirrors the approach taken by all of our partner countries with similar tri-service space commands. At the public launch event, then Minister for Defence Dutton indicated that he thought Space Command should grow into a fully fledged separate armed service similar to US Space Force, but Australia would be wiser not to seek to imitate what was seen by many nations as a disruptive and potentially destabilising assertion of military power in space. As well, the US has decades of space heritage, more space capabilities than any other nation, and budgets that far outstrip any middle power. As we leverage and grow our strengths as an effective space middle

power, we will have much more impact if we seek to further cultivate our role in the region and in partnership with other space nations more advanced than us such as Japan and Korea, than if we seek to mimic great power competition.

The vision for 2040 is for "Assured Australian civil and military access in space, integrated across Government, and in concert with allies, international partners and industry". This aligns with the core focus from the Defence Strategic Update of 2020 to "shape, deter, defend", though there is limited explicit reference to these core Defence values in the eManual, which a National Space Policy could underscore more.

Assured access in space requires commercial partnerships and coordinated space diplomacy, which is why "shape" comes first, and why it is laudable that the eManual vision underscores that Defence shall be working in concert with allies, partners and industry. The UN "responsible behaviours agenda" is case in point. How "deterrence" works in space, from space, to space, in support of other domains as well as through other domains in support of the space domain all requires further attention and critical thinking. It's a challenge that Canada's Department of National Defence and US Department of Defense have been tackling for a few years, and Australia has an opportunity to contribute to this thinking. The question of when Defence will "defend" Australian owned space assets also needs some careful thinking, when it comes to commercially owned assets and services in particular. Those two nations engage often with external experts and advisors, through academia and thinktanks, and Defence would do well to take a leaf out of those books when working through how "shape, deter, defend" will apply to space assets and space power.

Major Gabrielle Parker is talked through the display by Melanie Bushby at Defence Space Command at the Australian International Air Show 2023. (Department of Defence)

The mission to "prepare Space Power to secure Australia's interests in peace and war" is highly relevant and necessary. It's difficult to ascertain from documents in the public domain how Defence is defining space power, and how it aims to use it to secure Australia's interest, and it's another area that would benefit from external engagement with trusted experts.

The eManual outlines five lines of effort, which emphasise developing sovereign capabilities, space control, and whole of government engagement, including the Quarterly SCC Chaired by the Space Agency, and a quarterly National Security Space Interdepartmental Committee meeting (chaired by Defence). Indeed, a whole of government approach is evident throughout the whole document, which is not as clear in the Civil Space Strategy. Defence promised to advise on deployment of space capabilities across the spectrum from

humanitarian assistance to conflict, and to contribute to shaping international norms of responsible behaviour.

The lines of effort are described with five-year timelines as follows:

1. Enhance Defence's space capability to assure Joint Force access in a congested, contested and competitive space environment. This is where the commitment to develop sovereign capabilities through new and existing communications, intelligence, surveillance and reconnaissance, and space domain awareness programmes.
2. Deliver military effects integrated across Whole of Government and with allies and partners in support of Australia's national security.
3. Increase the national understanding of the criticality of space.
4. Advance Australian sovereign space capability to support the development of a sustainable national space enterprise.
5. Evolve the Defence Space Enterprise to ensure a coherent, efficient and effective use of the space domain.

There is no clear definition given of "space power", but it is mentioned six times. The word "responsible" is also mentioned six times, always in relation to "responsible behaviour", or being a responsible actor, which is a far broader notion than the way "responsible" is used in the Civil Space Strategy. The word "sustainable" appears seven times, only in relation to a "sustainable space enterprise", and not in relation to the sustainability requirements needed to ensure space remains accessible.

The 2017 Foreign Policy White Paper provided a starting point for a space strategy, with a short section focusing on space security under the chapter heading "Global Cooperation".[12] It took a holistic approach which is missing from the two individual strategies, and which could form an important part of a National Space Policy which is not just Defence oriented. The White Paper stated:

> *We need robust rules and norms to maximise the benefits of greater access to space while tackling challenges such as debris…At the same time, the expansion of space-based technologies creates risks. States are continuing to develop capabilities to disrupt satellites and degrade space-dependent military systems, threatening our defence networks and those of our alliance partner the United States. Potential state adversaries may also exploit space to obtain sensitive information about our security… Australia is committed to strengthening international rules and laws that apply to space, including military uses of space. We will work with partners, particularly through the United Nations Committee on the Peaceful Uses of Outer Space, to strengthen norms of responsible behaviour.*

The White Paper highlights the interrelationship between Australian dependencies on space-based technologies, the challenge of space debris, and the security, political and diplomatic issues. This is something the two strategies do not do sufficiently.

Indeed, suggestions have been made that that the Defence space strategy was written without having done a threat assessment of the space domain. This is a thoroughly troubling fact, since what is required is a sophisticated understanding of the geopolitics of space, the kinds of counterspace technologies being developed by friendly and potentially adversarial nations, the risks of the dependencies our defence forces have on space-based technologies, what strengths in space and in other domains we would need to develop in order to counter those risks, and what the impacts of extending conflict into space would be. There are legal, political, strategic, theoretical and technological aspects to all of this, which interact with civil space priorities as well.

Filling gaps between the strategies

Our partnerships with key space nations are a part of this picture. Both Defence and the Space Agency should be proactively capitalising on our ongoing space science relationship with Japan, and following through more explicitly on the Memorandum of Understanding that was signed between the Republic of Korea and Australia "to establish and develop mutually beneficial cooperation in the field of space activities on the basis of the principles of equality, partnership and mutual interest".[13] That MoU identifies points of contact between our governments, a practice Australia should expand with other space nations. It also promises an exchange of views on space policy and legislation, and "training of personnel in space and related fields". This MoU was brokered by DFAT, and was no doubt driven by the Republic of Korea's concerns about missile development activities of North Korea under the guise of a space program, and their commitment to drive an agenda of space for peaceful cooperation, including regional security. These are Australia's interests too, and that MoU could become a model for similar MoUs with other nations in our region.

The Royal Australian Air Force's showcase 2022 Air & Space Power Conference was held at the National Convention Centre in Canberra from 22-23 March 2022. (Department of Defence)

In doing so, Australia could be reflecting our values more explicitly. Regional security, climate action, and the sustainable development goals are all served by space and by cooperation, and we are only going to achieve our goals through partnerships.

The space capacity building agreement in the MoU with South Korea also speaks to these regional commitments. If we can support pacific neighbours, for example Indonesia, Papua New Guinea and others with our space industry, our space diplomacy efforts and our new sovereign space capabilities in the next 10 years, together with New Zealand, then we support them to be more robust, stable, independent, and not to have to turn to China for that support. This serves our own national security as well as supporting theirs as sovereign neighbour countries, and thus serves regional security in the Indo-Pacific.

Two useful models: UK National Space Strategy and Japan Basic Space Plan

In developing a National Space Plan, we do not have to re-invent the wheel. Two useful models can be found in our partner nations Japan and the UK, both of whom are also space middle powers with similar shared interests to Australia. Some lessons can be drawn from their centralised approach, based on clearly articulated values, and a clear set of goals. An Australian National Space Policy could incorporate everything being learned through the National Space Plan process, and provide an overarching national narrative to guide our civil and defence sectors, to communicate to Australians and to our external stakeholders why we are active in the space sector and who we are as a space nation.

Japan Basic Plan on Space Policy 2020

In 2020 Japan released its fourth decadal space plan, which spans another 10 years to 2030.[14] The Basic Plan highlights the importance of space technologies and partnerships in response to the COVID-19 pandemic, as well as for national and regional resilience. It highlights threat of denoting space as a "warfighting domain" rather than as an "operational domain", and reiterates Japan's commitment to peaceful uses of outer space and to space diplomacy, without undermining the need for space security capabilities.

True to its name, it provides a basic outline for how Japan will fulfil its interests in space, and what its values are. This is the framework for all government spending on space, whether civil or defence related, and for all international engagements, whether political or commercial.

The Basic Plan identifies two "targets": (1) to contribute to a wide range of national interests, and (2) to strengthen the comprehensive foundations of Japan's space activities including industrial, scientific and technological bases.

The first target includes four key areas:

1. Ensuring space security
2. Contributing to disaster management, national resilience, and solving global issues
3. Creation of new knowledge through space science and exploration
4. Realising economic growth and innovation for which space is the driving force (space as infrastructure)

These four areas cover the key issues that speak to Japanese citizens, and as such they provide an internal messaging as well as a justification for committing government resources to space technologies and efforts.

The second target is articulated more briefly, and includes Japan's commitment to international rule-making, its promise to provide human resources to ensure it can strengthen the "comprehensive foundations" of Japan's space activities.

Capabilities into which Japan wants to invest or strengthen are listed under each of the targets, as "specific approaches" to fulfilling those targets, alongside policy, diplomatic and regulatory approaches. This means capability areas are seen as underpinning values and targets, rather than being the targets themselves.

UK National Space Policy 2015

The UK National Space Policy[15] provides a single, overarching framework for all of the UK's space activities, whether civil, commercial, military, or diplomatic, and it identifies the values that these activities aim to serve. It also states clearly at the beginning what the roles and responsibilities are of each government department for space activities.

The National Space Policy identifies five core goals for all of the UK's space activities:

1. Grow and level up our space economy
2. Promote the values of Global Britain
3. Lead pioneering scientific discovery and inspire the nation
4. Protect and defend our national interests in and through space
5. Use space to deliver for UK citizens and the world

The second and fifth goals are noteworthy, as they point to how space can underpin and serve the values of the nation, and how space can support the needs of citizens. Similar to the Japan Basic Plan in this sense, this provides both an internal and an external stakeholder messaging.

The policy then identifies an implementation plan for each of those goals in clear detail, which makes it explicit and provides clear actions for various government departments as well as commercial space stakeholders.

As part of a plan of action, there are also four pillars. The goals are to be achieved by acting across those four pillars:

1. Unlocking growth in the space sector
2. Collaborating internationally
3. Growing the UK as a science and technology superpower
4. Developing resilient space capabilities and services

These are perhaps not too dissimilar from the Australian Civil Space Strategy in spirit, but they are more concrete and broader in definition, and they are placed in the policy as pillars for action, rather than descriptive pillars. Capabilities are only listed under the fourth pillar: listing which capabilities and services exist, will grow or will be developed, in service of the other four pillars.

Lessons for a national space policy

While these two models answer the political system and space sector needs of each country individually, what they share is the notion that a single, whole of government overarching document is critical to guiding the advancement of the space sector, and the advancement of the nation as a space actor. They also share clear statements about some of the nation's values, and they link space activities to those values. Capabilities in both documents are listed under pillars or lines of action—in other words, they result from actions, rather than being the focus of the document.

Compare this to the Australian Civil Space Strategy, which places the priority areas at the centre, but does not have a more general target or framework explaining why those are the capabilities to focus on. While the Defence eManual lists capabilities under one of the lines of efforts, there is more room to identify how these will serve Australians, and serve Australia's values in a broader sense, including our commitment to a stable Indo-Pacific.

NASA employees build a sounding rocket range in Nhulunbuy, NT with the additional efforts from local contractors. (Photo Credit: Brian Bonsteel)

A National Space Policy for Australia should begin by highlighting climate, supporting remote communities, aged care, and regional security as the pillars, clarifying how space supports these, and identifying lines of action under those that are across the entire sector. It should also list explicitly what the different government department responsibilities are for space activities. Currently the only model we have for this is in the case of recovering space debris.[16]

There are only two years before the global IAC conference will be hosted in Sydney. It is an opportunity for the Australian space sector to work together rather than in competition with each other, and what will facilitate this is a central national narrative about our commitments as a nation and our values as a space actor.

A National Space Policy needs careful thought, and two years might seem short. Thankfully, the work of the Space Agency on the National Space Plan has already led to significant advances in understanding the intertwined issues and interests. As well, there is unique expertise across academia and various government departments that could support a concerted effort to write this national narrative.[17] And moreover, there is a desire on the part of the space sector to see "Team Australia" present itself in the best possible, coherent light in 2025.

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4. Public opinion on space

Dr Kathryn Robison Hasani
Flinders University

Most people do not care about space, despite their everyday reliance on its technology and infrastructure. This lack of recognition of the value and importance of space is perhaps the greatest failure of public relations of any industry. Life, as we know it, cannot go on without the technology and innovations birthed in the space sector. This paper, in three sections, will address public opinion on space exploration, use, and exploitation in Australia and the United States. The first section will discuss the history and measuring of public opinion on space, the second will discuss the current landscape of public opinion (including the lack of data in the Australian context), and the final section will address ways in which the space sector can improve its public image and understanding with the general public and policymakers.

