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Space Agency

Economic snapshot of the Australian space sector: 2016-17 to 2018-19

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1. Overview

The Australian Government's *Advancing Space: Australian Civil Space Strategy 2019-2028* (the Strategy) sets overarching goals – to triple the size of the Australian space sector to AU\$12 billion and create up to 20,000 new direct and indirect space jobs by 2030¹. The Strategy, released in April 2019, also sets targets against key indicators – sector growth at an annual rate of 8.5 percent, and for inbound investment² to reach \$1 billion³ by 2025.

This report establishes a 2016-17 financial year (FY17) starting point of the sector's size and characteristics, and tracks its growth to financial year 2018-19 (FY19) – providing the first snapshot of the sector's progress towards the Australian Government's goals⁴. This initial report details a methodology to operationalise these targets and allow consistent tracking of the sector over time. This methodology is repeatable to inform a series of future economic snapshots approximately every two years, providing regular visibility of the changes in Australia's space sector.

The report draws on information from a number of sources including, independent data providers: IBISWorld and Illion, consultants Nous Group and AlphaBeta and the Space Industry Association of Australia (SIAA), and the Department of Industry, Science, Energy and Resources' Customer Relationship Manager (CRM) system. The dataset includes 816 organisations – some of which operated in the Australian space sector and others that have a close connection with it.

The time period covered by this report captures the Agency's first year of operations and phase one of the Strategy. The Agency was established on 1 July 2018, 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 national and international engagement. While the Agency achieved a great deal in its first year⁵, at the end of FY19, the Agency was just moving from phase one of the Strategy – *Setting conditions for growth (2018-19)* into phase two *Engaging with opportunity (2019-2021)* of the Australian Government's plan to grow Australia's space sector.

The period covered by this report, therefore, ends before significant Australian Government investments targeted to transform Australia's space sector began to reach the sector. Given the time period covered, the figures in this report do not reflect impacts of COVID-19. Table 1 provides a summary of the sector's progress against key indicators for the FY17 to FY19 period.

Table 1: Australian space sector performance – Snapshot of the key indicators

Indicator	FY17	FY19	2030 Target
Revenue	\$4.3 billion	\$4.6 billion	\$12 billion

¹ Australian Space Agency (2019), *Advancing Space: Australian Civil Space Strategy 2019-2028* - <https://www.industry.gov.au/data-and-publications/australian-civil-space-strategy-2019-2028>

² Inbound investment includes investments by industry, international space agencies and private foundations. It does not include investments from Australian governments or universities.

³ Monetary values are in Australian dollars (AUD) throughout this report unless otherwise noted.

⁴ The economic baseline for the sector is set in 2016-17, the financial year prior to the Agency's announcement. The 2018-19 snapshot measures the change in the sector from the baseline, up to the end of the Agency's first year of operations.

⁵ Australian Space Agency (2019), *Australian Space Agency 1 year on: A message from Head, Dr Megan Clark AC* - <https://www.industry.gov.au/news-media/australian-space-agency-1-year-on-a-message-from-head-dr-megan-clark-ac>

		+2.9% average annual growth	+8.5% annual growth
Jobs	10,430 direct jobs	11,560 direct jobs +5.4% average annual growth	30,000 direct & indirect jobs (which includes 20,000 new jobs)
Total Investment		\$2.02 billion (at September 2020)	N/A
Inbound Investment		\$774.6 million	\$1 billion (2025 Target)

Changes in the sector summarised in Table 1 show that the sector is making positive progress towards the Australian Government's goals to triple the size of the sector by 2030. The two years to FY19 saw:

- An 11.3 per cent increase in the number of organisations operating in the Australian space sector from FY17 to FY19.
- Increased employment with over 1,100 direct space jobs created between FY17 and FY19.
- Steady increase in space sector revenue, from \$4.3 billion in FY17 to \$4.6 billion in FY19, a 5.8 per cent increase over the two years (an average annual growth rate of 2.9 per cent).
- Australia's space industry revenue as a percentage of Gross Domestic Product (GDP) is small (relative to the OECD average) at approximately 0.25 per cent⁶.

Further, a growing investment pipeline into the Australian civil space sector has been identified, valued at a total of approximately \$2.02 billion. This includes \$774.6 million inbound investment from private industry and international space agencies.

While these results indicate progress to FY19 and a promising pipeline of future investment, the Agency has since been implementing a national plan to achieve the goals as set out in the Strategy under four strategic pillars: International, National, Responsible and Inspire. Since FY19, the Agency has been delivering the Australian Government's civil space programs the \$15 million International Space Investment (ISI) Initiative, the \$19.5 million Space Infrastructure Fund (SIF) and the \$150 million Moon to Mars initiative to accelerate the growth of Australia's space sector. Further, the Australian Government's Modern Manufacturing Strategy⁷ identifies space as a priority area for action, as part of its commitment to scaling a strong, modern and resilient economy. The impacts of these and other initiatives will be presented in the next report, anticipated to cover the period FY19 to 2020-21, when the Agency will be entering Phase 3 of the Strategy: *Delivering success (2021-2028)*.

Following this Overview, Chapter 2 sets out the tools to be used to measure Australia's space sector, including defining the space sector and identifying analytical frameworks and key indicators. Chapter 3 examines the space sector in FY17, while Chapter 4 assesses FY19 – and presents a comparative analysis of the sector between the two years. Chapter 5 looks to the future, presenting an analysis of an identified pipeline of future investment in Australia's space sector and an overview of the possible impacts of the COVID-19 global pandemic on the sector.

⁶ AlphaBeta (2020), The Economic Contribution of Australia's Space Sector in 2018-19 <https://www.industry.gov.au/sites/default/files/2021-02/the-economic-contribution-of-australias-space-sector-in-2018-19.docx> Note, Australian GDP for 2018-19 was \$1.89 trillion and AlphaBeta estimated space sector revenue was \$4.8 billion.

⁷ Australian Government (2020), Make it happen: The Australian Government's Modern Manufacturing Strategy - <https://www.industry.gov.au/data-and-publications/make-it-happen-the-australian-governments-modern-manufacturing-strategy>

2. Measuring Australia's space sector

This chapter of the report sets out definitions for the space sector and the broader space economy to ensure a common understanding and consistent measurement of the complex dynamics of Australia's space sector. This chapter also explains key indicators used to track the progress towards Australian Government targets.

The definition of the space sector used in this report (see 2.1) draws upon the current Organisation for Economic Cooperation and Development (OECD) definition for the space economy (see 2.2). The OECD space economy definition has also been used by New Zealand⁸, Canada⁹ and the United Kingdom¹⁰. Using this definition ensures consistency in measurement in Australia's space sector as it grows and evolves, and allows for comparability and consistency with other international space sectors.

2.1 Defining the sector and value chain

The Australian space sector is defined as a set of space-related activities along the space value chain and is part of the broader space economy.

All actors (private, public and academic) participating in production, operation, supply and enablement activities that form the space value chain are part of the space sector. Space value chain segments broadly include: Manufacturing and core inputs (Ground and Space segment manufacturing and services); space operations; space applications; and enablers (such as regulation and essential service delivery, infrastructure and capabilities, research, development and engineering, and specialised support services).

While the space sector captures the provision of space related goods, services and applications to broader industries, it does not include subsequent non-space (value adding) activities that are enabled by space activities (such as food grown using precision agriculture techniques). These flow-on activities are captured by the broader space economy.

The Agency commissioned the Nous Group to develop a value chain framework to categorise activities within the Australian space sector¹¹. This framework categorises activities into three main value chain segments: manufacturing and core inputs, space operations and space applications; all supported by a fourth enablers value chain segment.

- **Manufacturing and core input activities** comprise the building and integration of ground-based facilities and equipment that perform space-related activities and the building and integration of items to go into space, including spacecraft, satellites, payloads and products to be used in space.
- **Space operations** activities include launch activities, the management of objects in space, and activities associated with using and managing satellites in space. It also includes operations and remote operations conducted in space.
- **Space applications** activities refer to the use of space-derived resources to create usable and useful products and services, including software, hardware and publications, and services to be provided across the economy.

