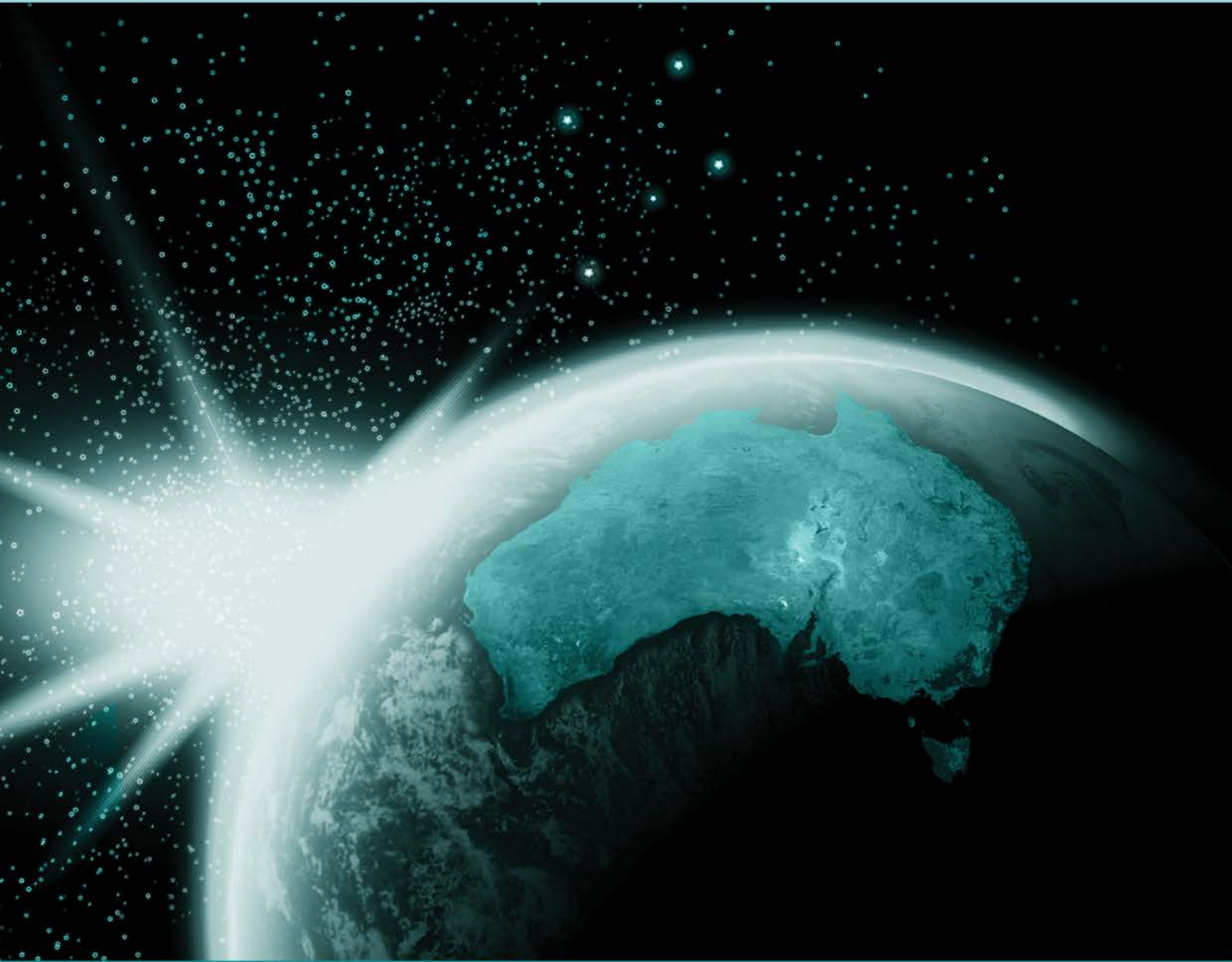




Australian Government



Review of Australia's Space Industry Capability

Issues paper - August 2017

industry.gov.au/industry/industrysectors/space

This paper has been prepared by the Expert Reference Group (ERG) for the Review of Australia's Space Industry Capability.