The golden days

A visitor poses for a photo in the NASA spacesuit at the Apollo 11 50th Anniversary celebration on the National Mall, Thursday, July 18, 2019 in Washington. (NASA)

Big rockets and even bigger dreams—a collective nostalgia for the days when everyone supported and cared about space—except, those days never existed. There was never a point in time where space exploration enjoyed sustained, broad public support, even in the United States during the Apollo era.[1] Instead, as noted historian Roger Launius contends, the drivers behind the space race were political, not popular.[2] This is further supported by Wendy Whitman-Cobb who found that space, like other niche issues, is important to only a narrow issue public (an issue which people feel strongly enough about to vote on it alone).[3] This adds further support to Launius' contentions as the issue public which supports space (young, male, conservative, educated with a high socioeconomic status) is often the same issue public which supports the often nationalistic arguments for maintaining superiority in space.[4]

Others have found evidence for the impact of public opinion on legislation about space in the United States when those issues are salient.[5] However, the public input into and effect on space policy is limited, and their attention span short. It is clear that the public is neither educated about the impact of space on their daily lives, nor are they interested in finding out about it. However, there is limited research and data available on the public's opinion on space, making detailed conclusions about public engagement difficult. It is a topic which is rarely researched and less frequently surveyed. This is true around the world, and even in the United States which has routinely included a question on space exploration for many decades in the United States' General Social Survey (USGSS).

Space activist and actress Nichelle Nichols talks to attendees at the Gaylord Palms Convention Center in Orlando. To encourage student attendees to focus on pursuing careers in science, technology, engineering and mathematics (STEM), NASA featured some of its greatest legends and trailblazers during a panel discussion at the reunion event. (NASA)

Why is measuring public opinion on space so hard? Firstly, as mentioned above, the limited data available to researchers is a hurdle, combined with the cost of running independent surveys on space. Second, it is difficult to measure how the public conceptualises space and spending on space. Finally, as space policy is a niche policy area, it does not neatly fit into our political science boxes as it is so often a domestic policy entangled in foreign policy and defence. While the first problem could be solved with more funding for researchers, or more broad inclusion of questions on space in general surveys, the latter two are more difficult to address. Given it is likely that space policy will remain a niche policy area for the foreseeable future, this leaves us with a question of measurement.

In the USGSS, respondents are asked if they think the amount spent by the US Government on space exploration is "too much," "too little," or "about right." They are also given the option to answer "no opinion." Until the 1980s, the answers tended toward "too much," before most people eventually settle at "about right" by the 2000s.[6] The problem with this question is the assumptions it makes about the respondents' ability to conceptualise how much the US Government spends on space compared to what they think the government spends—these estimates can range from 3-4% to nearly half the budget. While the US does spend more on its space budget than the six countries below it, the actual percentage of the US Federal Budget allocated to NASA is less than one half of one percent; even at its height during Apollo, NASA received around 4% of the budget.[7] Since the inception of the Space Force, that conceptualisation may now be even more convoluted.

Public opinion today

In the United States, NASA is well-known and respected, often topping the lists of respected government entities with little partisan divide among the ratings, according to the Pew

Research Center. How many Australians would put the Australian Space Agency on the top of their list? Unfortunately, there is little public opinion polling on space done in Australia. While Pew has done some polling in Australia, the most recent polling was done by Inmarsat, a private company, and not by an academic or government body. Despite that, their findings should give pause to those within the space sector.

According to Immarsat,[8] only a third of Australians are hopeful about space and only 10% are even interested in working in the space sector. Even more (49%) are worried about space debris and its dangers and 44% are worried about polluting space. Only 10% of the Australian public associate space with communications and connectivity while more than twice that number (21%) think about aliens when asked about space. A third of Australians do not associate space with climate, weather, or even GPS. Amazingly, for a country with a not insignificant rural population, 70% of Australians know nothing about space-based internet. Immarsat's findings point to a troubling conclusion for the Australian space sector: Space is not important to the Australian public.

Even within the space sector, there is a lack of consensus on what the Australian Agency should be, and what space should mean to Australia, its government, and the public (Framing the Future). This contributes to the inability of the Australian Space Agency to form its own distinct identity and effectively advocate for public awareness of the integral nature of space in the everyday life of Australians. Its mandate and focus on supporting commercialisation means that the Australian Space Agency is not NASA and it should not try to be what it can never achieve given its resources. It will not be able to trade on inspiration when its *raison d'etre* is to promote commercial success. Even NASA generates more public interest from its science and exploration missions than its significant achievements in supporting the United States' commercial space industry.

Public perceptions must change

The space sector is growing both in Australia and around the world. Without at least a minimum level of political and public support, Australia will miss out on its chunk of the soon to be trillion US dollar enterprise. Australia is home to the world's oldest continual culture and their long association with the night sky offers Australians a unique insight on humanity's relationship with its resources and one another as we push further into space and move towards working and living off planet.[9] However, if Australia does not work to assert its long experience on the world stage, and include indigenous leaders in that conversation, that advantage is worth nothing. We are at an inflection point in space that was missed with climate change. We still have the opportunity to implement common sense regulations and laws to ensure space remains open, accessible, and equitable for all. Australia must be willing to capitalise on its depth of expertise in this area and from its singular position as a signatory to the Outer Space Treaty, the Moon Agreement, and the Artemis Accords.

Many of the leaders in our growing private space industry are doing this work and engaging with local traditional custodians as they build their rockets and select their launch sites. These small steps can set the stage for major changes in the way we do space, both here in Australia and around the world. Yet, these engagements can also be seen as tokenistic, which cannot be the case if Australia is going to be a leader of a sustainable and responsible push into more space exploration and utilisation. These changes also require something that no country (except perhaps the Czech Republic) has yet achieved—a public that is both interested and invested in space. This leads us to ask—how do we involve the public in space?

Service Attachés and Advisor's Group (SAAG) Engagement Program members at the Australian Space Discovery Centre, Adelaide. (Department of Defence)

Communication is key

The cornerstone of any public campaign is communication, and this one would be no different. From what little public opinion polling does exist, we know that the public is un- or misinformed about space, its technology, and its benefits. The onus is on the space industry to correct this as its highly unlikely federal or state governments will have the budget or bandwidth to invest in the type of public information campaigns which would be needed to accomplish a successful public information campaign on space. Even NASA, which allocates significant funding to its outreach efforts (which include education about space spinoff technologies) continues to fight public misconceptions about space and its space programs. Australia is a different context, and one in which a public information campaign, led by the space industry might enjoy more success. Part of this is attributable to its smaller population and its geographic concentration around a relatively small handful of metropolitan areas. Additionally, many Australians rely on space technologies that have clear benefits in their daily lives. While this is true for most people, given the history of climate issues in Australia, the saliency here for space has the ability to remain high. From previous research, we know what when space is salient, people pay attention.[10]

Along with a public information campaign, the space sector needs to clearly link investment in space to positive economic outcomes. In the US context, we know that for every dollar spent on space, $7-14 dollars goes back into the economy, if spinoff technologies were included, that number could more than double. This information is valuable to both the public and policymakers. Also, we know that the average salary in the space sector well exceeds that of the average Australian, which is important to build the space workforce pipeline which is needed for the future. One of the great things about the space industry—especially if you build and manufacture your own hardware—is that there is truly a space for everyone within the industry from your engineers and scientists to tradespeople and policy officers. Australia could be a leader in the industry, if it is willing to invest more than just capital.

To measure the starting point, and any success of the above-mentioned recommendations, we need to understand exactly what the Australia public thinks about space. The only way to do this is to ask them. As it stands now, policymakers are making decisions on expensive and long-term investments in space, without understanding public interest, need, and comprehension of these efforts. Surveying the Australian public on space and related issues will allow us to establish the metrics by which our efforts in space will be measured. We will know where the gaps in education and understanding of the general public lie, we can gauge the interest of the potential space workforce, and gain valuable understandings of the Australian public's priorities for our future place in space.

An exhibit at the Woomera Heritage Centre. (Department of Defence)

Conclusion

The world is increasingly reliant on space technology—if we were to experience a day without space, most of us would be unable to function. We are reliant on space for our day-to-day interactions. However, previous research in this area tells us that this is unrecognised by most of the public, who see space as a luxury or as a playground for billionaires. While Australia has a long history in space, it is in many ways, just getting started; at this point we cannot even conclusively state what the Australia public thinks about or wants in space because we have not asked them. We have the opportunity, with input from its residents, to build a space sector that is supported by and responsive to the public.

This lack of information at the nascent stages of our modern space sector means it is in an ideal position where it can choose to do space differently. A small investment in bringing the public along on the journey now could pay huge dividends in the future as space becomes more expensive and complicated. A citizenry that sees space a necessary and important is a public that will support and invest in its future.

Notes

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SCIENCE AND INDUSTRY

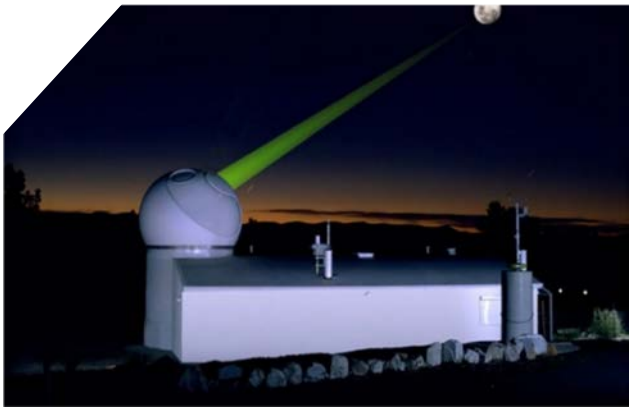
5. Neither cooperative nor centres: How cooperative research centres influence the exchange of knowledge between industry and academia in the space sector | *Annie Handmer*
6. Australian and industry space policy: A field of dreams | *Brett Biddington*

5. Neither cooperative nor centres: How cooperative research centres influence the exchange of knowledge between industry and academia in the space sector

Dr Annie Handmer
University of Sydney

Introduction: organisations

In this paper, I will be discussing almost exclusively organisational structures that try to sort people and their technologies into categories. In fact, I'll be doing a deep dive into a type of structure that is generally called 'an organisation'—specifically—a Cooperative Research Centre (CRC) called 'SERC' (Space Environment Research Centre). The bulk of my paper will therefore be far more engaging if the reader pays attention to the process of organisation, rather than just taking the organisation presented as a static entity, because this paper is an examination of a continual *process* of organisation; the CRC in question was organised and reorganised frequently over the years it operated. I will begin by outlining (very briefly) the history of the CRC program in Australia. I will keep it brief not because there isn't a lot to say, but because I want merely to provide context for my discussion about the Space Environment Research Centre (SERC), not to assess CRCs generally. I present SERC as an example of the entanglement of scientific research and commercial activity, and the way that funding, policy, and organizational structures shape both new technologies and participants' actions and thoughts. In particular, I examine the organisational structure of SERC and how it changed over the period that it operated, layering



The EOS Space Systems Satellite Laser Ranging Facility at the Space Environment Research Centre (SERC) in action tracking space debris, Mount Stromlo, Canberra. (EOS Space Systems)

this explanation against a description of how SERC functioned at a human-technological level (the kind of day-to-day interactions that every reader will be familiar with, which never show up on an org chart but which undoubtedly ensure the smooth (or not) running of things). Finally, I will outline some of the challenges encountered by the individuals working within the CRC structure, before finishing with some general conclusions about space policy and its interconnectedness with other policy in Australia.

An outrageously short overview of CRCs in Australia

The Cooperative Research Centres (CRCs) program in Australia was introduced in 1991 as a way to encourage collaboration between the public and private sectors in research and development.[1] The program is administered by the Australian Government and involves research organizations and private companies working together to develop new technologies or methodologies. CRCs receive significant financial support from the government and when they are created, they are structured as new entities with their own financial and administrative structures.[2]

At the time of writing there are 21 CRCs running in Australia, with a combined total of $960.75 million in grant funding (or almost $1 billion).[3] Topics range from cyber security, space and future energy (batteries, fuel, etc) to materials, agriculture, and digital finance. CRCs seem to be thematically focused on trying to use technology to solve some of the biggest problems we face.

There has been much debate about the effectiveness of the CRC program, with scholars and analysts assessing its operation from different perspectives. Sociologists and policy researchers have looked at the impact of CRCs on academic careers, while policy and public administration scholars have focused on the success of the program at an organizational level.[4] Research education policy advisors have studied graduate outcomes. In 2014, the Australian Minister for Industry and Science commissioned a review of the program to consider whether it was the most appropriate way to support business and researchers to work together to develop new industries.[5] In general, reviews conclude that there are myriad problems with the CRC program; that reporting is too onerous, and administrative costs too high; but that they should continue to be funded (probably because, for all their faults, we've yet to come up with something better for facilitating, relatively efficiently, the organised exchange of government and private sector funding for university-developed IP).