⁸Deloitte Access Economics, New Zealand Space Economy: Its value, scope and structure, New Zealand Ministry of Business, Innovation and Employment, Wellington, 2019.

⁹Economic Analysis and Research Team, Policy Branch of the Canadian Space Agency, State of the Canadian Space Sector Report 2018, Canadian Space Agency, Quebec, 2018.

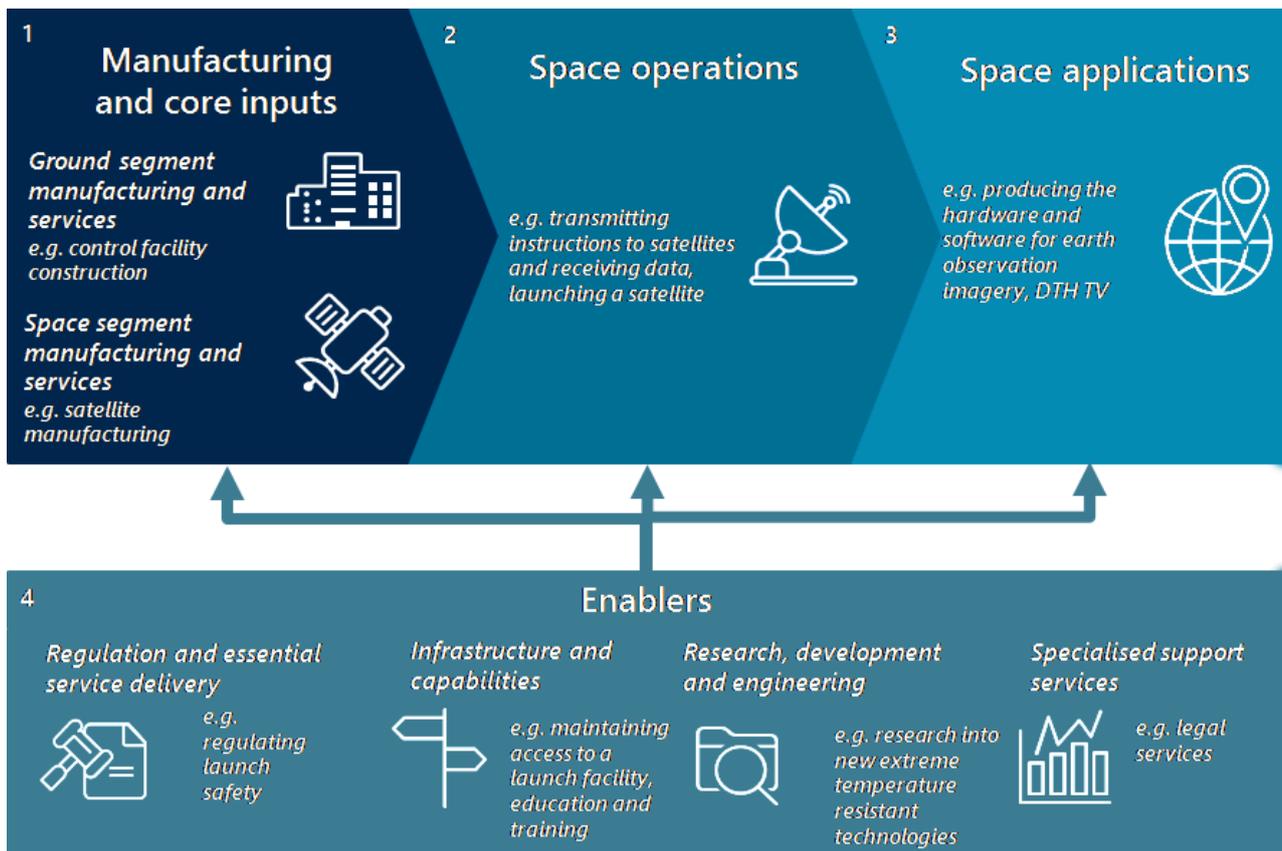
¹⁰London Economics, Size and Health of the UK Space Industry 2018, UK Space Agency, London, 2019

¹¹Australian Space Agency (2019), Definition of the Australian space sector - <https://www.industry.gov.au/data-and-publications/definition-of-the-australian-space-sector>

- Activities in the **space enablers** segment include a variety of product delivery and services which support the space activities within the other three value chain segments. These include essential service delivery, infrastructure and capabilities, research, development and engineering, and specialised support services, which facilitate and contribute to delivery of the products and services from manufacturing and core inputs, operations and applications segments.

This framework is presented visually in Figure 1.

Figure 1: Value chain of the space sector



For the purposes of this report, the Agency has captured space-related organisations and activities that fall within the value chain of the space sector. Space sector organisations can undertake activities in one or more segments of the value chain¹².

The Agency has also developed sub-sectors to further disaggregate the sector for analysis, building on the civil space priority areas identified in the Strategy. These sub-sectors were identified by the Agency drawing on analysis of Australia’s space sector and include: Advanced manufacturing (e.g. space objects); Communication technologies and services (including ground stations); Earth observation; Education and training; Infrastructure; Launch, rockets and hypersonics; Leapfrog research and development (R&D); Planetary science and astronomy; Position, navigation and timing; Robotics and remote asset management; Software and data; Space medicine; and Space situational awareness and debris monitoring. In some cases,

¹² For this analysis, the Agency’s estimates assume that for organisations operating in more than one segment, organisation activities are split equally across those segments.

where insufficient detail is available, activities, revenue or investment may be not be categorised within a sub-sector. Instead, these are grouped as “unallocated”.

2.2 Defining the space economy

Using the OECD’s definition, the space sector is a part of the broader space economy. As described below, the space economy captures the space sector and also the users of space technologies and spillover benefits to other parts of the economy.

The space economy is the full range of activities and the use of resources that create and provide value and benefits to human beings in the course of exploring, understanding, managing and utilising space. Hence, it includes all public and private actors involved in developing, providing and using space-related products and services, ranging from research and development, the manufacture and use of space infrastructure ([such as] ground stations, launch vehicles and satellites) to space-enabled applications ([such as] navigation equipment, satellite phones, meteorological services, etc.) and the scientific knowledge generated by such activities. It follows that the space economy goes well beyond the space sector itself, since it also comprises the increasingly pervasive and continually changing impacts (both quantitative and qualitative) of space-derived products, services and knowledge on economy and society.¹³

2.3 Key indicators

Using the definitions and parameters outlined above, the Agency has commenced analysing key indicators for the space sector aligned with targets identified in the Strategy.

Primary indicators used are the quantity of space-related jobs in the sector and space-related revenue from organisations in the sector. These are lag indicators for the sector’s historical performance. Notably, returns on investment and the impacts of government policy interventions usually take several years to be reflected in these lag indicators.

In this report, jobs in the space sector are indicated by a head count of employees that perform some space-related work in one or more categories of the space value chain. This report does not measure indirect jobs. International research suggests that a large portion of value from space activities is realised through indirect jobs, indirect revenues and other spillovers¹⁴, suggesting this report’s estimates of jobs in the space sector are likely conservative. Quantifying indirect jobs associated with Australia’s space sector may be explored for future economic snapshots.

Revenue, in this report, indicates the revenue organisations collect from the sale of space-related goods and services. Revenue provides an indication of the value generated from activities.

To complement these lag indicators, an estimate of future capital investment in the civil space sector provides a leading indicator of the sector’s potential future growth.