Chair's foreword

The Australian Government has called for a review of Australia's Space Industry Capability that will lead to a national strategy to grow the nation's space industry. This strategy will reflect Australia's national interests and align with whole-of-government priorities such as defence, critical infrastructure and cybersecurity. Australians are reliant upon space-related technology for everyday life from the daily weather report to managing our major infrastructure assets to tracking a bike ride or a walk. Space-related products and services are utilised in virtually every sector of the Australian economy, and the associated technology supports areas closely aligned with our national interest.

This review is timely. The global space sector is rapidly changing due to the capabilities of small satellites, faster development and deployment of satellites and the increasing value of data from space. In the last 40 years the sector has shifted from governments providing over 80 per cent of the revenue in 1973, to commercial industry, in 2015, generating three-quarters of the revenue for the sector, mostly driven by global telecommunications. Not only have new entrants arisen from the private sector but more countries are looking to operate their own space hardware. Revenue from space-related activities globally grew at a compound annual growth rate of 9.52 per cent from 1998 to 2015.

Australia can build on its position in the sector. Australia's technical expertise, geographical location and close alliances with space-faring countries provide a sound basis to develop our space industry capability. For example, we were one of the first countries to use satellite telecommunications; we have a proud history of managing one of NASA's ground stations; exciting Australian space companies are emerging and our universities have strong research capabilities including instrumentation fabrication and testing facilities.

However, Australia risks being left behind in this fast-moving area. The current Australian space industry sector represents approximately 0.8 per cent of the global space economy compared to Australia's 1.8 per cent share of the overall world economy. It is widely recognised that Australia now needs to create an overall vision for the sector with government working in partnership with industry to support Australia's space industry to capitalise on areas of comparative advantage.

Currently Australia benefits greatly from space systems and space-derived data from other countries. This reliance provides both risks and opportunities and will be investigated as part of this review.

The views across the country from industry, government and society will be integral to this review. I look forward to working alongside my colleagues in the Expert Reference Group to hear and understand these views to inform our strategy and recommendations to the Minister.



Dr Megan Clark AC
Chair of the Expert Reference Group

Rationale for the review

The Australian Government wants to ensure that Australia can capitalise on its areas of comparative strength in its space industry, to develop a strong and globally competitive domestic sector that is able to participate effectively in the global market.

There is a high degree of consistency in the views of stakeholders about the challenges facing Australia's space industry sector. These include concerns about the lack of:

- an overall vision for the sector
- a coherent framework to support the sector
- linkages between government departments/agencies that have responsibilities for the space sector.

The Review of Australia's Space Industry Capability will result in a better understanding of what Australia's space industry strengths are and how we can build on, and where appropriate augment these to support the development of a competitive Australian space industry. It will provide a policy framework for the space sector that will support business investment, encourage innovation and enhance competitiveness. It will also demonstrate the linkages with related areas of priority including defence.

The review takes account of the existing policies for the space sector and also builds on the findings from the review of the *Space Activities Act 1998*. Reform of the space legislation is underway separately to reflect advances in technologies and provide a regulatory environment that is appropriately conducive to commercial investment in the space sector.

Terms of Reference for the review are at Attachment A.

Defining the sector

The space industry¹ can be defined by two separate streams - upstream (the provision of technology) and downstream (the exploitation of technology). The upstream and downstream industries can be broadly categorised as the following:

- space systems (designing, building, manufacturing, operating components and systems that are based in space)
- launch activities and support services (designing, building, manufacturing, operating equipment and services related to the launch of satellites into space)
- ground systems (designing, building, manufacturing, operating ground systems)
- space enabled services and applications (designing, building, manufacturing, operating equipment and services related applications that require the data or services from space based systems or components)

¹ While the space industry is considered independently for the purposes of definition, it is important to note that activity that is considered part of the space industry has significant cross-over with other sectors.

- space activity support services (provision of professional services to support space-based activities)
- space-related research and development (space-related research)
- space education and training (education aimed at furthering knowledge about space science, or developing skills to undertake a career in space-related activities)
- space-related associations, media and public information activities (disseminating information, providing networking opportunities, and promoting space-related endeavours).