A brief history of SERC

The Space Environment Research Centre (SERC) was funded in part by the Australian government and in part by various academic and private entities. The two organisations at its core were the ANU Research School of Astronomy and Astrophysics (RSAA) and EOS Space Systems. SERC began operations in 2014, was gradually wound up in 2020, and was formally de-registered in 2021. One of SERC's core goals was to demonstrate the manoeuvre of an object in space using a complex setup comprising massive lasers, mirrors, adaptive optics systems, a telescope, and other technologies. Ultimately this particular goal was not met, although SERC did achieve a number of other goals.

In writing a history of SERC it's possible to start just about anywhere, but I think it makes most sense for a policy-focused analysis to begin in 2003, when a massive bushfire swept through the ACT and destroyed $80 million worth of the Australian National University's research infrastructure at Mount Stromlo Observatory.[6] The Australian Government stepped in with a sum of $7.3 million for the ANU Research School of Astronomy and Astrophysics (RSAA) to help them rebuild, possibly in part due to problems in recovering insurance money from the company with which the observatory had been insured.[7] The research school decided to build a different kind of facility at Mount Stromlo—what is now known as the Advanced Instrumentation and Technology Centre (AITC)—and transition astronomy-as-an-observational-practice to their Siding Spring observatory, which had far less light pollution to contend with.[8] The AITC was completed using funds provided by the Australian Government as part of the GFC strategic response in 2008.[9]

Mount Stromlo burnt out observatory, 2017. (Wikimedia Commons)

So far so good, but how did EOS Space Systems come to form an interest in working with the ANU RSAA on a laser-based solution to space debris? EOS Space Systems had had a presence at Mount Stromlo since 1997, conducting satellite laser ranging.[10] This form of tracking (one of the technologies that makes up a category called 'Space Situational Awareness' or 'SSA') uses lasers to measure the position and movement of objects in space. EOS Space Systems had demonstrated that they could use this technique to accurately track not only 'cooperative targets' (satellites) but also space debris, dramatically outperforming the accuracy of radar solutions and improving debris tracking efforts.[11] In 2003, the same bushfire that wiped out ANU RSAA's research infrastructure also destroyed EOS Space Systems' laser ranging facility.[12] EOS rebuilt it, and in 2009 received government funding through the Australian Space Research Program (ASRP) to do 'Space Debris Tracking'. [13]

By 2010, both ANU RSAA and EOS Space Systems had new, rebuilt facilities, and began a collaboration at the Stromlo site on adaptive optics capabilities for scientific and commercial purposes.[14] From a commercial standpoint, the researchers aimed to work together to improve the accuracy of EOS's space surveillance systems by using adaptive optics technology.[15] At the same time, they also looked into the possibility of a technology called 'laser ablation', which uses a high powered laser to move an object in space. Adaptive optics is a way of mitigating atmospheric perturbation to light waves. Whether it is used to 'correct' astronomic observations so that stars appear crisper, or to modify a laser beam so that the wavefronts arrive at a space-based target aligned (and therefore more powerful), the underlying technology is the same. The team also worked on how to improve the 'ranging and tracking' capability of EOS Space Systems' facility at Mount Stromlo.

EOS wasn't interested in debris removal for purely altruistic reasons. As might be expected, there were very good commercial justifications for improving lasers, tracking, adaptive optics, and accurate measurement of the locations of objects. Crudely put, a big powerful laser is also a type of technology known in military parlance as a 'Directed Energy Weapon', which is a way of exerting large quantities of energy on a small target from a long way away.[16] EOS had discussed its development of Directed Energy Systems in a 2009 Defence Business Update in the context of theatre and missile defence, as well as space applications.[17] As of 2009, EOS had spent a total of $45 million on R&D and scaling for Directed Energy technologies, but that "scaling up the deliverable thrust in space" had been slowed by "engineering issues".[18] EOS decided to focus on defence capabilities and put commercial space applications on hold.[19]

Artist impression of a satellite laser designed to target debris in space based on NASA images. (Wikimedia Commons)

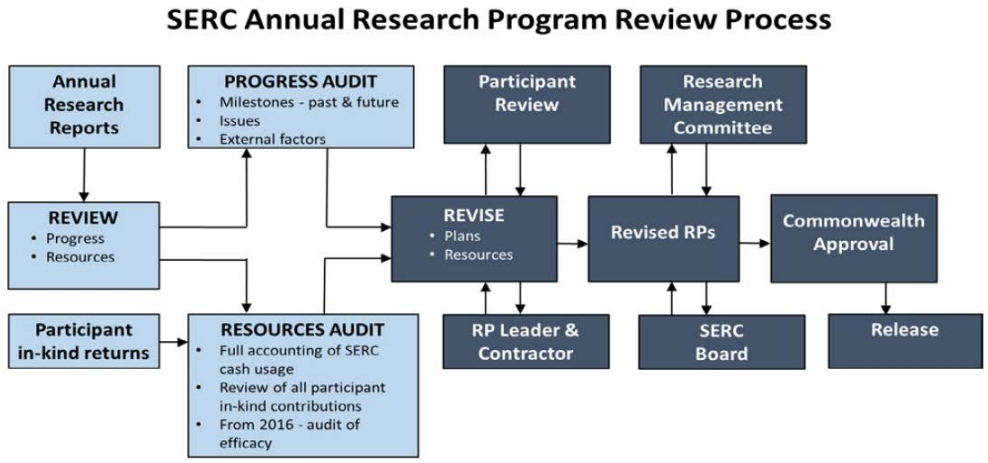
However, academic research on the civil, academic side of the challenge continued, and in 2012 researchers from ANU RSAA and EOS Space Systems published a joint paper titled 'Adaptive Optics for Laser Space Debris Removal' which outlined their progress in ranging, tracking, and adaptive optics that could support better laser ablation on a space target.[20] This success, and other factors too numerous to go into in this paper, led to the bid for a CRC which would formalise collaboration between the ANU RSAA and EOS Space Systems, and accelerate research towards the goal of demonstrating an in-space manoeuvre on a piece of space debris. After an initially unsuccessful bid,[21] the CRC opened as the Space Environment Research Centre (SERC) on 1 July 2014.

A new organisation

At SERC's core were research programs which were continuations and variations on previous collaborative work between the various organisations which were involved in the CRC.[22] Many of the scientific researchers remained employed by their original organisations (for example, ANU RSAA). However, SERC also had a team of administrative staff, professional staff, and even research staff who were employed and paid directly through the SERC entity. These staff had to run SERC as a corporate entity, specifically a charity (SERC was registered as a charity with the ATO) and meet all reporting requirements.

These requirements were onerous.[23] In addition to the standard reporting requirements imposed by participating organisations, there was grant funding to manage and report on, in-kind contributions from participants which had to be tracked and accounted for, and regular progress reports to all participants. In addition, all Australian CRCs are required to produce an Annual Report and End of Project Report, and to report (generally quarterly) to the relevant Commonwealth agency.[24]

The corporate entity running SERC also had to manage the budget, communicate requirements, keep a Board updated on progress and problems, and manage any issues arising from participant organisations or researchers. To make matters more complicated, the head office for SERC was located at the AITC at Mount Stromlo, as were the offices of many of the researchers from ANU RSAA and some of the PhD students working on the program, but many researchers and commercial participants were based in other cities, states, and even other countries. The SERC team aimed to keep operations as streamlined as possible, with a spend of roughly 25-30% of SERC's overall funding on administration. For CRCs generally, this was considered by those involved to be highly efficient.



Almost all individuals involved found SERC's Annual Research Program Review Process to be a significant administrative requirement. The process is shown here in diagrammatic form as it appeared in the SERC 2015 Annual Report.[25]

Although ANU RSAA and EOS Space Systems had, by this time, significant collaborative heritage, the structure of SERC changed the nature of the relationship between the organisations. Instead of budgeting and decision-making being something that could be worked out between collaborators, there was now a third party—the SERC administration—which centralised budget information and decision-making. Some participants found this opacity frustrating, their difficulties compounded by the fact that each organisation had its own processes, rules, and norms of behaviour, which made aligning deliverables and technological outputs very difficult. Individuals filled in their 'progress reports' which went to the SERC administrative office to be documented in formal reporting, but the resolution of problems occurred through separate, often informal mechanisms.

SERC, like many CRCs, was an awkward conjunction of industry and academia, stuck together (on paper) by an office of administrators. And yet the same 'glue' that on paper brought organisations closer together had the practical effect of making it harder, according to some participants, to collaborate. Nonetheless, it is worth reiterating for clarity that the administrative layer was non-optional. Without it, SERC would not have been a CRC, and researchers could not have gained access to significant funding, resources and facilities.

Individuals and organisations had to find ways of working within and around the CRC architecture, relying on strong social ties, shared goals, and interlinked interests.

The best way to understand the active organisation and re-organisation of SERC's research programs and reporting lines is to examine the organisational charts ('org charts') published annually in SERC's Annual Reports. These charts also demonstrate how individuals moved between roles, which demonstrates the formalisation of informal roles within the organisation over time, and it also shows situations where divisions between roles may have existed on paper, but not to the same degree in practical terms.

In 2015, SERC was structured in a way that appeared to separate out (as much has possible) the administrative functions of the organisation from the research programs. The org chart shows five divisions—four research programs, and one office function, sitting under a CEO and COO, who report to a Board. The Board is served by a company secretary. However, many of the individuals held multiple roles. Dr Ben Greene, who was the CEO of EOS, served as both CEO and the lead for Research Program 4, in which role he was responsible to SERC, rather than EOS (at least on paper). Mr Rod Drury (Lockheed Martin) had a Board position as well as filling the role of COO. Professor Craig Smith, then head of EOS Space Systems, led Research Program 1 as well as acting as Company Secretary.

By the time the 2016 Annual Report had been released, SERC had undergone a significant restructure. Greene had been replaced as lead of Research Program 4 by Matthew Bold (Lockheed Martin), and Dr Steve Gower had resigned from the Board in order to take up a new role—General Manager / Research Director. SERC was now split into two divisions—SERC Research, which housed the four research programs, and SERC Corporate, which managed financial, administrative and communication functions. Both divisions reported to Gower, who reported to the CEO, and ultimately the Board.

By 2017, SERC had restructured again. The division between SERC Corporate and SERC Research remained, but each now reported to a different manager: While this change made organisational sense for the researchers, each round of changes to the governance structure affected the development of technology. For example, the shift of instrumentation from one Research Program to another meant that the team had to redesign instrumentation that had been optimised for one use case—tracking and pushing debris—to work with the existing instrumentation being used in the other project.[26] Changes that made sense on paper had significant flow-on impacts for individuals who now found themselves reporting to different people and with different resources at their disposal.

Space Environment Research Centre (SERC), Stromlo, Canberra. (SERC)

The 2018 Annual Report looks similar, but with several important changes. Greene stepped down as CEO (in part due to concerns that having the same individual as CEO of both the key private entity involved in SERC and SERC itself may give rise to the appearance of a conflict of interest) and took up a Board position instead. The concept of 'SERC Corporate' and 'SERC Research' no longer existed. Instead, managers for Business, Research and Finance all reported directly to the CEO. This same structure persisted through to the final Annual Report in 2019. The one main change was that Smith and Gower who were running Research Program 1 also took over running Research Program 4. This is one of those examples of a paper separation between to programs which is not reflected in the personnel. It demonstrates that the links between the programs were perhaps always stronger than their division on either side of an org chart suggested.

Some participants in the CRC were able to move along the dimension of the organisation which is only hinted at in the org charts—the multiple corporate and research institutions which continued their operations in the background—and change employer throughout the course of the CRC's operations. For those more advanced in their careers, the CRC was a formal way of working closely with new teams. For PhD students and junior researchers, the CRC offered a valuable pathway to step sideways into employment opportunities in the private sector, as well as grounding for academic careers. In this way, SERC as an organisation also enabled the mixing up and redistribution of individuals from their existing employers and teams into new ones.

An informal structure

What the org charts cannot and do not show is how governance structures worked in practice. For example, when SERC underwent its first major restructure from 2015 to 2016, each research program theoretically reported up to Gower as General Manager / Research Director. Almost none of the researchers involved in SERC's research had any direct responsibility to Gower. They already had managers, reporting lines, responsibilities, and deliverables in their home organisations—universities or private entities. This is most visible in the case of senior leadership but applied across the board.