In this report, investment is the sum of commitments of capital from the Australian Government (excluding Defence), state and territory governments, universities, private industry, private foundations and

¹³ OECD (2012), OECD Handbook on Measuring the Space Economy, <https://doi.org/10.1787/9789264169166-en>

¹⁴ For example, indirect jobs were higher than direct jobs in both space sector reports for Canada and New Zealand - Canadian Space Agency (2019), State of the Canadian Space Sector, <https://asc-csa.gc.ca/eng/publications/2019-state-canadian-space-sector.aspx#economic-jobs>; Deloitte Access Economics (2019), New Zealand Space Sector: Its value, scope and structure, <https://www.mbie.govt.nz/assets/new-zealand-space-sector-its-value-scope-and-structure.pdf>

international space agencies. Inbound investment is the proportion of these commitments from non-Government sources (private industry, private foundations and international space agencies).

2.4 Ongoing measurement

The direct jobs, revenue and investment figures in this report are the result of the most detailed analysis of the Australian space sector since the 2018 ERG Review of Australia's space industry capability.

Details of the methodology, data and assumptions underpinning this analysis are set out in Appendix A. This provides a starting point for a repeatable methodology to inform future economic snapshots approximately every two years, providing continued insights into the changes in Australia's space sector.

Space sectors are not easily defined by traditional industry codes (such as the ANZSIC codes used by the Australian Bureau of Statistics) and many organisations active in space sectors are also active in other sectors. Differentiating space and non-space activities is critical to ensuring accuracy of space-related jobs and revenue estimates. These definitional and data issues are common across the world and therefore analysts generally rely on surveys to capture firm-level data from which to estimate the size and contribution of space sectors.

In developing this report, the Agency created the most comprehensive firm-level database of space organisations in Australia, drawing on a range of sources¹⁵. To ensure rigor, the Agency's estimates have been informed by independent studies, including complementary analysis commissioned from AlphaBeta¹⁶, to ensure the results can be interpreted and used within the limitations of the data.

The Agency continues to track committed cash investments for Australian civil space projects. The Agency will also continue to maintain, refine and update these datasets to ensure consistent measurements of the Australian space sector into the future.

Measuring space sector activity is a complex task and variation of estimates between studies is to be expected, reflecting the use of different data samples, scope, assumptions, methodologies and indicators. These are common issues for valuation of emerging sectors in Australia and around the world. Further detail on these issues and a comparison of this analysis with previous studies is included in Appendix B.

¹⁵ Set out in Appendix A.

¹⁶ AlphaBeta (2020), The Economic Contribution of Australia's Space Sector in 2018-19 <https://www.industry.gov.au/sites/default/files/2021-02/the-economic-contribution-of-australias-space-sector-in-2018-19.docx>

3. Australia's space sector in 2016-17

This chapter of the report provides an overview of Australia's space sector, using the definition in Chapter 2, in FY17. This retrospective analysis indicates the scale, nature and composition of space activities in Australia at this time and provides a starting point for future analysis.

FY17 saw global optimism about space sector growth. Estimations were that the global space sector could reach US\$600 (AU\$837) billion by 2030¹⁷, and trends indicated increasing numbers of commercial actors, driven by the evolution of smaller, more cost effective technology, lowering costs and access to space. The *2016 State of Space Report* noted that "Australia is increasingly reliant on space-enabled services" while cautioning that Australia's ability to capitalise on the benefits that satellite data provides was at risk. This was due to both Australia's reliance on satellites systems owned and operated by foreign entities and less than optimum ground infrastructure¹⁸. Table 2 provides summary results for Australia's space sector in FY17.

Table 2: Australian space sector summary results 2016-17 (FY17)

Indicator	Result
Number of organisations in the space sector:	432
Jobs (direct only, headcount):	10,430
Space sector revenue (AU\$):	\$4.3 billion

These summary results align with previous studies of the sector, which estimated the Australian space sector to have at least 388 organisations, generating \$3 billion to \$4 billion in revenue, and around 10,000 jobs (with an estimated range between 9,500 and 11,500 full-time employees) in 2015-16 (FY16)¹⁹.

Of the 432 organisations in Australia's space sector in FY17, many organisations were active in more than one segment of the space value chain²⁰. The distribution of organisations' activities across the value chain is set out in Table 3.

Table 3: Australian space sector organisations (all sizes) by value chain segment 2016-17 (FY17)

Value chain segment breakdown (by number of organisations)	Manufacturing & core inputs	Space operations	Space applications	Space enablers
Active in value chain segment (count)	87	48	169	221
Active in value chain segment (%)	20 %	11 %	39 %	51 %

Identifying the size and nature of activities in the sector in FY17 provides a robust initial starting point against which to identify and analyse future changes in the sector.

¹⁷ Expert Reference Group (2018), Review of Australia's Space Industry Capability - <https://www.industry.gov.au/data-and-publications/review-of-australias-space-industry-capability>; Morgan Stanley (2020), Space: Investing in the Final Frontier - <https://www.morganstanley.com/ideas/investing-in-space>

¹⁸ Department of Industry, Innovation and Science (2016), 2016 State of Space Report - <https://www.industry.gov.au/data-and-publications/state-of-space-report-2016>

¹⁹ APAC (2015), Report on Australian Space Capabilities; Expert Reference Group (2018), Review of Australia's Space Industry Capability - https://www.industry.gov.au/sites/default/files/June%202018/document/pdf/review_of_australias_space_industry_capability_report_from_the_expert_reference_group.pdf?acsf_files_redirect

²⁰ Space organisations can operate in more than one value chain segment, hence the total count of 525 organisations or 121% of the organisations) in Table 3.

4. Australia's space sector in 2018-19

This chapter provides an overview of Australia's space sector, using the definition in Chapter 2, from FY17 to FY19. The analysis includes comparison with FY17 (outlined in Chapter 3) and a more detailed examination of the sector's organisations, jobs and revenue in FY19²¹.

From July 2017, an Expert Review Group (ERG) conducted a review of Australia's space industry, commissioned by the Australian Government, which was completed in March 2018. The ERG found that while Australia's space sector had strong potential, it was lacking strategic direction and coordination, and had limited access to global supply chains.²² Recognising the potential of this sector, the Australian Government established the Agency on 1 July 2018, to deliver initial measures targeted at growing the sector and transforming the use of space in other areas of the economy. In April 2019 the Australian Government released *the Strategy* outlining its goals to triple the size of the Australian space sector to \$12 billion and create 20,000 more jobs by 2030. At the end of 2018-19, the Agency had achieved a great deal in its first year²³, and was just moving from phase one of the Strategy – *Setting conditions for growth (2018-19)* into phase two – *Engaging with opportunity (2019-2021)* of the Government's plan to grow Australia's space sector.

Significantly more detailed analysis of FY19 than FY17 has been undertaken, enabled by the availability of richer data for this later time period, and following establishment of the Agency. Table 4 provides summary results for Australia's space sector in FY19.

Table 4: Australian space sector summary results 2018-19 (FY19)

Indicator	Result
Number of organisations in the space sector:	481
Jobs (direct only, headcount):	11,560
Space sector revenue (AU\$):	\$4.6 billion (approx. 0.25% GDP) ²⁴

We can compare the changes from FY17 to FY19, indicating how Australia's space sector has changed and progress towards our national goals for growth of the Australian space sector. A summary of these changes are set out in Table 5.

Table 5: FY17 to FY19 Australian space sector summary results

Indicator	FY17	FY19	Change
Number of organisations in the space sector:	432	481	Increase of 49 organisations (11.3% increase, equating

²¹ The same methodology was used for FY17 and FY19, ensuring comparable results over time.