Globally, revenue from space-related activities in 2015 was US\$323 billion², growing at a compound annual growth rate of 9.52 per cent from 1998 to 2015. This is more than three times the annual growth rate of world GDP, which was 2.87 per cent for the same period. The global space economy revenue included:

- 39 per cent from commercial space products and services (US\$126.33 billion)
- 37 per cent from commercial infrastructure and support industries (US\$120.09 billion)
- 13 per cent from the US government (US\$44.57 billion—US\$23.57 billion for national security and US\$21.00 billion for civil space)
- 10 per cent from non-US government space budgets.³

While revenue from government is still important in space-based activities, presently most of the industry revenue goes to commercial interests. This was unlike 40 years ago, when the government had an important role in building the industry. In 1973, the government contribution to global space revenue was around 80 per cent and commercial industry accounted for the remaining 20 per cent. In 2015, commercial space revenue was 76 per cent of the global space revenue and the remaining 24 per cent was from government contribution (with 11 per cent of total space revenue was attributed to defence). Commercial space activities made up more than three-quarters (76 per cent) of the space industry markets, mostly driven by global telecommunications.⁴

Drivers of change in the international space industry sector

- Use and capabilities of small satellites, driven through miniaturisation and a movement towards more agile development and deployment of satellites.
- The digital revolution increasing the utilisation (and value) of space-derived information and data.
- New entrants to the space sector, both in the form of the private sector and from more countries desiring to operate their own space-hardware.

² The Space Report 2016 – The Authoritative Guide to Global Space Activity, SpaceFoundation.org

³ The Space Report 2016 – The Authoritative Guide to Global Space Activity, SpaceFoundation.org

⁴ The Space Report 2016 – The Authoritative Guide to Global Space Activity, SpaceFoundation.org

The economic output of the Australian space industry is estimated to be in the range of \$3–4 billion, with export revenue constituting roughly eight per cent of this figure. Employment in the sector is estimated to be between 9500–11 500 fulltime equivalent staff, with the workforce being characterised as highly technical.⁵

Australia is reliant upon space-related technology for a wide variety of activities that contribute to the broader national economy, as well as the operation of infrastructure and the major workings of everyday life. Space-related products and services are used in virtually every sector of the Australian economy, and the associated technology supports many important areas closely aligned with our national interests. These areas include:

- Position, navigation and timing data is becoming increasingly central to personal navigation and planning, and the ongoing economic productivity and security of industry sectors such as transport, logistics, mining and agriculture.
- Earth observations from space help us understand weather predictions, droughts, forest fires, urban development, and future social planning needs.
- Satellite communications technologies, including broadband, enable Australian citizens and companies to conduct essential business and access critical services such as emergency transport.

Currently Australian industry relies heavily on space systems and space-derived data from other countries. This dependency will be investigated as part of this review. The development of a domestic space industry is an opportunity to reduce this reliance and enable Australian organisations to participate in the global market for space services and data products.

⁵ A Selective Review of Australian Space Capabilities, Asia Pacific Aerospace Consultants 2015.

Key principles

This issues paper has been prepared by the Expert Reference Group (ERG) of the Review of Australia's Space Industry Capability. The purpose of the issues paper is to provide a starting point for the considerations of the ERG and to frame discussions with stakeholders.

The Issues Paper is framed around three key principles:

1. Capability

The 'Capability' theme will consider Australia's current industry capability, the identification of capability gaps, the identification of Australia's areas of comparative advantage, and strategies to promote and support Australian organisations in the space sector.

2. Development

The 'Development' theme will consider how to promote innovation in the Australian space sector, with particular attention to identifying opportunities in the international space industry for Australia to develop niche capabilities, provide value-add or to exploit competitive advantages. Opportunities for Australian innovation to be considered will encompass both the upstream and downstream elements of space activities. Methods for promoting development will consider technical innovation, adoption or fostering of new processes to drive innovation, and the skills required for innovation. This theme will also look closely at the risks and opportunities that need to be addressed in an Australian space strategy.