Where SERC really shone was in that the leadership recognised that fostering informal social ties and interdependencies were vitally important for ensuring continuous coordination between research groups. They understood that many of the participants already had a history of trust and collaboration, with longstanding relationships that could be drawn on to promote beneficial outcomes for SERC without having to try to exert authority over individuals who reported to managers and hierarchies outside of the organisation. SERC was a group of individuals and institutions, actively organised in such a way that they felt compelled to complete their work because they knew that failure to do so would negatively affect others. It was also in exercising judgement to recognise where those invisible and informal exchanges were already occurring and avoiding heavy-handed interference.[27]

Thus, the strands of SERC were knitted together through rituals and symbols that would be invisible to anyone looking at SERC's formal reporting processes in isolation, just as the true

structure was not visible on the org chart. The SERC team became a team through Friday lunch barbeques, travel to conferences in far flung locations, humorous newsletters, 'SERC Colloquia' (SERC's own conferences), cups of tea in the kitchen area, and other social interactions. At times, the team bonded over their frustration with leadership, delays, and reporting. More than one participant I spoke to described SERC as a 'family'. The close social ties that were formed were integrally important in smoothing over gaps between formal reporting lines, imperfect organisational structures and significant technological challenges and setbacks.

Conclusion

SERC is a fascinating object of study for several reasons. First, it was dreamed up and enacted by some of the most influential stalwarts of the Australian space sector. Second, it was, for much of its operation, utterly chaotic, but still managed to produce an impressive number of PhDs and some ground-breaking research. Third, despite what I maintain was a failure of the goal of moving a piece of space debris in orbit using a high-power laser, SERC has been largely billed, unchallenged, as a success. Fourth, the aforementioned failure remains contested by some of those who were involved closely in SERC, and if that's not an example of the social construction of facts in action I don't know what is. Finally (and this should not be overlooked), SERC is interesting because it involved research on and operation of powerful space lasers, which is objectively cool.

Mount Stromlo Satellite Laser Ranging Facility, Canberra. (Wikimedia Commons)

But what are we to take from all of this? At its core, my goal in presenting SERC in this paper was to highlight the challenges involved in creating effective public-private partnerships in scientific research. I did so not by simply saying that it was challenging, but by laying out on paper how it was that things really worked against how they were supposed to work. My purpose in doing so was equally to highlight these CRC-specific challenges as well as to demonstrate the value in examining the process of organisation (putting things into categories and sorting them) when studying *an* organisation. Knowing where a project came from, and how it operated is essential for being able to spot where formal signifiers of structure like org charts are missing important information. In a world dominated by the desire to sort things and people into neat categories, by who they are or the functions they perform, it is always valuable to point to the messy 'other', and to understand that perhaps it is the things that we cannot fit into neat boxes that are the most essential to how organisations operate. SERC shows us the importance of considering political, social and technological interests at play in collaborations, and how these 'other' things can shape the production of new scientific knowledge and technologies.

Notes

1 Turpin, T, Woolley, R and Garrett-Jones, S, 2011, 'Cross-sector research collaboration in Australia: The Cooperative Research Centres Program at the crossroads', *Science & Public Policy*, vol. 38, no. 2, pp. 87-97, p. 87.

2 Those interested in CRCs generally can find more information in [4]; in O'Kane, M, 2008, *Collaborating to a Purpose: Review of the Cooperative Research Centres Program*, Canberra, Department of Innovation, Industry, Science and Research, p. xi; and in Miles, D, 2015, *Growth through Innovation and Collaboration: A Review of the Cooperative Research Centres Programme*.

3 https://business.gov.au/grants-and-programs/cooperative-research-centres-crc-grants/current-cooperative-research-centres-crcs, as at 11/12/2022. For historic CRCs see (2020). CRCs Over Time. Cooperative Research Centres (CRC) Program. Australian Government Department of Industry, Science, Energy and Resources.

4 See, for example, Turpin, T and Garrett-Jones, S, 2010, 'Reward, risk and response in Australian Cooperative Research Centres', I*nternational Journal of Technology Transfer and Commercialisation*, vol. 9, no. 1/2, pp. 77-93; Turpin et al, 2011, n1; *Sinnewe, E, Charles, MB and Keast, R, 2016, 'Australia's Cooperative Research Centre Program: A transaction cost theory perspective', Research Policy*, vol. 45, no. 1, pp. 195-204; Palmer, N, 2012, *The CRC Contribution to Research Training: Report of a Scoping Study for the Cooperative Research Centres Association*, Canberra, Australia, Cooperative Research Centres Association.

5 Miles, D, 2015, *Growth through Innovation and Collaboration: A Review of the Cooperative Research Centres Programme*.

6 The fire destroyed "the heritage Commonwealth Solar Observatory Building, where the library and administration staff was housed, all observing facilities, and several homes on Mount Stromlo', 2003, *Annual Report 2003*, ANU Research School of Astronomy & Astrophysics. p. 2.

7 Bhathal, R, Sutherland, R and Butcher, H, 2014, *Mt Stromlo Observatory: From Bush Observatory to the Nobel Prize*, Victoria, Australia, CSIRO Publishing. p. 229.

8 *Annual Report 2005*, ANU Research School of Astronomy & Astrophysics. p. 66.

9 Some readers may remember the Education Investment Fund (EIF) that was created as part of the Nation-Building Funds Act of 2008. See Bhathal, et al, 2014, n7; DESE, 2015, Education Investment Fund, Australian Government Department of Education, Skills and Employment, https://web.archive.org/web/20210221084210/https://www.education.gov.au/education-investment-fund.

10 Moore, 2014, *History of Satellite Laser Ranging in Australia. 19th International Workshop on Laser Ranging*, Annapolis, MD.

11 Australian National University, 2018, 'With EOS we're working with business and satellite technology, *Research Stories*, ANU Research School of Astronomy and Astrophysics.

12 Moore, 2014, n10.

13 *Biddington, B, 2019, Space Security in the 21st Century: Roles, responsibilities and opportunities for Australia*, pp. 160-161.

14 Electro Optic Systems, 2010, *Annual Report 2010*, p. 4.

15 The history of Adaptive Optics and its development in the classified and unclassified domains is endlessly fascinating, a starting point is: https://www.lastwordonnothing.com/2015/02/06/charles-hard-townes-made-things-happen/

16 There are of course a number of types of Directed Energy Weapon, of which lasers are just one. You can read an overview here: https://unidir.org/commentary/directed-energy-weapons-new-look-old-technology

17 Electro Optic Systems, 2009, *EOS Defence Business Update*, Canberra, Electro Optic Systems Holdings Limited, p. 2.

18 Ibid, p. 2.
19 Ibid, p. 3.
20 Bennet, F, Conan, R, D'Orgeville, C, Dawson, M, Paulin, N, Price, I, Rigaut, F, Ritchie, I, Smith, C and Uhlendorf, K, 2012, *Adaptive Optics For Laser Space Debris Removal*, Proceedings of SPIE—The International Society for Optical Engineering 8447: 44.
21 The first (unsuccessful) bid included some classified research. I'm reliably informed that the successful bid was more or less the same as the unsuccessful one, but for the removal of the classified portion of research.
22 It is important to note that while my focus in this paper is on ANU RSAA and EOS Space Systems, there were a number of other organisations involved in SERC, each with their own goals and requirements.
23 The Miles and O'Kane Reviews of CRCs both identified reporting requirements as one of the core frustrations raised by researchers involved in CRCs. The problem has yet to be satisfactorily solved.
24 Australian Government, 2020, *Commonwealth Standard Grant Agreement*, Cooperative Research Centres Program Round 21/Round 22, Australian Government Department of Industry, Science, Energy and Resources, p. 9.
25 SERC, 2015, *Annual Report 2014-2015*, Space Environment Research Centre. p. 40.
26 Korkiakoski, V, Grosse, D, Stone, B, Lingham, M, Bennet, F, d'Orgeville, C, Travouillon T and Smith, C, 2018, *Adaptive Optics for Tracking and Pushing Space Debris: Performance of the Adaptive Optics System*, 69th International Astronautical Congress (IAC), Bremen, Germany, International Astronautical Federation (IAF). p. 2.
27 Noting that this was not always possible and did not always occur.

6. Australian and industry space policy: A field of dreams

Dr Brett Biddington AM
Biddington Research Pty Ltd

There is no explicit industry space policy in Australia. Rather there is a string of pronouncements, that have led some to conclude that a succession of Australian Governments are serious about establishing a viable national space industry (however that might be defined). Invariably, the initiatives have been included in broader programs or justified it terms other than a standalone case for space. Happenstance, serendipity, opportunism and good luck are the drivers of the sector's development. Carefully developed and tested public policy and a corresponding public debate have yet to emerge.

A fundamental question, to which no convincing public policy response exists is, "Does Australia need to develop a domestic space industry?" There are many products, including motor vehicles and aircraft, that Australia imports from foreign suppliers. Are space capabilities any different and, if they are, what are the differentiators? What is the rationale for Australia to invest in a domestic space sector, especially for in-space systems including satellites and space exploration systems? Finally, what are the opportunity costs? What are we prepared to forego to realise our space ambitions?

Two engineers working at aerospace satellite manufacturing facility. (Shutterstock)

Rhetoric and modest investment notwithstanding, the Commonwealth seems yet to be convinced that a compelling case for large scale investment beyond Defence exists. Defence regularly makes clear that it will buy the best equipment the nation can afford for the armed forces. Australian jobs are a bonus if they emerge but are a secondary consideration. There is no reason to think that this approach will not apply to space investments. A consequence for launch providers is that Defence may purchase launches from Australian companies that are commercially viable but is not likely to prop-up companies that would not survive if Defence were not a customer.

Some background

In September 2017, the Space Industry Association of Australia (SIAA) hosted the 68th International Astronautical Congress (IAC) in Adelaide, South Australia.[1] The Commonwealth was aware that the heads of many of the world's space agencies would converge on Adelaide and they would ask one question of Australian Ministers and senior officials, "Why does Australia not have its own space agency?"

Possibly to avoid embarrassment, the Commonwealth quickly arranged for a nationwide review to determine the interest in and the need for a space agency and at the Opening Ceremony of the Congress, the Minister for Education and Training, Senator the Hon Simon Birmingham announced that Australia would have a space agency from 1 July of the following year (2018). He received a standing ovation before scuttling to the airport and a flight to another meeting. There seems to have been no formal Cabinet process and no way to appropriate money to the Agency immediately. That had to wait another ten months.

The Commonwealth's support for the 68th IAC was muted. Its direct investment was less than generous and attendance by Ministers was not a priority. Those who did attend fitted their visits to the Congress around other commitments that they judged to be more important.

The rationale for the establishment of the Australian Space Agency (ASA) was the mantra of 'jobs and growth'. There was no reference to the Australian Government being convinced of the intrinsic value of investing in space activities. The ambition and the task of the ASA was to create a situation in which by 2030, the size of the Australian space sector was to have trebled from $3-4 billion annually to $10-12 billion and for 20,000 new jobs to have been created as well.[2]

Australian Space Agency Head Enrico Palermo, left, and NASA Deputy Administrator Pam Melroy, sign a joint statement of intent for cooperation in Earth science during the 37th Space Symposium, Monday, April 4, 2022, in Colorado Springs, Colorado. (NASA)

In parallel with the establishment of the ASA, a cooperative research centre (SmartSAT CRC) was also established with funds from government, as well as from industry and research organisations, most importantly, the Defence Science and Technology (DST) element of Defence. The CRC bid was led by the University of South Australia (UniSA) and the CRC is headquartered in Adelaide with nodes in several other capital cities.[3]

In the context of the 2019 election, the Prime Minister of the day, announced that the Space Agency would be headquartered in Adelaide. A conclusion that the logic for selecting Adelaide was political, with scarce regard for the function of the ASA and its roles and obligations within the national and global space sectors, is difficult to avoid. The Morrison Government's aim would

seem to have been to boost the chances of Coalition candidates in South Australia in the 2019 general election (an election that the polls and many pundits predicted the Government would lose) and to bolster the standing of the then Liberal Premier in South Australia.

The polls and pundits were wrong and Mr Morrison was elected for a further three year term of office. The opportunity was lost, perhaps it was never intended to be taken, to establish the Agency as an important organ of national government with integral links to many other Departments and agencies, almost all of which are located in Canberra. Instead, the Agency, created with a 'jobs and growth mantra' that makes little objective sense (discussed below), now sits in Adelaide and, its best efforts notwithstanding, struggles to find its place in the policy fabric of the nation. It remains an outlier. There is a strong industry perception (and perception matters here) that the space industry in South Australia gains an unfair advantage because of the Agency's location and that the Agency, despite its best efforts, struggles to fulfil and be seen to be fulfilling, its national mandate.

Absent strong national leadership, the States and Territories fiercely compete for investment and attraction in the space sector. Some companies have self-selected their location because their founders live in a particular State or because a particular location offers a specific advantage, such as northern Australia for equatorial space launch. All jurisdictions have produced space industry development plans and all have invested in local companies with space ambitions.