²² Expert Reference Group (2018), Review of Australia's Space Industry Capability - <https://www.industry.gov.au/data-and-publications/review-of-australias-space-industry-capability>

²³ Australian Space Agency (2019), Australian Space Agency 1 year on: A message from Head, Dr Megan Clark AC - <https://www.industry.gov.au/news-media/australian-space-agency-1-year-on-a-message-from-head-dr-megan-clark-ac>

²⁴ AlphaBeta (2020), The Economic Contribution of Australia's Space Sector in 2018-19 <https://www.industry.gov.au/sites/default/files/2021-02/the-economic-contribution-of-australias-space-sector-in-2018-19.docx>

Indicator	FY17	FY19	Change
			to an annual growth rate of 5.7%)
Jobs (direct only, headcount):	10,430	11,560	An increase of 10.8% (Equating to an average annual growth rate of 5.4%)
Space sector revenue:	\$4.3 billion	\$4.6 billion (approx. 0.25% GDP) ²⁵	An increase of 5.8% (Equating to an average annual growth rate of 2.9%)

The Agency's analysis shows that in FY19, 49 more organisations are a part of the space sector than in FY17. This describes a growth of 11.3 per cent over this period, or an average annual growth rate in the number of organisations of 5.7 per cent. This rate of growth is approximately equivalent to one additional organisation commencing activities in Australia's space sector every two weeks. This growth in organisations comprises new start-ups, existing organisations transitioning into space sector, and international organisations opening space operations in Australia.

Organisations that only conduct activities in the space sector are rare. It is estimated that just 14 per cent of the 481 organisations active in the space sector in FY19 performed only space-related activities – the majority of Australian space organisations also perform non-space work.²⁶

Organisations in the space sector often conduct activities outside the sector, suggesting there is an opportunity for non-space industry organisations to translate their capabilities outside the sector into activities within the space sector. Survey data from the Nous Group evidences several cases where long-established organisations have recently diversified or pivoted into the space sector.

Research by AlphaBeta identifies 23 adjacent industries to the space sector with capabilities that are transferrable to space, demonstrating significant growth potential for the space sector. Additionally, AlphaBeta classified 380 firms out of a total 4,000 space-adjacent firms as having high potential to transition into the space sector. The 10 most common capabilities of space-adjacent firms are: precision machining and design; remote operation and automation; machinery and component manufacturing; R&D and manufacturing; advanced manufacturing and design; systems design and engineering; electronics manufacturing; network operation; engineering design, manufacturing and support; and major infrastructure delivery.²⁷

²⁵ AlphaBeta (2020), The Economic Contribution of Australia's Space Sector in 2018-19 <https://www.industry.gov.au/sites/default/files/2021-02/the-economic-contribution-of-australias-space-sector-in-2018-19.docx>

²⁶ The space-related revenue and jobs for organisations are identified separately to total revenue and jobs for analysis in this report. See Appendix A.

²⁷ AlphaBeta (2020), The Economic Contribution of Australia's Space Sector in 2018-19, Chapter 2.3. <https://www.industry.gov.au/sites/default/files/2021-02/the-economic-contribution-of-australias-space-sector-in-2018-19.docx>

Example areas of transferrable capability

Remote operations with artificial intelligence and machine learning: Australia is a world leader in remote asset management in industries including mining, oil and gas, transport, agriculture and fisheries. Australia can leverage its expertise in robotics technology and systems for remote operation and exploration in space. This includes developing algorithms to enable space borne capabilities.

Scientific exploration using in situ resource utilisation (ISRU): Australia's mining industry has world class capabilities in mineral exploration. Leveraging this experience for space exploration has the potential to unlock new businesses and markets while creating significant value for international partnered missions.

Space medicine and human life sciences: Australia has significant expertise to contribute medical technologies, expertise and materials for human exploration missions. With the potential increase of commercial human space flight, this field will become more important to space markets in the future.

Digital mapping of celestial bodies: Australia has significant capabilities in the application and processing of data sets (e.g. Digital Earth Australia, Open Data Cube). These skills can be leveraged and applied to other celestial bodies to assist with international exploration mission planning and planetary science objectives.

It is anticipated that over time, space technologies and applications will become more integrated into the activities and processes of other industries such as manufacturing, agriculture, logistics, and environmental and emergency management – growing the space economy and transforming the use of space. In some areas it is already becoming difficult to draw the line between activity in the direct space sector and the broader space economy²⁸.

4.1 Sector activities and organisations

Organisations by location

Australia's space sector is geographically distributed across Australia. Table 6 outlines the geographic distribution of organisations' headquarters²⁹ over this period, noting that many organisations undertake activities at other sites.

Table 6: Count of known space organisation headquarters by location

Year	NSW	VIC	QLD	WA	SA	TAS	ACT	NT	Total
FY17	126	114	59	33	51	4	40	5	432
FY19	136	120	69	36	61	4	49	6	481
Difference	+10	+6	+10	+3	+10	-	+9	+1	49
Growth	7%	5%	14%	8%	16%	-	18%	17%	11.3% (average)

²⁸ This challenge is demonstrated by the variance in assumptions and results in AlphaBeta's FY19 analysis. For further detail see Appendix B.

²⁹ Organisation locations mapped include the one office location registered under each organisation's Australian Business Number. Organisation headquarters location may differ from registered office address. Organisations may also have multiple locations not represented here.

All states and territories (except Tasmania) saw growth in the number of organisations in the sector from FY17 to FY19. The number of active organisations headquartered in Tasmania remained steady over this period.

Organisation size

SMEs represented 74.3 per cent of all space organisations, and the remaining 25.7 per cent of the sector is comprised of large organisations (such as Telstra, Singtel (Optus), Foxtel and various universities), which accounted for 68 per cent of space sector jobs (7,850 jobs) and 78.4 per cent of the revenue (\$3.6 billion) for the sector in FY19.³⁰ Additionally, space organisations classified as start-ups (SMEs operating for less than five years) represented 17.7 per cent of all space organisations in FY19.

Organisation activities by value chain segment

Of the 481 organisations in Australia's space sector in FY19, many organisations were active in more than one segment of the space value chain. Table 7 describes how the activities of the 481 organisations active in FY19, categorised by organisation size, are distributed across all four segments of space sector value chain.

Table 7: Space value chain segment breakdown by organisation activities

Value chain segment breakdown	Manufacturing & core inputs	Space operations	Space applications	Space enablers
Small organisation activities	16 %	14 %	27 %	61 %
Medium organisation activities	29 %	12 %	50 %	38 %
Large organisation activities	22 %	12 %	43 %	50 %
Total activity (all organisation sizes)	21 %	13 %	38 %	52 %

In FY19 more organisations operated in the applications (38 per cent of all space organisations) and enablers (52 per cent) segments, indicating stronger capacity and capability in these value chain segments.

Over half of all Australian space start-ups³¹ are active in the space enablers segment of the space value chain. Common enabling activities included specialised professional and technical services such as: engineering; space business and project management; regulatory and legal services; development, provision and servicing of specialised equipment and instrumentation or infrastructure; and targeted R&D and prototyping services.

Space-related R&D is a key strength for Australia – education and research institutions form a large part of the sector. In FY19 there were over 30 research organisations providing services in the Australian space sector, in particular in the enabling value chain segment. IBISWorld also observed high R&D expenditure in space manufacturing as current and emerging businesses work to create more cost-efficient ways to develop space technologies³².

That 21 per cent of organisations were active in the manufacturing and core input market segment indicates a significant pre-existing base.

³⁰ The space-related revenue and jobs for organisations are identified separately to total revenue and jobs for analysis in this report. See Appendix A.

³¹ Start-ups are SME organisations that have been operating for less than 5 years (see above).

³² IBISWorld (2020) Industry Report OD5545: Satellite Communications and Astronautics in Australia.

Some space activities were more common for different sized organisations. For instance, 27 per cent of small space sector organisations conducted activities in the space applications segment, compared with 50 per cent of medium-sized organisations.

4.2 Sector employment

With a total head count of 11,560 direct space jobs in FY19, the Agency estimates that jobs have increased by 10.8 per cent since FY17. Table 8 provides an indication of direct space jobs by value chain segment in FY19.

Table 8: Direct space jobs (head count) breakdown by space value chain segment³³

Year	Space manufacturing & core inputs	Space operations	Space applications	Space enablers	Total direct space jobs
FY19	1,970	1,200	3,600	4,790	11,560

The increase in direct space sector jobs from FY17 to FY19 can be attributed to growth in space organisations and their activities.