3. Governance

The 'Governance' theme seeks to understand the current arrangements for engagement and industry development within the Australian space sector and to consider potential future arrangements that are suited to the current global space sector and Australian needs. This theme will consider Australia's regional and international engagement/collaboration (including our international obligations), the alignment of Australian space activities with overarching Australian Government priorities, and the alignment of the Australian space sector with other interdependent/complementary sectors.

Across these three principles, the issues paper asks for consideration of **opportunities for Australia's space industry**.

The consideration of opportunities will reflect a number of issues, including:

- the Australian Government's overall economic reform agenda
- space-related dependencies
- changes in the international landscape
- emerging international space-related issues.

Examining future opportunities for Australia's space industry is a key focus for the review, especially in the context of the benefit that they can deliver to Australia beyond the space sector.

Principle 1: Capability

The Australian space industry is estimated to generate revenue in the range of \$3–4 billion and employ between 9500–11 000 fulltime equivalent staff. In 2015, the global ‘space economy’, comprising launch and ground services, satellite manufacturing, satellite television and communications, government exploration, military spending and other interests, was calculated at approximately US\$323 million, commercial space activities were estimated as representing 76 per cent of this amount.⁶

The current Australian Government policy settings identify Earth Observations from Space (EOS), Position, Navigation and Timing (PNT) applications, and Satellite Communications as the focus for Australian capability development.

Space-related capability has been supported by the Australian Government through the Cooperative Research Centre on Spatial Information (CRCSI), the Space Environment Research Centre (SERC), other initiatives that support advanced manufacturing and government-to-government MOUs that encourage collaboration in these areas. The \$40 million Australian Space Research Program (ASRP) operated from 2010–14 and supported a number of projects that have realised lasting benefits for the Australian space sector. In addition, support for appropriate infrastructure has facilitated opportunities to develop capabilities within, or relevant to, the space industry sector.

In 2017, the Australian Government announced the \$100 million Advanced Manufacturing Fund which will support the manufacturing sector to move to other high technology advanced manufacturing areas; the space industry is a sector could benefit from this fund.

Changes in the international market and emerging technologies are creating opportunities for new participants to enter the space industry, especially from the private sector. The Australian Government is supportive of a high technology advanced manufacturing sector in Australia.

Review focus areas

Identify Australia’s current industry capability and areas of comparative advantage for Australia to develop

This focus area seeks to build a clear picture of Australia’s strengths in the development and application of space products and services as well as Australia’s unique challenges and opportunities. It aims to increase the understanding of Australia’s current space capabilities. Quantifying this focus area could use the following measures:

- commercially mature Australian companies participating in the international space industry
- innovative technologies being developed by industry and/or the research sector
- space-related fields where Australian research activity is world-class or world-leading

⁶ Freeland, S. (2016) Review of Space Activities Act 1998: Analysis Report p.3

- space-related fields that are being used by Australia's major industrial sectors to increase productivity, efficiency and competitive advantage.

Identify capability gaps to support the global competitiveness of Australian firms in the space sector

An underpinning of Australian industry policy is to leverage existing capability while addressing identified capability gaps to allow Australian firms to compete in global markets. Within the space sector, Australia has demonstrated research and development excellence in a range of space-related activities but it is perceived that Australian companies have not been able to efficiently translate this technical capability into commercial outcomes. Capability gaps that are holding back the Australian space industry may include, but are not limited to:

- specific technical capability requirements that are not available in Australia
- specific skills and knowledge limitations
- capacity to recruit/retain skilled staff
- access to appropriate facilities to undertake activities in Australia
- global supply chain constraints
- intellectual property constraints
- access to capital to develop space industry participants/concepts
- inadequate framework for collaboration, both domestically and/or internationally.

Identify capability gaps to support the use of products and services of the civil space sector

The uptake of beneficial technology or services can often be impeded by other structural factors. These factors can include:

- regulatory barriers that restrict new approaches or services
- specific infrastructure to support the communication, agricultural, mining, aviation, defence, transport and logistics industry sectors
- specific skills and knowledge.

Strategies to promote Australian firms engaged in the civil space sector, both domestically and internationally

Australian firms are actively contributing to international space activities and carrying commercially mature space-related activities. Despite this, there is a domestic and international perception that Australia does not/cannot take part in the space sector. This focus considers how we communicate the work of Australian firms involved in the space sector, both from the perspective of increasing global industry awareness of Australian capabilities and to change the perception that Australia is not capable of contributing to global space activities.