The Head of the ASA, Mr Enrico Palermo, at a reception in Melbourne in March 2022, warned that competition between the States and Territories for ascendency over each other in the space economy may well become a self-defeating enterprise. The space industry is a global industry and unless companies and the States and Territories have their eyes set firmly on global markets and global opportunities, they surely, will struggle to succeed.[4] There is no evidence that the States and Territories have heeded this message and all seek to tout their advantages, vis-à-vis the rest. This leads to hyperbole and to unrealistic expectations by governments, investors and the broader public.

International links

From its earliest days, the ASA set about creating Memoranda of Understanding and similar instruments with numerous space agencies and selected large companies as well. Most of these instruments are best effort arrangements with no money on the table, at least in the first instance. The Agency would seem to have adopted a deliberate policy to link itself to as many other space organisations as possible. Perhaps, and this is speculation, the Agency saw these arrangements as insurance against a future government seeking to disband the Agency as occurred to the Australian Space Office in the 1990s.

Artemis

An exception, where funding is concerned, is Australia's commitment to NASA's return to Moon program, known as Artemis. In the context of a visit to Washington in 2019, which included a rare White House dinner with President Trump, Prime Minister Morrison announced that

Australia would invest $150m into the Artemis program. Why this figure was chosen has never been explained, other than in terms of helping to grow the Australian space sector. A cynic might argue that this was the price of a White House dinner, aimed more to achieve a palatable 'announceable' for political ends rather than a carefully considered contribution to Artemis.

As with other programs, including the Modern Manufacturing initiative (MMI (see below), the money has been split into penny-packeted grants that have been awarded to a number of companies and universities across Australia. Every jurisdiction gains something in the short to medium term. Whether this is the most effective way either to contribute to the objectives of the Artemis program, or to grow a resilient and self-sustaining Australian space industry remains an open question.

The modern manufacturing initiative (MMI)

Australia's manufacturing sector contracted severely when motor vehicle production ceased in 2017, although the major shut-downs occurred in the decade prior. Many component manufacturers closed; others remained open but struggled. Some companies re-invented themselves by investing in advanced manufacturing capabilities and developing export markets. Many, of these are niche and described, somewhat dismissively, as "cottage industries" by some observers because they lack scale, capital and reliable markets.

A few Australian companies have gained acceptance into the Joint Strike Fighter (JSF) program, supported by Commonwealth grants to strengthen governance and to introduce new machines and production processes that demand highly accurate and reliable work continuously. The governance, security, quality assurance, process and personnel certifications, typically, was a five-year journey before these companies could even bid for JSF work. Defence set up a specific program, the New Air Combat Capability (NACC) program, that provided funds to companies to gain acceptance into the JSF supply chains. No similar program has been established to support the nascent space industry.

Director General Joint Strike Fighter, Air Commodore Damien Keddie presents his opening address during the opening ceremony of MOOG's new facility, referred to as 'Factory Four' in Heatherton, Victoria. (Department of Defence)

The closest approach was the Modern Manufacturing Initiative (MMI) program announced by the Morrison Government in October 2020. It was a fund that proposed to spend 1.3billion dollars over four years in six identified priority areas, two of which were space and defence.[5] As with previous programs, the money was broken into small amounts that could be shared across State and Territory jurisdictions, more likely to meet immediate political needs than to construct a policy driven space industrial base that is resilient and capable of meeting well-defined national needs.

In the October 2022 budget, the Albanese Government scrapped the MMI, replacing it with a National Reconstruction Fund (NRF). The NRF does not call out space as an area for special attention as did the MMI. This implies that companies seeking support from this fund for space initiatives will need to compete against a wider field. This change point to the fact that space is less important to the Albanese Government than other policy areas about which election promises were made. Space is going to have to wait its turn.

Technology push versus user pull

Many of Australia's space start-up companies have been established by engineers who are seeking to commercialise technologies that they have developed—some in the course of post graduate studies, others through self-funded research and development. Angel investors, venture capital and institutional investors, have made some investments but a broad observation is that the market remains to be convinced about the prospects of the Australian space sector over the longer term—once the grants have ceased or been reduced and companies are fending for themselves. The challenge is not confined to Australian space companies and may be viewed as reflection of the tiny size of Australia's domestic market, especially for highly specialised and sophisticated products that need to be sold into the global market at competitive prices.

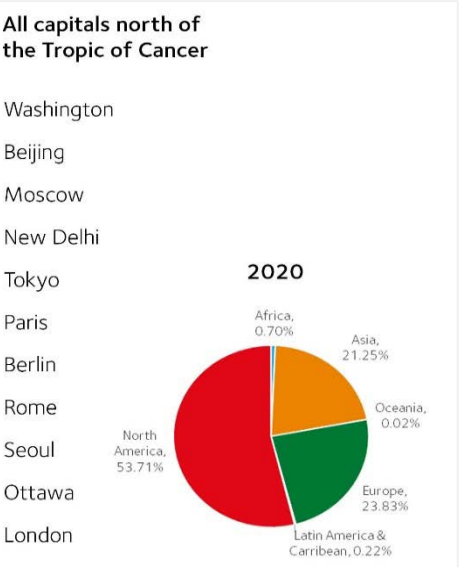
The 'dual use' nature of many space technologies means that many of them are subject to export controls which can limit the markets into which some technologies can be sold.

Space is the preserve of a VERY few nations

OECD figures published in 2013 indicate that space activities are focussed in the northern hemisphere.

Figure 1. OECD space activities

Space budget in US$ millions PPP 2013		
Nation	US$m	%
USA	39,332.2	52%
China	10,774.6	14%
Russia	8,691.6	12%
India	4,267.7	6%
Japan	3,421.8	5%
France	2,430.8	3%
Germany	1,626.6	2%
Italy	1,223.3	2%
South Korea	411.5	1%
Canada	395.9	1%
United Kingdom	338.9	<1%



Source: OECD.

A more recent (2020) study confirms these figures. Almost 99 cents in every dollar spent on space activities in any year is spent by just 11 countries the capital cities of which are all above the Tropic of Cancer. Australia spends at least one order of magnitude less on space activities than does the UK.

Numerous studies predict that the global space market will turnover more than a trillion dollars annually sometime between 2035 and 2040. This figure is frequently quoted by proponents of the Australian space sector to illustrate the size of the opportunity that exists for the nascent Australian space sector. In reality, the portion of the market that Australian companies might aspire to sell into is a fraction of this amount. If any Australian companies succeed, more likely, they will be those that look beyond the domestic market to the lucrative markets of the northern hemisphere.

Space and the Australian Government

Proponents of an Australian space industry point to overseas experience and the shift from governments being the major investors in space capabilities to private interests. In Australia, this is not yet the case and Defence is by far the largest single investor in space capabilities. Other government departments and agencies are deeply invested in data from space including Geoscience Australia, the Bureau of Meteorology and CSIRO. Other agencies, including the Australian Communications and Media Authority (ACMA), the Civil Air Safety Authority (CASA) and the Australian Space Agency itself, play important regulatory roles.

Numerous departments have input into Australia's space policies including Defence, Foreign Affairs and Trade, Home Affairs (for critical infrastructure protection), Attorney Generals, Industry and Science, Communications, Treasury, Finance and the Department of the Prime Minister and Cabinet. Only the last mentioned has the breadth of responsibility and oversight to fashion a national space policy that takes account of the many interests across government as well as in the community from which clear national priorities for investment can occur.

Defence

Defence is the largest single investor in space capabilities in Australia, however, within the portfolio there are several interests that do not always work too well in tandem. At the heart of Australia's alliance with the United States is the Joint Defence Facility Pine Gap (JDFPG). This is a ground station that supports satellites that collect intelligence across the Indo-Pacific region. Kim Beazley, a former Defence Minister and Ambassador to Washington, has written about the importance of Pine Gap to Australia in these terms:

> *"[Pine Gap is] no longer simply a price paid for broader Western interest and the broader alliance. Activity at the bases is an integral part of the Australian military and intelligence communities' order of battle. Their removal would not simply diminish US direct capabilities, they would diminish Australia's, leaving a gap Australia could not replicate technologically, let alone afford to replace."* [6]

The Australian intelligence community, therefore, would seem to be an especially important contributor to Australia's space policy because of its critical importance to the Alliance, which is a fundamental pillar in our national security architecture.

The Department of Defence established a Space Command in January 2022 and has foreshadowed that the command may morph into a separate Service, alongside the Navy, Army and RAAF perhaps by the mid-2030s. In creating the Command, Defence has acknowledged, tacitly at least, that space is now a warfighting domain—joining the maritime, land, air and cyber domains. For many years Defence has invested in satellite communications to support terrestrial military operations. The Services are also reliant on space-based systems for position, navigation, and timing (PNT) and on imagery from satellites to support operations. Space Command has the task of understanding the space domain as a theatre for military operations and of working out Australia's contribution to an inevitably highly integrated effort between Allies and other partners. The aim is to provide secure and assured access to space to all who would seek to use the domain for peaceful purposes.

From an industry development perspective, the split between Defence and civilian space activities is somewhat artificial because the companies and the workforce that support both classified and unclassified activities come from a common pool.

The Australian space workforce

Consistent with the jobs and growth mantra under which the ASA was established, numerous studies into Australia's space workforce have been undertaken. One of the more important is a 2021 Skills Gap Analysis Report conducted jointly by the SmartSAT CRC and the ASA. The report identified 319 separate skills that are needed within a self-reliant space industry workforce. Australia lacked capability, or capacity or both in all but nine of the identified skill areas. This led to the conclusion that unfilled demand for skills could compromise the development of "an industry poised for growth".[7]

A further study, the results of which have yet to be published, is seeking to aggregate the 319 skills in ways that make sense to the universities and technical education providers. They cannot provide 319 separate courses or training pathways so aggregation will be necessary. Just what might be connected to what and how and by whom such education and training will be provided is not yet clear.

NASA Kennedy Space Center Director Bob Cabana talks with members of Team 3132, called "Thunder Down Under," made up of students from Sydney, Australia, which is participating in the regional first robotics competition at the University of Central Florida in Orlando. (NASA)

Also in 2021, the Chief Scientist of Australia tasked the Australian

Academy of Science to conduct a review of the space workforce. This study concluded:

> *"To deliver 20,000 new space-related jobs by 2030, around 300 new qualified scientists and 900 engineers, as well as 800 non-STEM graduates, are required to be trained each year for a decade"*[8]

These people, in addition to those required by other sectors of the economy, are simply not going to exist, especially those needed from the STEM disciplines. The space sector is in intense competition with other parts of the economy, especially for experienced middle-level project managers and engineers. In the past, these people have been sourced through immigration, but that pipeline is closing due to global demographic shifts not assisted by decisions made by the Australian Government in the early days of the COVID-19 pandemic to close Australia's borders.

Where to from here?

The question of whether Australia needs a domestic space industry that attracts significant Government support and investment is not capable of being answered whilst authority for space policy remains dispersed. There is no champion for space inside Cabinet and no department with unambiguous executive authority. In a recent note to members, James Brown, the CEO of the Space Industry Association of Australia (SIAA) made this point directly and bluntly.

> *After 100 days of Australia's new government, it appears to many that space has fallen through the cracks in Canberra.*
>
> *There has been no substantial engagement with the space industry by any Ministerial office in Canberra, space policy is in a vacuum, and critical national space infrastructure projects totalling nearly $2.5bn are stalled on departmental desks.*[9]

A long-held view of this writer, first expressed formally in 2008, is that the only department capable of synchronising the numerous strands of space policy, which affect matters that extend from the existential to the mundane, is the Department of the Prime Minister and Cabinet. In particular, the highly classified space equities that are the long pole in Australia's alliance text with the US need to be synchronised with policies that increase Australia's STEM workforce including the provision of the wrap-around services, such as an effective and affordable childcare system, that are precursors to many more women entering or re-entering the workforce, including the space workforce.[10]

A national space policy that covers all elements of Australia's space endeavours is missing and sorely needed. From that policy would flow strategy and a discussion about the relationship between ends, ways and means that would point to the levels and types of space investments and capabilities that are appropriate to Australia's circumstances. The aim must be to contribute to Australia's social, economic and political fabric, to our security, and to our international responsibilities as well.

The space domain needs to be demystified and brought within the reach and experience of ordinary citizens. Phrases such as, "You do not need to be a rocket scientist to solve this problem," and "She has a head like a planet," lead many students to self-exclude from even aspiring to have careers in space because they do not consider themselves smart enough to work in the domain. Today, space activities, of all types—astronomy, planetary science, humans in space, satellite manufacture and launch operations, to name but a few, have become the preserve of elites far removed from the experience of most people. Somewhat paradoxically, those very same people are more dependent on assured and secure access to data and services from space than ever before. Perhaps, the time has come for these dependencies to be explained.

Two steps that could materially assist this process involve the Australian Space Agency.