The Agency's employment estimates (developed using known and modelled space jobs data³⁴) are reasonable in comparison to previous analyses. Due to different analytical methods and samples used, the Agency's direct space jobs estimate is slightly higher than independent analysis by AlphaBeta at 9,000 to 10,000 space jobs in FY19, and lower than IBISWorld's estimate of 13,200 FY19 space jobs³⁵.

Analyses by both the Agency and AlphaBeta support conclusions that space operations represented the smallest segment of space employees in Australia. AlphaBeta identifies space operations as a potential area of global competitive advantage for Australia³⁶. If future years see growing demand for local operations services and commercial opportunities in international markets, this may help stimulate local growth in operations capabilities (such as space object and debris tracking) and organisations.

Compared with operations, space manufacturing and core inputs employed a somewhat larger segment of the direct Australian space workforce according to both analyses. This segment captures skills and capabilities for core space inputs such as coding and development of specialised operating software, as well as a variety of skills used in ground or space segment manufacturing processes. While some capabilities (such as optical instrumentation integration) are more applicable to space manufacturing, many generic capabilities employed across this segment (such as design and composite materials production) can be transferable to other advanced manufacturing sectors such as aviation, shipbuilding, and health.

³³ This breakdown assumes that for those organisations operating in multiple value chain segments, headcount of workers is evenly allocated across respective value chain segments.

³⁴ Direct space jobs data was used where available. Where data on a firm's space jobs was unavailable, the Agency modelled the firm's number of space jobs by applying the same rate or portion of space jobs as the firm's nearest neighbours (that is, the other organisations in its strata) for each year. See Appendix A for further detail.

³⁵ AlphaBeta (2020), The Economic Contribution of Australia's Space Sector in 2018-19. <https://www.industry.gov.au/sites/default/files/2021-02/the-economic-contribution-of-australias-space-sector-in-2018-19.docx>; IBISWorld (2020), IBISWorld (2020) Industry Report OD5545: Satellite Communications and Astronautics in Australia.

³⁶ AlphaBeta (2020), The Economic Contribution of Australia's Space Sector in 2018-19 - <https://www.industry.gov.au/sites/default/files/2021-02/the-economic-contribution-of-australias-space-sector-in-2018-19.docx>

Overlapping or transferable capabilities can lower barriers for organisations using their existing workforce to pivot into new opportunities in adjacent industries as they arise. Development of transferable skills can also help broaden career pathways for individual workers. The niche advanced manufacturing workforces of the space sector and other industries position Australia well to take up growing manufacturing opportunities. Space manufacturing activity is supported by enabling capabilities such as quality assurance and standards certification testing, along with enabling engineering and design skills.

The Agency’s analysis found the space enablers segment to be the largest employer, very closely followed by the space applications segment. AlphaBeta’s analysis supports that applications and enablers were by far the two largest segments of direct space employment in FY19, however, AlphaBeta estimated significantly more jobs in applications than enablers. This variance is likely due to difference in samples, assumptions for how jobs are classified within value chain segments, and how jobs within organisations are distributed.

Direct space jobs only capture part of the space employment story. As outlined in Chapter 2, this report does not measure indirect jobs. International research suggests that a large portion of value from space activities is realised through indirect jobs, indirect revenues and other spillovers³⁷, suggesting this report’s estimates of jobs in the space sector are likely conservative. Quantifying indirect jobs may be explored for future economic snapshots.

4.3 Sector revenue (value)

Revenue provides an indication of the value generated from producing goods and services. The Agency’s analysis found that organisations in the Australian space sector generated \$4.6 billion in revenue in FY19; equivalent to 5.8 per cent revenue growth since FY17.

More broadly, global space industry revenue was valued at US\$360 billion in 2018, projected to grow at a compound annual growth rate (CAGR) of 5.6 per cent, to value US\$558 billion by 2026³⁸. Australia’s overall share of the global space industry was 0.9 per cent in FY19³⁹, a slight increase of 0.03 percentage points from FY17.

Revenue by value chain segment

Activities from each segment of the space value chain contribute to the overall sector revenue, as illustrated in Table 9.

Table 9: Australian space revenue contribution by space value chain segment

Year	Space manufacturing & core inputs	Space operations	Space applications	Space enablers	Total Revenue
FY19	\$777.6 m	\$473.0 m	\$1.4 b	\$1.9 b	\$4.6 b

³⁷ For example, indirect jobs were higher than direct jobs in both space sector reports for Canada and New Zealand - Canadian Space Agency (2019), State of the Canadian Space Sector, <https://asc-csa.gc.ca/eng/publications/2019-state-canadian-space-sector.asp#economic-jobs>; Deloitte Access Economics (2019), New Zealand Space Sector: Its value, scope and structure, <https://www.mbie.govt.nz/assets/new-zealand-space-sector-its-value-scope-and-structure.pdf>

³⁸ Research and Markets (2018), Global Space Industry Market and Technology Forecast to 2026 - https://www.researchandmarkets.com/research/p9gpjp/global_space?w=4

³⁹ Morgan Stanley (2020), Global space economy in 2019 was estimated at US\$355.4 billion (AU\$499.17) - <https://www.morganstanley.com/ideas/investing-in-space>

This analysis identifies space enablers as the highest value chain segment contributor to space revenues at \$1.9 billion in FY19. Enabler segment goods and services add value as intermediate inputs across the space value chain. (AlphaBeta estimated space enablers segment revenue at \$432 million⁴⁰. The difference in these estimates is due to different methodologies for categorising revenue from space activities to value chain segments.) Further detail on the Agency's methodology, data and assumptions is in Appendix A and AlphaBeta also discusses their estimation approach in more detail in their report.

Space applications also account for a significant proportion of the Australian space sector's value. This is unsurprising given that globally, space applications are considered to be the largest revenue generators, accounting for 54 per cent of the global space sector's revenue⁴¹. Space applications are capable of generating value through productivity and efficiency gains (which can result in cost savings, and thus improved profit margins).

While the space manufacturing and core inputs segment was responsible for less than a quarter of Australian space revenue in FY19, this is reflective of the small number of participants. Australia has an opportunity to capture a greater proportion of emerging markets such as small satellite manufacturing. An IBISWorld report states that manufacturing of satellite sub-systems (such as high-performance optics, radio communications equipment, on-board data processing systems and other satellite components) has emerged as a growing market for Australian manufacturers⁴².

The Australian Government's Modern Manufacturing Strategy identifies space as a priority area for action, as part of its commitment to scaling a strong, modern and resilient economy. The industry-led space manufacturing road map being developed as part of the Modern Manufacturing Strategy will help to identify the roadblocks to scaling manufacturing in the space sector and actions to overcome them. Globally, it is estimated that satellite manufacturing generated \$12.5 billion USD in revenues for FY19⁴³.

According to AlphaBeta's analysis of the Australian space sector, the operations value chain segment provides a potential global competitive advantage for Australia.⁴⁴ The Australian Government is making significant investments in projects like the Satellite-Based Augmentation System (SBAS) and the National Positioning Infrastructure Capability (NPIC). It is anticipated that the importance of the space operations segment will continue to increase. For example, demand for access to space situational awareness and debris monitoring services, a key priority area for the Agency, is only expected to increase as more satellites are launched into orbit. This extends a significant opportunity for Australian organisations to build their capabilities and capacities to service these growing needs and cement Australia's position as a leading global player in space operations.

Contribution to GDP

A sector's contribution to national Gross Domestic Product (GDP) is an indicator for the value it contributes to the economy.

⁴⁰ See Appendix B for discussion of methodological differences between previous studies.