Identification of current risks and opportunities in critical space derived data sets and strategies to provide resilient national access to such data sets

Australia is well regarded for its ability to take data produced by multiple platforms and integrate it to develop space-enabled services and products that meet our needs. Noting that the market for such products and services is global and demand is anticipated to only increase, the collaborative relationships and capabilities that underpin this activity need to be both maintained and enhanced. Australian space-derived data needs are provided by space systems operated by a range of countries and private companies. For both the Australian Government to have continued access to this vital data and the Australian space industry sector to be able to exploit it commercially, strategies for long-term assured access need to be considered.

Issues for consideration

- What are Australia's space capability strengths? What are the factors that contributed to the development of these strengths?
- What are the weaknesses in the Australian space industry sector?
- What is the cross-over potential of space-related industry capabilities to the rest of the Australian technology/manufacturing sector?
- Are there space systems or activities that require Australia to maintain specific sovereign space industry capabilities?
- Are there specific space services that provide greater opportunities for the Australian space industry sector within Australia or the Australian region?
- What space products, upstream or downstream, are being exported by Australia? What products could be exported in the future?

Principle 2: Development

The current Australian space industry sector is considered to be under-developed, with it only contributing approximately 0.8 per cent to the global space economy while Australia's share of the overall world economy is 1.8 per cent. Australia's technical expertise, geographical location and close alliances with other space-faring countries provide a sound basis for us to undertake further development of our space industry capability.

The 2013 Australian Satellite Utilisation Policy focuses on the development of capabilities to ensure access to critical space-enabled services and the prioritisation of domestic capability that can make valuable contributions to international satellite projects. To support identified focus areas, the National Earth Observations from Space Infrastructure Plan (NEOSIP) and the National Positioning Infrastructure Plan (NPIP) were also developed.

Recent Australian investments that are developing space-related capabilities include \$15.3 million for Digital Earth Australia project to enable new insights from satellite imagery to be used to drive growth in agriculture and support evidence-based decisions for the environment and \$12 million to test a Satellite Based Augmentation System (SBAS) to deliver positioning information across Australia and investigate its potential to generate economic benefits across a range of different industry sectors. In addition, NBN's 'sky Muster' satellite service is extending high-speed broadband services to remote areas of Australia.

The challenge motivating the development Australia's space industry capabilities is ensuring that we are able to effectively utilise the space systems and data streams that are essential to our national security and economic prosperity. Meeting this challenge has the potential to create Australian space industry capabilities that compete in the global space market as well as benefit other advanced manufacturing and technology elements of the Australian economy.

Review focus areas

Technologies and practices that promote innovation in both the downstream (users of space technologies) and upstream (providers of space technologies) elements of space activities, particularly in areas of niche capability and competitive advantage

With this focus area, we are seeking to identify enabling technology, processes and skills that underpin (or need to be established for) successful participation. In identifying these elements, we need to be mindful of the niche capabilities that Australia may be seeking to progress in or current/potential competitive advantages that can be leveraged.

Risks and opportunities, including ongoing access to space data and associated infrastructure essential to our national interests

This focus area is an opportunity to identify risks and opportunities both within the global space sector and those that are more specific to Australia's national interests. In an advanced economy, we are increasingly reliant on space systems and their data streams to underpin critical aspects of our economy (presenting opportunities to innovate but also creating dependency risks). The growth and changes within the global space sector that embrace a smaller, more agile environment attuned to private sector involvement also presents both challenges and opportunities for the Australian space industry sector.

Issues for consideration

- What elements of the global space sector are most beneficial for an Australian space industry to participate in?
- What are the key enabling technologies, infrastructure, processes and/or skills that will underpin the future of the Australian space sector?
- What are the competitive advantages available to space activities in Australia?
- What opportunities are available to develop Australia's space industry capability?
- How can Australia grow the capabilities needed to foster an internationally competitive space sector?
- What capabilities are needed to ensure access to the space systems and data flows that are becoming critical to Australia's economy?
- What linkages could be made between the space sector and other sectors to achieve the most benefit from the development of Australian space industry capability?
- What are the technology trends over the next 5-10 years and what opportunities/impacts for Australia?
- What 'blue sky' future opportunities can Australia prepare for now?