The first would be to move the headquarters of the ASA to Canberra thereby providing unambiguous reinforcement to its national mandate.

The second would be to review the Agency's Charter with the aim of replacing its "jobs and growth" mandate with something more ambitious—a statement about the place that Australia seeks for itself in humanity's quest to make use of and possibly inhabit places beyond Earth. Do we seek to be involved—as colonisers, as stewards, as lawmakers, as communications providers? There are choices to be made with policy, strategy, investment and security consequences. Does Australia's geography and location on Earth offer advantages and pointers to opportunities and even to responsibilities that may not be open to others?

A third step would be to develop a compelling national space narrative that is grounded in reality and not hyperbole. In September 2022, in contested circumstances, Sydney was selected to host the International Astronautical Congress in 2025. The international audience that will attend this Congress will be looking for evidence of substantial progress in policy, strategy, investment, industry development, research and education in the Australian space sector. If this is not apparent, Australia will stand accused of having raised many expectations about its commitment to space and not to have delivered. An unintended consequence is that the reputational damage may well extend beyond the space domain.

Flight control employees witness successful space rocket launch. (Shutterstock)

Conclusion

Australia's space industry is growing, funded by a mix of government grants and private investment. The largest investor in space capabilities is Defence and it is unequivocal that its responsibility is to buy the best capabilities that it can afford for Australia's warfighters. If Australian industry happens to benefit that is a bonus; it is not a necessity.

In the October 2022 Budget, the Albanese Government delayed spending on civil andDefence space projects to make way for higher priority initiatives that were promised to the electorate ahead of the May 2022 election.

Opening ceremony of the 70th International Astronautical Congress (IAC), 21 October 2019. (NASA)

The task for the space sector, as a whole, is to present a united front to Ministers that explains why space capabilities matter to Australia, what capabilities Australia needs, based on argument and analysis and not simply assertion. Some order of priority with indicative costings and timeframes will also be important.

Using IAC2025 as an aiming point, the challenge for the space community will be to develop a compelling space narrative for the nation that makes sense to Ministers, bureaucrats, investors, businesspeople, researchers and the wider public. This is a serious challenge that will require acknowledgement of three key points:

- Australia's geography which is a compelling differentiator,
- Australia's alliance relationship with the US, which is both a critical advantage and also a constraint, and
- Australia's small workforce, which directly limits what may and may not be done.

Whilst happenstance, serendipity, opportunism and good luck continue to drive policy development and investment, Australia's space sector will remain fragile and not optimised to meet the needs of the nation.

Notes

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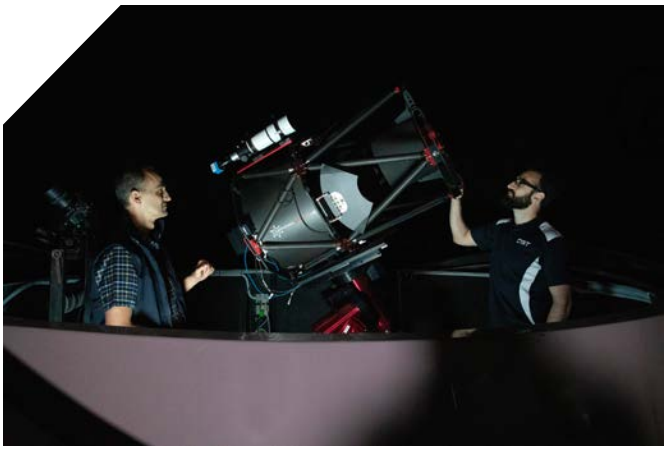
AUSTRALIA'S SECURITY AND RESILIENCE IN SPACE

7. Defending Australia and space capability—next steps and future possibilities

Dr Malcolm Davis
Australian Strategic Policy Institute

'If we lose control of space, we lose the war and we lose it quickly'. This thought paraphrases Field Marshal Bernard Law Montgomery—'Monty' of El Alamein—on his perception of the importance of airpower in the 1950s.[1] His actual statement was 'If we lose the war in the air, we lose the war and lose it quickly', reflecting the importance of gaining and maintaining control of the air, and achieving air superiority, or even air dominance, as a critical requirement for success in modern warfare.

The nature of the space domain is very different from the air, and whilst 'control of space' doesn't guarantee victory on Earth, a failure to at least deter or defeat an opponent's attempts towards space denial almost certainly guarantees a much more tenuous military advantage in terrestrial domains, with a commensurately greater risk of military defeat and strategic failure in the next war.



Senior Researchers prepare the DSTG 50cm SDA Telescope for collecting observations of satellites and debris in orbit around Earth. (Department of Defence)

In defence and national security terms, the importance of the space domain cannot be overstated. It is now *the* critical operational domain that is essential for undertaking joint and integrated military operations. The central role that space capabilities play in modern warfare means that states no longer see it just as an enabling adjunct to the traditional terrestrial domains of air, sea, and land, but as an operational domain in its own right. This has been the case with Australia's perception of space since 2020, which has led to a much more sophisticated approach to space as part of defence policy than in past years, culminating in the establishment of Defence Space Command in March 2022.[2]

Driving the increasing focus on space by Australia's defence force is a recognition that space is not a peaceful global commons. It isn't a sanctuary that sits serene and untouched by terrestrial competition and conflict below. Space has been militarized from the 1960s, and now verges on becoming a weaponized warfighting domain as some states develop a full range of counterspace capabilities to threaten essential satellites critical to supporting our defence and national security requirements, as well as our broader national activities.[3] Whilst important legal, diplomatic, and regulatory efforts are underway to constrain and ideally prevent the weaponization of space, there's no guarantee that these efforts alone will succeed in the end.

Senior Researcher and Space Control Group Coordinator Squadron Leader preparing the DSTG 50cm SDA Telescope. (Department of Defence)

For Australia, as new space actor with an old space history, there's acceptance within the defence policy community that we do not have the luxury of assuming unchallenged access to orbit, nor can we totally rely on a hope that adversaries will play by norms of responsible behavior as laid down in international fora. Hope is not a strategy. Certainly, Australia supports and participates in on-going diplomatic, legal, and regulatory efforts that are now underway such as the UN's Committee on Disarmament's efforts towards constraining and avoiding non-weaponization of space. We are playing a full and visible role in the Open-Ended Working Group towards Reducing Space Threats, established under UN General Assembly Resolution 76-231, and convened on 7th February 2022.[4] Australia fully supported the UK's tabling of UN General Assembly Resolution 75-36 on December 7th, 2020, to reduce space threats through norms, rules and principles of responsible behaviour.[5] We have recently supported the unilateral ban on destructive testing of direct-ascent ASATs.[6] These are good and sensible moves.

In parallel, the Australian Defence Force is now seeking to develop its own sovereign space capability to support its operational needs, and those of its partners and allies, in a manner that burden shares in orbit. A key goal is to strengthen deterrence against threats posed by adversary counter-space operations and assure access to space through resilient space capability. This paper will explore some aspects of how the Australian Defence Force perceives the space domain, and in particular, highlighting the role of Defence Space Command in supporting space deterrence through denial and resilience.

A new-old space power

There's an important commercial dimension in Australia's place in space, with Australia's rapidly growing commercial space sector playing an increasing role in supporting the establishment of sovereign space capabilities. The growth and diversity of this sector represents a decisive break with a past that eschewed any ambition for a meaningful role in space, and instead saw successive Australian governments limiting Australia's role to providing a 'suitable piece of real estate' for ground facilities and analyzing data from

satellites.[7] That era was best summed up by these statements in the 2013 Satellite Utilisation Policy, released by the then Department of Industry, stating:

> *'The Australian Government does not see an Australian satellite manufacturing or launch capability as an essential element of its approach to assured access to critical space-enabled services.[8] Australia's Satellite Utilisation Policy does not commit Australia to human spaceflight, domestic launch capabilities or to the exploration of other planets.[9]*

That era of passive dependency on others, and a complete absence of sovereign capability, during which Australia's sole contribution was a suitable piece of real estate for ground facilities and the processing of data from foreign satellites, has thankfully passed. So how did we get from there to here, where Australia is a vibrant and growing participant and provider of space capabilities, and on the cusp of being able to launch Australian satellites on Australian launch vehicles from Australian launch sites? A far cry from the limited vision of the Satellite Utilisation policy!

The establishment of the Australian Space Agency in 2018 following a review in 2017 of Australia's commercial space sector by the then Turnbull Coalition government, and the announcement of the Agency at the 2017 International Astronautical Congress (IAC) in Adelaide, South Australia, marked a key turning point in establishing Australia's future in space.[10] The release of the Australian Space Agency's Civil Space Strategy—'Advancing Space—Australian Civil Space Strategy 2019-2028' highlighted the agency's key role to stimulate the growth of Australia's commercial space sector, supporting regulatory development and leading international space collaboration, amongst other key tasks.[11] Rather than embrace with a traditional role of dependency on other states for provision of space capabilities, including satellites in orbit, the decision by government to prioritise growth of a commercial space sector means that there is now the opportunity for establishing greater sovereignty in the space segment—also known as 'upstream.' Australia's space efforts across commercial, civil and defence sectors, are embracing an ambitious and comprehensive approach to developing a full range of sovereign space capability, though there is no move towards complete autarky. In a key shift, there is broad support for the establishment of sovereign space launch as a major element of Australia's space activities.[12] This marks a fundamental shift in mindset, from passive dependency on others as a consumer of space, to an active provider of space capabilities for national purposes and to support key allies and partners. It represents a key shift in thinking that suggests a more mature and ambitious approach for Australia as a new space power. It was only logical therefore that these developments in the commercial and civil space fields would be followed by progress towards a more ambitious approach to the space domain for defence and national security purposes. The establishment of Defence Space Command in March 2022, and the release of the Defence Space Strategy and the Space Power Manual, reinforces that perspective that Australia is no longer content to simply be a passive consumer of space, or to rely on others for its security in space.

This shift is now being reflected within defence and national security circles at the governmental level, in the broader strategic policy community, and finally within defence industry. Our reliance on assured access to, and resilience within, the operational space domain is only going to sharpen, whilst the importance of working with allies in that domain will deepen. Potential adversaries aren't going to end their own reliance on space or cease

development of increasingly threatening counterspace capabilities. At the same time, the transformation brought about by the commercial space sector that is generating falling cost to access and utilise space, means that Australia has both the opportunity and incentive to be an active provider of space capabilities, with commercial space companies allowing defence and national security actors to take advantage of lower cost space technologies and enhancing assured access. The ADF is headed to orbit, and this raises intriguing possibilities for the types of capabilities, the evolution of defence space strategy, and future organizational transformation.

Australia's approach to defence and space

The 2022 Defence Space Strategy is the central basis of Australia's approach to space for defence and national security, released shortly after the establishment of Defence Space Command. At the heart of the Strategy is assuring access to space for both civil agencies and for the ADF, as well as to support key allies, international partners, and to leverage industry to facilitate capability solutions for providing space support to the ADF. The strategy is one component of a 'whole of government' and indeed a 'whole of nation' approach to space, which is now being formulated under the National Space Policy, that hopefully will be released sometime in 2023.

The Defence Space Strategy is focused around five lines of effort ('LOEs'). Of key importance is **'**LOE1' which is focused on assuring joint force access to space that is a congested, contested, and competitive domain. It states that 'Assurance of access to space capabilities in a congested, contested and competitive space environment cannot be achieved unless Defence develops a space architecture that is focused on capabilities that are resilient, can be reconstituted if compromised and defended if under attack.'[13]

Australia's AUSSAT satellite deployed from the Space Shuttle payload bay. (NASA)

Such an objective cannot be met without greater investment in sovereign space capabilities for small satellite development and manufacturing as well as sovereign space launch. Simply put, Australia cannot enjoy assured access or an ability to reconstitute by continued dependency on others to provide critical capabilities. The Defence Space Strategy acknowledges the importance of commercial space, or 'newSpace' in providing solutions based around small satellite technologies, and states that '…defence anticipates it will need access to a responsive and assured space launch capability in the future.'[14]

It also covers other important roles related to assured access and resilience, such as space domain awareness (SDA), real time satellite communications and enhanced positioning, navigation, and timing (PNT)

services to facilitate not only precise navigation and targeting, but essential timing services to support networked command and control.