⁴¹ AlphaBeta (2020), The Economic Contribution of Australia's Space Sector in 2018-19 - <https://www.industry.gov.au/sites/default/files/2021-02/the-economic-contribution-of-australias-space-sector-in-2018-19.docx>

⁴² IBISWorld (2020), IBISWorld Industry Report OD5545: Satellite Communications and Astronautics in Australia

⁴³ Statista (2020), Satellite manufacturing: worldwide revenues 2001-2019 - <https://www.statista.com/statistics/185975/world-revenues-of-the-satellite-manufacturing-sector-since-2001/>

⁴⁴ AlphaBeta (2020), The Economic Contribution of Australia's Space Sector in 2018-19 - <https://www.industry.gov.au/sites/default/files/2021-02/the-economic-contribution-of-australias-space-sector-in-2018-19.docx>

IBISWorld's industry value added estimates for the Australian space sector were \$1.8 billion in FY17 and \$2 billion in FY19⁴⁵. This equates to a contribution of approximately 0.1 per cent to GDP for FY19. Note, the Agency did not estimate value added and is therefore using IBISWorld's estimate. Further discussion of differences between previous studies is in Appendix B.

Space sector contributions to GDP are usually higher in leading space nations such as the US (1 per cent of GDP) and the UK (0.7 per cent of GDP)⁴⁶. The Australian space sector's lower contribution is reflective of the sector's nascent status in FY17 and FY19.

4.4 Spillover benefits

Growth in the space sector translates to growing benefits to the broader economy, as a large portion of value generated from space activities is delivered through spillover benefits (such as productivity and efficiency gains). To date, there has been a significant global effort to understand and value the spillover benefits of investing in space-related activities. International research suggests that a large portion of value from space activities is realised through indirect jobs, indirect revenues and other spillovers⁴⁷.

While it is difficult to quantify the spillover value stemming from the space sector, broader benefits and opportunities to maximise them are apparent across the economy. For example new remote and extreme environment medicine techniques can assist rural medical practices, advancements in robotics can automate agricultural activities, helping farmers manage their land, and next generation communication technologies can improve connectivity on Earth – all of which have potential to generate additional economic activity and productivity.

⁴⁵ IBISWorld (2020), IBISWorld (2020) Industry Report OD5545: Satellite Communications and Astronautics in Australia.

⁴⁶ AlphaBeta (2020), The Economic Contribution of Australia's Space Sector in 2018-19 - <https://www.industry.gov.au/sites/default/files/2021-02/the-economic-contribution-of-australias-space-sector-in-2018-19.docx>

⁴⁷ For example, indirect jobs were higher than direct jobs in both space sector reports for Canada and New Zealand - Canadian Space Agency (2019), State of the Canadian Space Sector, <https://asc-csa.gc.ca/eng/publications/2019-state-canadian-space-sector.aspx#economic-jobs>; Deloitte Access Economics (2019), New Zealand Space Sector: Its value, scope and structure, <https://www.mbie.govt.nz/assets/new-zealand-space-sector-its-value-scope-and-structure.pdf>

5. Looking forward

To complement the historical assessment of Australia's space sector in Chapters 3 and 4, this chapter provides a forward-looking assessment of the sector's potential future growth. It examines future capital investment in Australia's civil space sector and touches on possible impacts of the COVID-19 global pandemic on Australia's space sector.

5.1 Investment pipeline

The pipeline of planned investments in civil space sector projects, including R&D investment, provides an important leading indicator for its future growth.

As at September 2020, the Agency estimated investment activity in the period 2018 to 2028 of around \$2 billion associated with 90 identified projects. Some examples of recent investments in the sector include:

- A \$3 million Australian Government grant to manufacture lightweight rocket fuel tanks and make space transport more affordable – A collaboration between Gilmour Space Technologies, Teakle Composites and the University of Southern Queensland.
- The \$15 million International Space Investment initiative (funded by the Agency) also attracted just over \$2 million in cash co-contributions from industry, universities and international space agencies. It also attracted a significant amount of in-kind contributions (not included in the pipeline value).
- Myriota raised \$28 million in Series B funding to grow its satellite network.
- Fleet Space Technologies raised \$10.8 million to fund Internet of Things (IoT) connectivity to remote industries using nanosatellites.
- The Australian Government's \$19.5 million Space Infrastructure Fund aims to increase capability and fill gaps in Australia's space infrastructure.

Though many defence-related space investments are likely to impact the civil space sector, defence space investments have not been accounted for in this civil space capital investment pipeline. For example, while the Australian Government will invest \$7 billion in defence-related space capabilities, including investing in Australia's first fully owned and controlled military satellite communication constellation⁴⁸, this is not captured in the civil space investment pipeline.

Investment by source

Table 10 shows a breakdown of investment identified by the Agency, grouped by funding sources.

Table 10: Civil space committed capital pipeline for 2018-2028 by source of capital (as at September 2020)

SOURCE OF CAPITAL	\$m	% share
Australian Government	1,096.4	54.2%
Industry	627.5	31.0%
International Space Agencies	136.5	6.8%
State Government	111.3	5.5%
University	39.5	2.0%
Private Foundations	10.6	0.5%
Total⁴⁹	2,021.7	100%

⁴⁸ Australian Government media release (2020): Morrison Government invests in a new sovereign controlled satellite capability - <https://www.minister.defence.gov.au/minister/lreynolds/media-releases/morrison-government-invests-new-sovereign-controlled-satellite>

⁴⁹ Due to rounding, numbers presented in this chapter of the report may not add up precisely to totals provided and percentage shares may not precisely reflect comprehensive figures

Around \$774.6 million (38 per cent of total pipeline activity) is inbound capital investment in projects from industry, private foundations and international space agency partners. The Strategy identifies a target of \$1 billion in inbound capital investment by 2025. This provides an indication of interest in the potential for future performance in the space sector.

The ability of Australian space organisations to access finance should become easier as local and international investors (venture capitalists in particular) see growth potential in the sector. Further, AusTrade – the Australian Government’s investment promotion agency – identifies defence, advanced manufacturing and space as a growth area for foreign direct investment⁵⁰.

Venture capital is an important source of funding for growing space companies. A 2020 report by KPMG indicates that while Australian space firms such as Myriota, Gilmour Space Technologies and Fleet Space successfully completed funding rounds over the last two years, fewer than three per cent of the 587 venture capital funds that invested in space sector start-ups globally in the last two years, invested in Australian space companies. Australian space start-ups are more likely to attract seed funding from government grants, angel investors, and through self-financing.⁵¹

London Economics estimates that the lag between investments and spillover impacts for space projects are in the order of three to five years, with impacts realised sooner for companies providing downstream services or contract manufacturing services, and longer for companies developing their own products⁵².

Approximately \$1.2 billion (62 per cent) of the pipeline is attributed to government (Australian, state and territories) and university investments. This includes funding committed to the Agency and its programs, space-related programs within Geoscience Australia and CSIRO. It also captures funding provided to Cooperative Research Centres Projects (CRC-P) including SmartSat CRC and grants provided by the Australian Research Council (ARC).

Examining cash investments committed since FY19 indicates that Australia is beginning to see growing investment fuel new space projects, and increasing international attraction. Investment in the Australian space sector is growing in both civil and defence segments, which indicates high levels of investor confidence in the sector’s long-term growth potential.

In addition to the projects described above, the Agency is tracking (approximately) 30 further projects that have no (or unknown) committed cash funding.

Investment by location

Table 11 and Figure 2 provide a breakdown of the investment pipeline by location. Funding for a number of projects has or will be distributed across Australia and cannot accurately be attributed to a single location. For example, the Australian Government’s \$150 million Moon to Mars program is captured but grants under this program have not yet been made.