Principle 3: Governance

Central to a strategy for Australia's space industry is that industry takes a lead role with government playing a partner role to support the space industry in areas of comparative advantage. Any Australian Government support for the sector will need to be aligned with overall government priorities, especially in regards to policies for industry growth. As part of a strategy, a governance structure should align the space-related activities of industry, research and government organisations to maximise the benefit to Australia.

Current policy settings acknowledge Australia's reliance on international space systems and our need to participate actively in international forums to support a rules-based approach to international space activities, facilitate international research collaboration and ensure Australian requirements are incorporated into international projects. The Australian Government maintains appropriate arrangements to coordinate Australian space activities and engage with international forums.

The Australian Government has reviewed the *Space Activities Act 1998* with the objective of any reform to reflect advances in technologies and provide a regulatory environment that is appropriately conducive to commercial investment in the space sector. Reform of the legislation is currently underway. Australia's is also hosting the 2017 International Astronautical Congress (IAC) in 2017 and will be hosting the Committee of Space Research (COSPAR) assembly in 2020. Within government, the Space Coordination Committee (SCC) is responsible for coordinating Australian Government space activity.

Building an Australian Government governance framework to support Australian space industry development needs to recognise opportunities from greater coordination and focus on realising the benefits of a holistic approach to Australian space activities.

Review focus areas

Australia's level of regional engagement and international collaboration, including identifying critical future and existing partnerships

This focus area seeks both to identify the current level of international engagement and consider the merits of different levels of engagement/collaboration. Potential measures of international engagement/collaboration could be:

- government involvement in regional/international forums
- non-government involvement in regional/international forums
- space-related collaborations/industry links between Australian and international organisations.

Alignment with other sectors and Australian Government priorities, including Defence, critical infrastructure and cyber security, and meeting Australia's international obligations

A strategy for Australian space activities needs to be aware of activities in other sectors that need to be accommodated or may be complementary. This focus area seeks to ensure the

broader needs of the Australian Government are taken into account, including international obligations and concerns raised from interdependent activities.

The most effective institutional arrangements to support the strategic direction of Australia's space industry

There have been calls for Australia to establish a 'space agency' to increase space activities and provide a recognisable point of contact/coordination/funding. This focus area considers what institutional arrangements are needed for the different aspects of space activity. It also draws attention for the need of this activity to align with a strategic direction, requiring any institutional arrangements to be able to support a government led strategic direction.

Issues for consideration

- What are the successful international models for the governance of national space activities, especially in regards to the development of space industry capabilities?
- What responsibilities appropriately fall under an Australian Government space activities governance framework?
- How should the priorities of non-government organisations be incorporated into an Australian Government strategy?

Opportunities for Australia's Space Industry

The global space sector is changing. New technologies and approaches to space activities have created an environment that is conducive to the participation of new entrants, especially from the private sector. The review will consider the opportunities that are available to Australia's space industry and how best to take advantage of them.

These opportunities are also driven by the increasing global and domestic need for and use of space-derived data. This need creates new demands on governments to facilitate access to this data and opportunities for the private sector to provide products to a global market.

In parallel to our growing use of space-derived data and systems is our growing dependence on them. Access to these data and systems, as well as the capability to exploit them, is an increasing requirement of both government and the private sector. Meeting this challenge has the potential in itself to create opportunities if we position ourselves to take advantage of them.

In a sector that is undergoing exponential change and with increased global competition, we need to also carefully consider priorities to secure the future of Australia's space industry. These priorities will provide guidance to appropriately address the principles of capability, development and governance discussed earlier in this paper.

For Australia to maximise its investment in space activities it is not feasible to develop space industry capabilities in all aspects of international space activity. The identification of appropriate niche areas to focus the Australian space industry will deliver the most benefit to Australia. The outcomes of the review will also focus on ensure that future policy drives innovation and entrepreneurship, rather than making it dependent of government assistance.