A NASA Black Brant IX suborbital sounding rocket was successfully launched on July 11, 2022, from the Arnhem Space Center (ASC) in the Northern Territory of Australia. (NASA)

The key challenges facing Defence in space in this decade and beyond is the 'contested' and 'congested' elements of the space domain. Defence cannot ignore growing counterspace threats including soft kill (co-orbital and ground based) and hard kill (co-orbital and direct ascent) being developed by adversaries, and the risk posed by adversary grey zone actions in space.[15] The latter is becoming particularly concerning, given the potential use of dual-role satellites undertaking rendezvous and proximity operations, potentially for development of on-orbit repair and refuel capabilities, or debris mitigation, but equally for intelligence gathering, and potentially co-orbital counterspace applications, as highlighted in a recent CSIS report that examined grey zone challenges in orbit.[16] In this regard, the development of sovereign space access including, specifically, sovereign launch and sovereign satellite development, is important. Rather than remaining dependent on foreign actors and commercial companies to provide upstream capability, sovereign development, and manufacture of satellites, as well as sovereign launch, opens up the potential for Australia to undertake augmentation of space capabilities, and rapid reconstitution of space support in a crisis. This is particularly the case in relation to small satellite technologies that can be developed through the commercial space sector and launched from Australian launch sites on Australian launch vehicles, to augment and reconstitute space support as operational needs demand.

There are clear advantages of embracing the 'small, the cheap and the many' in relation to deterrence in space against counterspace threats. Local production allows rapid replacement and updating of satellite capabilities, whilst sustaining growth of Australia's commercial space sector. That generates current experience and proven capability that makes Australian commercial space competitive internationally, generating growth and prosperity in the sector. Such a capability also strengthens deterrence through denial and resilience by making the use of adversary counterspace capabilities less effective. It becomes harder for an adversary to launch a decisive single counter-space blow—a 'Pearl Harbour in space' if their opponent's space capabilities are spread across a larger number of satellites and can be rapidly reconstituted.[17]

That deterrence by denial and resilience in turn reinforces the opportunity for further progress in legal and diplomatic means whereby norms of responsible behaviour leading

potentially to arms control and confidence and security building measures in space. If aggression in space can be shown to be ineffective or counterproductive, there's more likely to be mutual agreement to limit counterspace capabilities and respect norms of responsible behaviour in a manner that builds stability.

In terms of congested space, Australia is directly supporting allied efforts to monitor the threat of space debris, as well as to ensure attribution of dangerous activities in space and reducing the risk of grey zone attacks in space through preventing an opponent from exploiting anonymity.

Of key importance in fulfilling LOE1 is developing space architectures that are resilient, both in terms of 'upstream' capabilities—i.e., the 'satellites and sovereign launch—and the 'downstream' elements of survivable ground segments and user segments. Australia is well placed to fully make use of its rapidly growing commercial space sector, including small to medium enterprise 'space startups' that could offer small satellite development for the ADF, and the emerging sovereign space launch sector both in terms of launch vehicles and launch services (i.e., launch sites). It's not just about providing responsive and resilient space capabilities to the ADF, and more broadly, national Australian requirements. Australia can 'burden share in orbit' with key allies and partners through the five-eyes ('CSpO') and potentially through technology development via agreements such as AUKUS and even the Quad.[18]

The commercial sector must play a key role in this regard. Australia's entire space enterprise is a 'Space 2.0' focused one—*not* an old-fashioned government run, taxpayer funded space program akin to a NASA or an ESA. There is a strong incentive to take this approach, given the key importance of jobs growth and increasing the contribution of the space sector to national GDP overall. There is a declared goal repeated by the Australian Space Agency, of 'tripling the sector's contribution to GDP to AUD$12 billion and creating an additional 20,000 jobs by 2030' that continues to shape Australia's approach to space.[19] Certainly the Australian Space Agency, together with the Department of Defence, need to provide high level policy guidance that shapes strategy and capability development in a coherent National Space Policy, and it must be Australia's commercial sector that provides the capability, in collaboration with key allies, but also independently when and where appropriate.

The Defence Space Strategy recognizes this important dynamic of 'newSpace' and nominates options such as small satellites that boost space resilience via mega constellations, and which take full advantage of rapid innovation cycle through regular launch and refresh of space capabilities. It nominates a balanced approach—both large, complex satellites, such as what are envisioned under Joint Project 9102 (at least initially) together with small satellites that could be locally developed. The integration of commercial space within Australia to support Defence requirements opens the prospect of a mature Australian space capability—that is, Australian developed and built satellites being launched on Australian sovereign launch vehicles from Australian launch sites in a responsive manner. This should be the goal, going forward, to maximize benefit to Australia's growing space sector, and to sustain the growth and profitability of that sector.

Space control

Australia is moving forward with several key projects for advanced satellite communications with a decision on down select likely in coming months. These include JP-9102 for advanced satellite communications, DEF-799 Phase 2 for sovereign space based ISR, and JP-9360 for enhanced space domain awareness. [20] As highlighted in both the 2022 Defence Space Strategy and Defence's 2020 Force Structure Plan, Space Domain Awareness is becoming vital both in terms of avoiding threats due to growing space debris, but also to monitor potentially hostile space activities by adversaries.[21] But merely watching a counterspace attack occur isn't likely to be sufficient in terms of a response. Certainly, there may be time for satellites to be moved out of harm's way, but the issue of Space Control is yet to be clearly explained. The 2022 Defence Space Strategy states that:

> *"Defence will continue to identify Space Control gaps and opportunities to develop a credible Space Control capability and space capability developments will actively seek to improve the resilience of space capabilities. Defence will explore options consistent with its commitment to be a responsible actor in space, in close consultation with DFAT."*[22]

Personnel from the Australian Army and civilian equivilients participate in a Space Domain Exercise at the Australian Space Discovery Centre in Adelaide. (Department of Defence)

Like the 2020 Defence Strategic Update, the 2022 Defence Space Strategy doesn't give much hint as to what the ADF is envisioning with 'Space Control'. Certainly, it's clear that Australia won't be acquiring kinetic kill ASATs, but DEF 9358, which covers Space Electronic Warfare, may give some indication at where we may head in terms of non-kinetic defensive capabilities to defeat an adversary use of offensive ASATs, perhaps through hardening of existing satellites, electronic support, and electronic protection measures to defend our own satellites against soft kill threats.[23] Space Control is further examined in LOE 2, which considers Space Control within the context of deterrence, suggesting that Defence will "evolve its doctrine, command and control procedures, and tactics, techniques and procedures' to address Space Control as an integrated component of joint warfighting."[24] It notes that Space Control will be seen as part of a Whole of Government deterrence approach that includes diplomatic, information, military and economic measures.

Looking forward

We're just embarking on what is likely to be a new golden age of space exploration and commercial space activity, that will transform our approach to space. Consider two contrasting eras—the Apollo/Shuttle era, now continued by NASA's Space Launch System—versus the future, epitomized by reusable launch vehicles such as SpaceX Falcon and the soon to fly SpaceX Starship Super Heavy that open up very low cost per kilograms of payload to orbit in comparison to traditional expendable launch vehicles.[25] Go deeper, and consider how commercial space actors

are poised to undertake new types of space activity by growing a complex space domain that extends from LEO to Cislunar Space, with everything from space manufacturing on orbit, space resource utilisation, and on-orbit refueling and repair, through to the potential for space-based solar power on the horizon.[26] Satellite mega-constellations that offer everything from broadband in the sky and the 'internet of things' through to pervasive real time earth observation, will open up the prospect for radical new types of societal change, in how we function on earth, and how economies will be transformed through tapping a space-based economy that will see space-based manufacturing using space resources as feedstock. Suggestions of the global space economy, mainly based around commercial space, reaching a value of US$1 Trillion by 2040 are a galvanizing factor in shaping thinking about space and demand that Australia be an active participant and provider of space capabilities—not a passive consumer as has been the case in the past.[27] Returning to passive dependency, by walking away from supporting sovereign space capability, would see a key sector of the economy collapse just as it begins to grow, with companies closing or relocating overseas, and jobs growth fall apart. Australia's ability to compete in a rapidly growing global commercial space industry would collapse as would confidence in our ability to be a credible partner for other space actors across the globe. At the same time the benefits of Australian sovereign space development are set in stark relief to the risks generated by competitive and complex dynamics within a contested, congested, competitive and complex space domain. Australia's increasing reliance on space for national prosperity is only set to grow, and thus the demand to protect this vital domain will grow as well.

The 2022 Defence Space Strategy needs to begin a process of debate and discussion that ultimately supports the drafting of a national space policy, and which must be reflected in the soon to be released Defence Strategic Review.[28] The national space policy, development of which is underway within the Australian Space Agency, and shaping Defence's approach to space within Defence Space Command after the release of the Defence Strategic Review, should embrace a future that is fast approaching. Remaining stuck on 'old space' mindsets and being risk averse about embracing new technologies and new missions for the ADF in space is a strategy for failure.

Defence Space Command needs to 'boldly go' into a future space domain that will be contested, congested, competitive and complex, and explore new paths beyond simply satellite acquisition projects. How can the ADF contribute towards defeating emerging threat technologies, such as hypersonic weapons, electromagnetic operations, cyber threats and swarming lethal autonomous weapons? How might it facilitate the establishment of an ADF A2AD capability to better defend Australia against long-range threats posed from regional adversaries?[29] How can it directly ensure space resilience through distributed networks of small satellites that can be directly supported and reconstituted from Australia, by Australia when needed? What is the next step for Australia in space—including, whether Australia needs to further develop the Defence Space Command through new organizational approaches. Might that take Australia one day to establish a Royal Australian Space Force and what benefits might such a new defence organisation bring? The Defence Space Strategy's other Lines of Effort provide some clues in terms of how the organisation may evolve, including how its relationship across a whole of government and whole of nation context may emerge; the development of space power thought and doctrine; and the chance to establish a cadre of space power professionals within Defence as part of a future workforce plan. These steps must occur through close cooperation with the Australian Space Agency, Australia's commercial space sector, and with key allies and partners. There are some interesting possibilities that I think need to be debated in coming years. The future is beginning and that's an exciting time for Australia's space community.

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8. Space and AUKUS: What is the relevance and impact of Australia's participation in AUKUS in the space domain?

Professor Melissa de Zwart
Flinders University

The announcement of the Australia-United Kingdom-United States ('AUKUS') Partnership on 15 September 2021 came as a surprise to most people, even close watchers of defence developments in the three states involved. Details provided at the time of the announcement were scant and focused predominantly on the controversial decision for Australia to discontinue its existing submarine program with the French Naval group in favour of building nuclear-powered submarines with the assistance of US and UK. Media coverage overlooked the broader benefits of the partnership to focus on the fallout of the consequential rift between Australia and France and the question of how Australia could rapidly develop the requisite expertise in nuclear power.[1]

Australian Deputy Prime Minister and Minister for Defence, the Hon. Richard Marles MP, met with his AUKUS counterparts for a trilateral meeting in Washington on 7 December 2022. (Department of Defence)

AUKUS is described by the Department of Defence as 'an enhanced trilateral security partnership between Australia, the United Kingdom and the United States [which] is based on our enduring ideals and a shared commitment of our three countries to a stable, secure and prosperous Indo-Pacific region.'[2] The announcement foreshadowed cooperation on submarines and 'advanced military capabilities'. The specific technologies identified as advanced capabilities are quantum, cyber, Artificial Intelligence, autonomous undersea capabilities, hypersonic and counter hypersonic capabilities and electronic warfare.[3] The question addressed in this paper is, in the context of this formal effort to address advanced capabilities, where does co-operation between the AUKUS partners with respect to space technology feature, if at all? Is there a benefit to be gained by including space in AUKUS and if so, is there still an opportunity for space to be included as an area of strength and focus for AUKUS cooperation? The answers to these questions further raise the ongoing issue of how Australia regards itself and how its allies

regard it as a 'space power'. Consequently, it is also questioned whether Australia is still living under the shadow of ELDO and the role played by Australia in various activities undertaken at Woomera supporting the efforts of the UK and US with respect to space and related technology?[4]

Is there space for space in AUKUS?

Malcolm Davis and others have argued for the specific inclusion of space technology within the ambit of AUKUS, emphasising both civilian and defence reliance upon space, and the need for co-operation of both commercial and military operators in the vital area of space domain awareness.[5] As the space domain becomes more congested and more vulnerable to hostile activity, co-operation, information and joint capability will become vital to resilience.[6] Australia already plays an essential role in space surveillance with facilities such as the joint US-Australia space surveillance telescope at Exmouth in Western Australia, as well as commercial operators, including Leo Labs and Sabre Astronautics, each of whom operate from both US and Australia.

The addition of space to the AUKUS list of advanced capabilities would offer some clear opportunities to Australia to learn from best practices in the US and UK. Such opportunities were at the heart of the ELDO project and other activities undertaken at Woomera from the 1950s onwards. It may be said that Australia did not capitalise fully upon these engagement activities and subsequently lost much of the expertise that was gained. However, it is clear engagement with allies created the opportunity for Australia to send its first homegrown satellite into orbit, on an unwanted US Redstone rocket.[7] Hopefully lessons learned from this history may prevent a similar experience for current Australian space activities. Engagement through the AUKUS framework may provide Australian space start-ups with the opportunity to access US and UK markets, creating greater viability for their business, without needing to move states. Unlike earlier partnerships, underpinning AUKUS is a shared understanding of the greater need for knowledge sharing in the context of technological competition with other states, hence it features an emphasis both on technology transfer and the need for engagement with commercial operators.