⁵⁰ AusTrade (2020), Invest in Australia, <https://www.austrade.gov.au/International/invest>

⁵¹ KPMG (2020), Investment in the Australian Space Sector - <https://home.kpmg/au/en/home/insights/2020/02/investment-in-the-australian-space-sector.html>

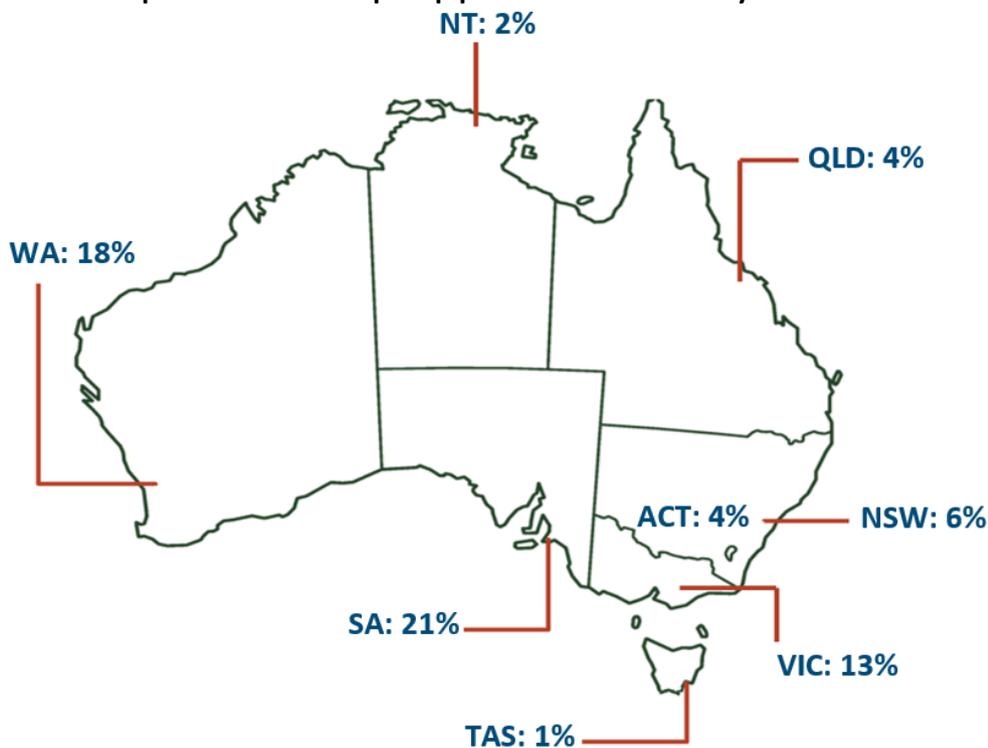
⁵² London Economics (2018), Spillovers in the space sector - https://www.ukspace.org/wp-content/uploads/2019/04/Spillovers-in-the-space-sector_March2019.pdf

Table 11: Civil space capital pipeline for 2018-2028 by location (as at September 2020)

Location	Total Investment \$m	% share	Inbound \$m	Inbound % share of total
South Australia	423.5	20.9%	277.7	65.6%
Western Australia	367.2	18.2%	70.0	19.1%
Victoria	258.2	12.8%	207.0	80.2%
New South Wales	121.7	6.0%	58.9	48.4%
Australian Capital Territory	90.0	4.4%	79.3	88.1%
Queensland	81.7	4.0%	40.0	49.0%
Northern Territory	41.1	2.0%	41.1	100.0%
Tasmania	11.3	0.6%	0.5	4.4%
Unallocated*	627.2	31.0%	0.0	0.0%
Total⁵³	2,021.7	100%	774.6	

* Unallocated refers to funding that is not yet allocated to a specific state or territory of Australia or funding that is split across multiple states.

Figure 2: Civil space committed capital pipeline for 2019-2028 by location



Unallocated: * 31%

* Unallocated refers to funding that is not yet allocated to a specific State or Territory of Australia or funding that is split across multiple states.

⁵³ Due to rounding, numbers presented in this chapter of the report may not add up precisely to totals provided and percentage shares may not precisely reflect absolute figures

Investment by sub-sector

Table 12 provides the breakdown of the 2018-2028 capital pipeline by sub-sectors and funding source.

Table 12: Civil space committed capital pipeline for 2018-2028 by sub-sector (as at September 2020)

Sub-sector	Total investment \$m	% share	Inbound \$m	Inbound % share of total
Communications technologies and services, including ground stations	420.4	20.8%	410.8	97.7%
Leapfrog R&D	375.3	18.6%	264.5	70.5%
Position, navigation and timing	368.3	18.2%	-	-
Planetary science and astronomy	354.1	17.5%	10.6	3.0%
Unallocated*	179.8	8.9%	-	-
Infrastructure	103.1	5.1%	5.0	4.9%
Launch, rockets and hypersonics	81.9	4.1%	65.5	80.0%
Earth observation	78.7	3.9%	-	-
Advanced manufacturing (e.g. space objects)	16.1	0.8%	9.1	56.4%
Robotics and remote asset management	14.2	0.7%	6.8	47.8%
Space medicine	11.0	0.5%	-	-
Education and training	11.0	0.5%	0.1	1.1%
Software and data	4.2	0.2%	-	-
Space situational awareness and debris monitoring	3.9	0.2%	2.2	56.7%
Total⁵⁴	2,021.7	100%	774.6	

**Unallocated refers to funding that has not yet been allocated to a sub-sector (e.g. state and territory government grants commitments that have not been allocated), or investments cutting across sub-sectors where splits are not available (e.g. Queensland Government funding for Earth observation, Launch, and Ground stations)*

The Communications and Ground Stations sub-sector, the largest civil space sub-sector, accounts for around 21 per cent of the investment pipeline, of which almost all (almost 98 per cent) is inbound investment.

Mostly funded by the Australian Government, major position, navigation and timing projects include Geoscience Australia's Satellite Based Augmentation System (SBAS) and National Positioning Infrastructure Capability (NPIC).

The Leapfrog R&D sub-sector accounts for the second largest share of the investment pipeline. Most investment is inbound, rather than funded by government or universities. This is indicative of productive industry-research collaboration, which can lead to significant indirect impacts to the economy. A report by London Economics indicates that every £1 of expenditure on R&D in the space sector has been associated with a further £0.43 to £6.00 in impact⁵⁵.

5.2 Impacts of COVID-19

While this report focuses on Australia's space performance between FY17 and FY19 and future investment pipeline, it is important to recognise the potential future impacts of the COVID-19 pandemic from early-2020.

Space is a key enabler of the economy, opening up new capabilities and new markets for existing industries such as manufacturing and advanced technologies. Many space technologies and applications are supporting

⁵⁴ Due to rounding, numbers presented in this chapter of the report may not add up precisely to totals provided and percentage shares may not precisely reflect absolute figures

⁵⁵ London Economics (2018), Spillovers in the space sector - https://www.ukspace.org/wp-content/uploads/2019/04/Spillovers-in-the-space-sector_March2019.pdf

and enabling remote services and communications, helping businesses and communities in unprecedented conditions. Accordingly, the space sector is a potential driver for recovery and exposed to downturns in other sectors of the economy.

The OECD observed in mid-2020 that the full impacts of COVID-19 on the global space industry are yet to be determined and figures quantifying that impact are not yet readily available⁵⁶. However, according to a report released by Quality Analytics on 18 March 2020, it is anticipated that several areas within the global space industry will fare better than other industries because demand for many space services is largely undiminished by the pandemic⁵⁷.

The activities of Australia's space sector (and the Australian economy more broadly) will be impacted by uncertainty and changing economic conditions. Overall, current indications are that the Australian space sector has so far proven comparatively resilient.

In spite of early concerns about the resilience of various sectors at the start of the COVID-19 pandemic, offshore investment in the Australian space sector has continued – with recent commitments captured in the investment pipeline above. As at December 2019, the Agency estimated the pipeline for activity between 2018 and 2028 was approximately \$1.7 billion (including 71 projects). As at September 2020, the Agency estimates pipeline activity between 2018 and 2028 to be \$2 billion (including 90 projects). While a number of these projects are government-funded and others were already underway and only identified during this period, the capital investment pipeline figures suggest there is strong interest in Australia's space sector over the next decade.

The Australian Government's investment through the International Space Investment initiative, the Space Infrastructure Fund and the Moon to Mars program, and the Modern Manufacturing Strategy, will further enhance Australia's opportunities for future growth in the space sector.