Issues for consideration

- What opportunities are available for Australia in the global space sector?
- What should the priorities be for the Australian space industry?
- How can the private sector be encouraged to invest in areas of Australia's comparative advantage?
- Should priorities for space industry capability development be applied across all space-related research funding?
- What should the vision for the Australian space industry be?

Contributing to the review

Consultation with key stakeholders is an integral part of the review. These consultations will inform the considerations of the ERG and influence its final outcomes.

There are a range of opportunities to contribute to the review process, including:

- written submission to the review in response to this issues paper
- contributions to roundtable meetings to be held across Australia
- one-on-one engagement with key stakeholders by the chair of the ERG.

Written submissions

The call for written submissions is made with the release of this document on 3 August 2017. The opportunity to make written submissions will close on 22 August 2017. Written submissions should address the consultation questions contained in this document but may also provide additional input. Written submissions can be uploaded via the Consultation hub on the Department of Industry, Innovation and Science website:

<https://consult.industry.gov.au/space-activities/review-of-australian-space-industry-capability>

Roundtable meetings

Roundtable meetings will be held in capital cities across Australia, depending on demand, from late August to early September 2017. Participants should lodge their interest in taking part in the roundtable meetings via the Consultation hub, indicating their preferred location for planning purposes.

One-on-one meetings

The chair of the ERG will conduct one-on-one meetings with key stakeholders as required to inform the discussions of the ERG. These meetings are conducted at the discretion of the chair of the ERG.

Further information on the consultation process can be found at

industry.gov.au/industry/IndustrySectors/space/Pages/Review-of-Australian-Space-Industry-Capability

If you have any questions regarding the review or the consultation process, please contact space@industry.gov.au.

Attachment A

Terms of Reference for a Review of Space Industry Capability

The Australian Government (Government) has announced a review of Australia's space industry capability which will lead to a national strategy for the sector that reflects both our developing strengths and national interests over the next decade. Ensuring that the right strategic framework is in place to support the growth of Australian's space industry will be core to the review process.

This review builds on the existing *Australia's Satellite Utilisation Policy* (2013) and the findings from the recently completed review of the *Space Activities Act 1998*. Reform of the space legislation is now underway to reflect advances in technologies and provide a regulatory environment that is appropriately conducive to commercial investment in the space sector. It is therefore timely for the Government to review its civil space policy and refine its strategic, long-term plans for this important sector.

The review will be undertaken under the direction of an Expert Reference Group (ERG) chaired by Dr Megan Clark AC. The ERG membership is at [Attachment A1](#).

The Terms of Reference for the review are below.

Review of Australia's Space Industry Capability Terms of Reference

- The Review of Australia's Space Industry Capability will build on the principles set out in the existing *Australia's Satellite Utilisation Policy* (2013) by developing a strategic framework for the Australian space sector that supports leadership, innovation, opportunity and entrepreneurship across the sector along with our broader national interests.
- The review will specifically address the following matters:
 - identifying Australia's current industry capability and areas of comparative advantage for Australia to develop,
 - technologies and practices that promote innovation in both the downstream (users of space technologies) and upstream (providers of space technologies) elements of space activities, particularly in areas of niche capability and competitive advantage,
 - Australia's level of regional engagement and international collaboration, including identifying critical future and existing partnerships,
 - identifying capability gaps to support the global competitiveness of Australian firms in the civil space sector,
 - strategies to promote Australian firms engaged in the civil space sector, both domestically and internationally,
 - risks and opportunities, including ongoing access to space data and associated infrastructure essential to our national interests,

- alignment with other sectors and Australian Government priorities, including Defence and cyber security, and meeting Australia's international obligations, and
- the most effective institutional arrangements to support the strategic direction of Australia's space industry.
- Consultations with key stakeholders and state jurisdictions will be conducted as part of this review with a focus on the matters set out above.
- The review will commence from July 2017 and be completed by end March 2018.

Attachment A1

Expert Reference Group

Chair

Dr Megan Clark AC

Expert Reference Group members

Prof Russell Boyce

Mr Michael Davis

Dr David Williams

Dr Stuart Minchin

Prof Steven Freeland

Prof Anna Moore

Dr Jason Held

Ms Flavia Tata Nardini