Much space technology is inherently dual-use, meaning the expansion of markets offers multiple benefits. While AUKUS is a defence-focused partnership, it is important to keep in mind that defence and civilian uses of space are closely related and that in many cases, both services may be supplied by a commercial provider. Certainly, the Russian invasion of Ukraine has provided renewed focus on the strategic and civilian importance of the space domain. The provision of internet connectivity by SpaceX for both military and civilian use in Ukraine has highlighted the vital role played by commercial space operators in facilitating communication.[8] In May 2022, US LeoLabs announced a multimillion-dollar contract with the Japan Air Self Defense Force to provide space domain awareness data, services and training. It already provides LEO collision analysis to the US Department of Defense as well as a number of commercial satellite operators.[9] These experiences suggest expanding opportunities for innovative space startups.

Could AUKUS remove impediments to space co-operation?

In addition to the specific articulated technological areas, 'innovation' and 'information sharing' are included in the list of capabilities. Innovation relates to the acceleration of defence innovation enterprises 'including ways to more rapidly integrate commercial technologies to solve warfighting needs'. Information sharing requires expansion and acceleration of 'sharing of sensitive information' and enabling workstreams to facilitate work on agreed areas of advanced capabilities.[10] The highly classified nature of space technology has long been recognised in the US as an impediment to advances in space. Military leaders have stated for several years that the level of secrecy attached to both the nature and level of space threats and US space capabilities 'make it extraordinarily hard to share technology and requirements with industry and friendly national governments'.[11]

NASA employees build a sounding rocket range in Nhulunbuy, NT with the additional efforts from local contractors. (NASA)

The problem of over-classification of space threats and space technology has been called out by high-ranking members of the US intelligence and national security community. Over-classification operates both as a barrier to partnering on space technology with allies and serving as a deterrent to hostile space actors. Despite some changes, such as the direction in 2018 by General John Hyten, then Commander, US Strategic Command, for the expansion of sharing of Space Situational Awareness by USSTRATCOM, [12] concerns persist regarding the impediments created by over-classification.[13] In a speech to the National Security Space Association in 2021 General Hyten again stated: 'In space, we over-classify everything' observing that this operates as an impediment to deterrence: 'Deterrence does not happen in the classified world. Deterrence does not happen in the black; deterrence happens in the white.'[14] Despite this, the US Department of Defense 2022 Strategic Space Review will not be released in an unclassified version, even though one of the issues addressed by the Review was the level of secrecy surrounding space technology.

Issues regarding the sharing of sensitive and classified information would certainly need to be addressed if space was to be explicitly included within the AUKUS work program. As noted above, space is inherently a dual-use domain and much defence related work is being undertaken by commercial space companies. Therefore, including space in AUKUS will involve commercial service providers who will need access to classified technologies and information.

Current arrangements for shared space-related activities, even outside of the defence context, remain complicated by a stringent set of security protocols. For example, the 2022 launch of three sounding rockets by NASA from Equatorial Launch Australia's Northern Territory launch site, the first NASA launch from a commercial provider outside of the US, necessitated strict adherence to contractual obligations regarding secrecy and materials handling. NASA operated a 'clean range policy' with respect to the ELA site, meaning everything related to the launch, including all spent motor cases and payloads, was recovered or removed from the site and returned to the US. If more regular launches are to occur from

Australia, a number of other export, arms and technology control regimes (identified bellow) will need to be addressed.

Work is already well underway on the Australia-US Technology Safeguard Agreement (TSA), with an expectation that negotiations will be concluded in 2023. A TSA is required by the US to be in place prior to export of specific technologies governed by the Missile Technology Control Regime (MTCR) and related US non-proliferation policies and US export control laws and regulations. The TSA will prescribe the specific restrictions and procedures that must be applied to US launch vehicles and related data, processes and equipment.[15] The US already has a TSA in place with New Zealand and the UK.

Another impediment to open information and technology sharing is the International Trade and Arms Regulations (ITAR), which regulate the manufacture, sale and distribution of defence-related items and services that appear on the United States Munitions List (USML). The USML includes space-related technology due to its connection to missile technology. Calls have been made in the context of the increasingly complex security environment of the Indo-Pacific region, noting the close relationship of the US and Australia and specifically the existence of AUKUS, that the ITAR system, 'the most significant obstacle to win this strategic competition' should be revised and updated with respect to Australia, as it is operating as a serious impediment to important strategic cooperation.[16] Chair of the Australian Parliamentary Joint Committee on Intelligence and Security, Peter Khalil, has confirmed that AUKUS partners are 'working cooperatively to address gaps and barriers… in order to ensure that trilateral technology transfer can occur smoothly.' Specifically, this includes work on simplifying ITAR and other export control regulations.[17]

Again, AUKUS opens the door for more focused discussions on removing some of these procedural impediments to a closer engagement between the US and Australia with respect to space technology.

Where does AUKUS fit with other space-focused relationships?

AUKUS is not the only security focused partnership of which Australia is a member. How then does it fit within some of the other space-related relationships that affect our activities in the space domain?

Quad: The Quad is a diplomatic partnership between Australia, India, Japan and the United States, focused on the security of the Indo-Pacific Region. Space has been explicitly included in its past and future areas of cooperation.[18] It has been observed that the Quad offers Australia a relationship which is less overtly 'China-focused' providing for co-operation amongst a group with a greater diversity of views.[19] Notably, each of the Quad members has unique space capability.

Artemis Accords: The Artemis Accords articulate a 'shared vision for principles, grounded in the Outer Space Treaty of 1967, to create a safe and transparent environment which facilitates exploration, science, and commercial activities for all of humanity to enjoy'.[20] As at February 2023 there are 23 signatories to the Accords: Australia, Bahrain, Brazil, Canada, Columbia, France, Israel, Italy, Japan, the Republic of Korea, Luxembourg, Mexico, New

Zealand, Nigeria, Poland, Romania, Rwanda, Saudi Arabia, Singapore, Ukraine, United Arab Emirates, United Kingdom and United States. The Accords are concluded between the space agencies of the participating states and are focused on commercial rather than military cooperation. However, they do focus on the development of interoperable standards and equipment and represent a move to shape international norms regarding use of outer space.

Combined Space Operations (CSpO): The stated mission of CSpO, a strategic initiative between the Five Eyes (US, UK, Australia, Canada, New Zealand), France and Germany is to 'Generate and improve cooperation, coordination, and interoperability opportunities to sustain freedom of action in space, optimise resources, enhance mission assurance and resilience, and prevent conflict.'[21] Included in the CSpO lines of effort are plans for the development and operation of 'resilient, interoperable architectures to enable space mission assurance and unity of effort, through identification of gaps and collaborative opportunities'; 'combined and synchronised operations'; collaboration on 'strategic communication efforts' and sharing of 'intelligence and information to create a common understanding and support unity of effort'.

JAUKUS?: Japan has remained positive about the formation of AUKUS, and the opportunity now appears to be looming for Japan to join the partnership. The AUKUS Leader's Level Statement of April 2022 clearly leaves the door open for engagement with other state partners, although it is unclear if this was intended to include new members within the core partnership or to add partners by other bilateral or multilateral means: 'As our work progresses on these and other critical defence and security capabilities, we will seek opportunities to engage allies and close partners.'[22] However, the potential for Japan to become an AUKUS participant seems to be getting closer to reality. In a speech in Japan, Australian Defence Minister Richard Marles stated that he was intent on 'growing defence industry integration with Japan: bilaterally, through our trilateral mechanisms with the United States, and, when ready, via our advanced capabilities work in AUKUS as well.'[23] He noted that whilst Australia and Japan were already strengthening their defence connections, all three AUKUS member states were keen to involve Japan in AUKUS once there had been some progress on AUKUS outcomes: 'when it's delivering, I absolutely think there's a chance to involve Japan in the work we're doing and I think that view is shared by both the UK and the US.'[24]

Prime Minister of Japan, Kishida Fumio met with Australian Deputy Prime Minister and Minister for Defence, the Hon. Richard Marles MP and Foreign Affairs Minister Penny Wong in Tokyo on 9 December 2022. (Department of Defence)

The benefit of each of these overlapping partnerships is to build a flexible network which has broad consensus on regional and international security, premised on an understanding of the global rules-based order and the importance of international cooperation. These networks are also fundamental in developing responsible norms of behaviour, including with respect to space.[25]

Given the global nature of its effects, the space security environment requires multilateral action. The UK led initiative to bypass the deadlock in the Committee for Disarmament on the Prevention of an Arms Race in Outer Space (PAROS) on the development of norms for responsible behaviours in outer space, through UN General Assembly Resolution 75/36, is supported by all three AUKUS partners. UK, US and Australia are all actively involved in the ongoing work of the UN Open-Ended Working Group on Reducing Space Threats and each state has declared a moratorium on conduct of debris-producing direct-ascent anti-satellite tests. The inclusion of space technology in AUKUS would provide another avenue for the partners to actively collaborate and demonstrate the behaviours necessary to develop new international norms of responsible behaviour and to demonstrate the implementation of these behaviours in daily activities. As with the implementation of the Artemis Accords, the demonstration of activity and associated rhetoric influences the interpretation of existing international space law and may lead, through persistent state practice, to the development of new customary international law.

Where to from here?

Clearly this paper advocates for the position that there would be much to be gained from the inclusion of space as advanced capability under AUKUS. If nothing else, it may act as an incentive for further investment in the developing Australian space economy. It may also ease the way for more efficient processes to be developed around compliance with applicable export controls.

However, it may be worth considering the associated burden that inclusion of space within the AUKUS program may bring to states from where the capability is being acquired. This may be especially the case where resources, including personnel, are limited in areas of growth and novelty. Concerns have already been raised by nations leading in particular technological areas concerning how obligations imposed by meeting partnership expectations may create delays with their own domestic production timetables. For example, the possibility that Australia's first nuclear submarines may need to be constructed in the US has been flagged as potentially detrimental to the US's own needs for submarine construction and maintenance, in an environment of increasing resource scarcity.[26]

It is already clear from some of Australia's current space activities, led by an entrepreneurial space startup sector, that space-related technological advances may be quicker and potentially easier wins for AUKUS than nuclear submarines, if space was to be included in the enumerated 'advanced capabilities'. Therefore, there is both a symbolic and a pragmatic benefit to including space in this list. Further, the deteriorating security environment brings focus on need for capability sharing amongst allies, whilst not losing sight of the importance of sovereign capability, for example, through the development of sovereign launch capabilities.

A Report by the USSC in July 2022 made several recommendations regarding strengthening Australia's high-tech ecosystem in support of AUKUS and Australia's own sovereign capability. These included the need for Australia to '[s]hare lessons learned and best practices on models of defence innovation with the United States and the United Kingdom, including to support higher rates of commercialisation' and to '[s]trengthen government, research, and industry collaboration through the establishment of secure high-tech research precincts for each

AUKUS advanced capability stream.'[27] A proposal for an 'AUKUS visa' to facilitate ease of transfer of highly skilled workers across multi-country research and training programs has however met with concerns about facilitating an ongoing 'brain drain' from Australia of high-tech workers.[28]

It is clear that laws, regulations and procurement processes are all vital in leveraging up success for the Australian space economy. Participation in AUKUS may rachet up the need to clarify funding support for and possibly even justify the need for establishing the Australian Space Agency as a statutory authority.[29] As noted by the UK Space Power Doctrine, achieving sovereign capability will require a whole of government approach. That Doctrine observes:

> *[a] thriving commercial space sector is valuable to Defence both for developing innovative projects that offer the potential of delivering decisive military advantage but also to reduce the costs and increase the capacity and availability of existing systems. The growth of commercial and dual-use capabilities provide options to military planners; increasingly, choices can be made as to which capabilities need to be owned on a sovereign basis, which can be obtained by collaboration with allies, and which can be accessed from commercial sources.*[30]

It is vital that Australia moves away from any suggestion that space is not important as a domain for Australian defence and commerce. Australia must also overcome any lingering lack of confidence in our capability as a space power. AUKUS provides a unique focus on the importance of technology for security advantage and a dedicated pathway which should be developed to remove existing impediments to further implementation of joint improvements in space security and safety.

Technicians work at Wallops on the Dual-channel Extreme Ultraviolet Continuum Experiment, or DEUCE, payload before it ships to Australia. (NASA)

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GRIFFITH ASIA INSTITUTE

Grifith University Nathan campus
Nathan Queensland 4111, Australia

Email: gai@griffith.edu.au

griffith.edu.au/asia-institute

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