⁵⁶ OECD (2020), The impacts of COVID-19 on the space industry - <http://www.oecd.org/coronavirus/policy-responses/the-impacts-of-covid-19-on-the-space-industry-e727e36f/>

⁵⁷ SpaceNews 2020, Space should fare better against coronavirus than other industries, report says <https://spacenews.com/space-may-fare-better-against-coronavirus-than-other-industries-report-says/>

Appendix A – Methodology and data

This appendix outlines details of the Agency's methodology, data and assumptions used to produce this report.

Methodology

In developing this report the Agency created the most comprehensive firm-level database of space organisations in Australia, drawing on independent supporting work from the Nous Group and AlphaBeta (part of Accenture). For further detail, see Data section, below.

The Agency identified and classified space sector organisations into stratified samples (stratas) for each year of analysis (FY17 and FY19). Each year of analysis contained four stratas: small (1-19 employees), medium (20-199 employees), large (200+ employees) and unknown size organisations.

For revenue and jobs indicator calculations, the Agency applied the same step-wise process to calculate space revenue and space jobs figures (noting that data for each year and each indicator was analysed and processed separately). For determining FY19 space revenue, a linear regression of space revenue was used to interpolate missing space revenue values in each strata. The mid-point of upper and lower modelled figures was used in the reported sum of sector space revenue for FY19 (\$4.6 billion).

This methodology is repeatable to inform future economic snapshots approximately every two years, providing continued insights into the changes in Australia's space sector. The Agency will also continue to maintain, refine and update the supporting datasets to ensure consistent measurements of the Australian space sector into the future.

Data

The Agency is currently tracking 816 organisations that either operate in the Australian space sector, or demonstrate strong linkages with space through space-adjacent industry activities, transferable capabilities to space, or significant dependence on use of space-enabled technologies/services.

The Agency's database was compiled using information from a number of sources:

- The Agency collects organisation-level data and information about space related or adjacent organisations through its engagement activities, and its subscriptions to providers such as IBISWorld and Million.
- The Agency has subscribed to access the Space Industry Association of Australia's (SIAA's) space capability database. The Agency's database utilises relevant information from SIAA's rich database of over 500 organisations that are involved with or interested in space.
- The Agency procured the services of the Nous Group to conduct an Australia-wide economic survey of space-related organisations. Outcomes of this survey were integrated into the Agency's organisation-level database.
- The Agency is part of the Department of Industry, Science, Energy and Resources (the Department), and therefore was able to incorporate organisation-level data from the Department's Customer Relationship Manager (CRM) system. The CRM links organisation data from the Australian Business Register, and grant applications to the Australian Government.

These data are presented in this report in an aggregated manner to ensure confidentiality and privacy, as appropriate. For further detail on how these were brought together, see Assumptions section, below.

Of the 816 organisations of interest, the Agency classified 432 organisations as operating in the Australian space sector in FY17, which increased to 481 in FY19⁵⁸. The Agency applied the Definition of the Australian space sector (see Chapter 2) to classify organisations as part of the sector.

The Agency acknowledges that in the broader space economy there are many additional space adjacent firms with transferrable capabilities, and many more firms that are highly dependent on space technologies and services, which were not identified in the Agency database. For example, AlphaBeta's analysis of adjacent sectors identified 4,000 firms with transferable capability.

Key variables in the Agency database include: size, value chain segment activity, organisation age, Australian headquarters location, sub-sector, jobs and revenue. No industry code matching the space sector definition for space exists under the Australia and New Zealand Standard Industrial Classification (ANZSIC). ANZSIC codes for organisations were recorded, but were not used in the Agency's analysis due to observed variance in codes registered to space organisations that conduct similar activities or operate in similar markets.

Assumptions

Assumptions were used to provide a consistent scope and consistent categorisation of organisations. Inconsistency with any one of the Agency's assumptions will result in variance to Agency estimates (as demonstrated by AlphaBeta and IBISWorld figures).

Key assumptions for the Agency's analysis included:

- Space activities are defined as per the Definition of the Australian space sector (see Chapter 2).
- Space-related defence activities are included in revenue and jobs estimations, as distinguishing between civil and non-civil activities was not practicable for this report.
- For activities to be carried out, they require minimum inputs in the form of: demand or need, relevant resources (e.g. funding, staff, and infrastructure), and relevant capabilities (comprised of components such as skills and capital).
- A space sector organisation is an organisation that conducts some amount of activity in at least one space sector value chain segment. This includes private industry, not-for-profit organisations, government, universities, research organisations, and foreign owned organisations operating in Australia.
- Organisations were categorised according to their size as small (1-19 employees), medium (20-199 employees), large (200+ employees) and unknown size organisations.
- Each organisation can conduct its space activities in one or more value chain segments. Where an organisation operates in more than one segment, it is assumed that its space activities, space employees and space revenue are distributed equally between those segments. (Note that this assumption could be improved in future with availability of additional data.)
- An organisation's type(s) of space activities in FY17 fall into the same value chain segment(s) as in FY19. (Note this assumption can be improved in future with access to additional information.) However, an organisation's ratio of the amount of space to non-space activity conducted can vary from year to year.
- An organisation's total jobs headcount comprises all paid individuals in space-related and non-space roles. This includes, casual, part-time and full-time roles. (Note volunteers are not counted.)
- Direct space jobs headcounts include all paid individuals in space sector organisations that work on space activities, and all paid individuals whose work role exists only as a result of the space activity being undertaken as the primary activity of the employing organisation (or where space activities account for

⁵⁸ Note, not all 816 organisations were operating in FY17, some of them were established between FY17 and FY19. Both the number of space organisations in FY17 of 432 and FY19 of 481, are a subset of the larger 816 sample of organisations that are being tracked by the Agency.

at least 80 per cent of organisation revenue). This includes casual, part-time and full-time roles. (Note volunteers are not counted.)

- An organisation's total revenue includes all space and non-space revenue. For research and government organisations revenue may include grants, administered or departmental funding for space activities where appropriate.
- An organisation's space revenue includes all revenue generated from the sale of space products and services. It does not include revenue generated from non-space products and services.
- Space capital investment includes cash committed since 1 July 2018 to a space project in Australia. It does not include the value of in-kind commitments (such as labour hours or equipment purchase). Space projects include commercial and research projects that conduct space activities and/or build capabilities or infrastructure with a primary goal to enable immediate space activities to occur.

Appendix B - Previous studies

This Appendix provides a high-level comparison of this report and the findings of previous studies of Australia's space sector.

Measuring space sector activity is a complex task and variation of estimates between studies is to be expected, reflecting the use of different data samples, scope, assumptions, methodologies and indicators. These are common issues for valuation of emerging sectors in Australia and around the world.

- Compared to the ERG's original estimates for FY16 (prepared in 2017), the Agency's estimates were generated using a much larger sample, providing greater confidence that estimates are representative of the whole sector.
- AlphaBeta's estimates for FY19 were based on a sample of a larger number of space organisations, owing to a different set of assumptions and methodology used to categorise organisations, whereas the Agency's categorisation was more conservative.
- Higher estimates by IBISWorld are likely because these estimates provide a snapshot of the Australian satellite communications and astronautics industry – which is a broader scope of activity than the 'space sector' as defined by the Agency in line with the OECD's best practice guidance.

In short, the Agency analysis relies on richer data (in particular for SMEs) drawing on the Agency's regular engagement with the sector, and utilisation of the data from the Department of Industry, Science, Energy and Resources datasets, Illion, the Space Industry Association of Australia and other sources.

Further, to ensure rigor, the Agency's estimates have been informed by independent studies to provide a balanced position on how these figures can be interpreted and used within the limitations of the data. This was necessary due to a lack of consistent, reliable and publicly available information on the sector.

For these reasons, the Agency's estimates provide a reliable snapshot of the Australian space sector.