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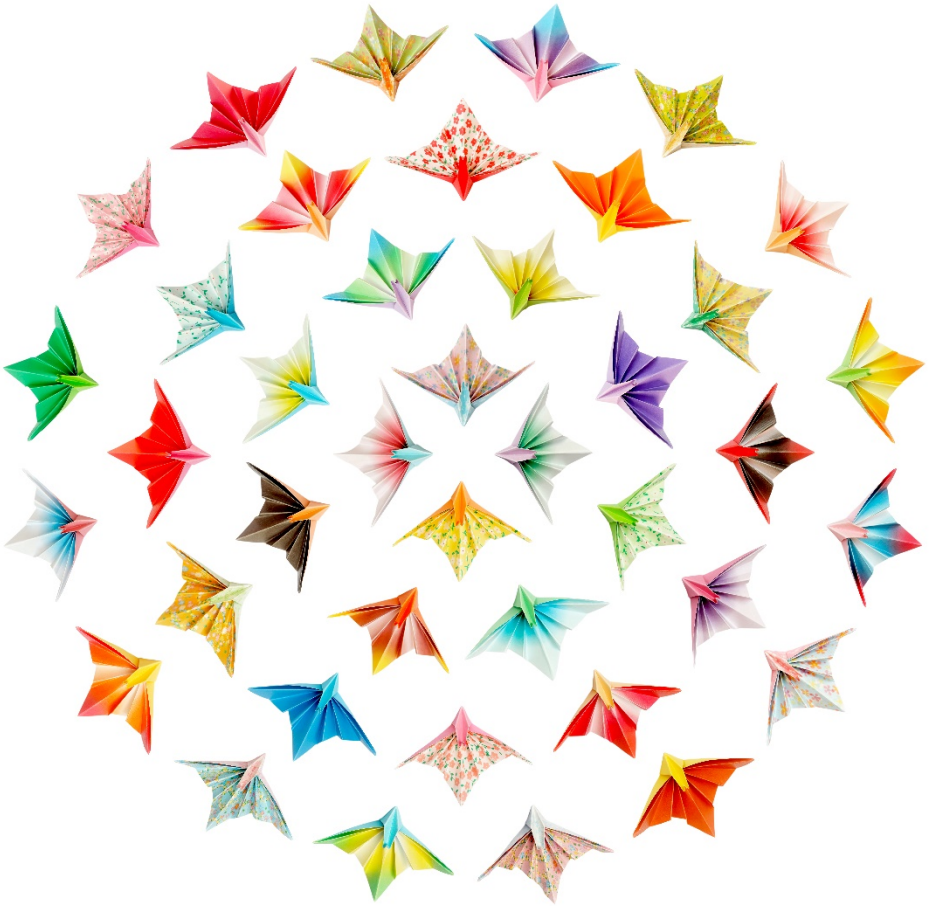
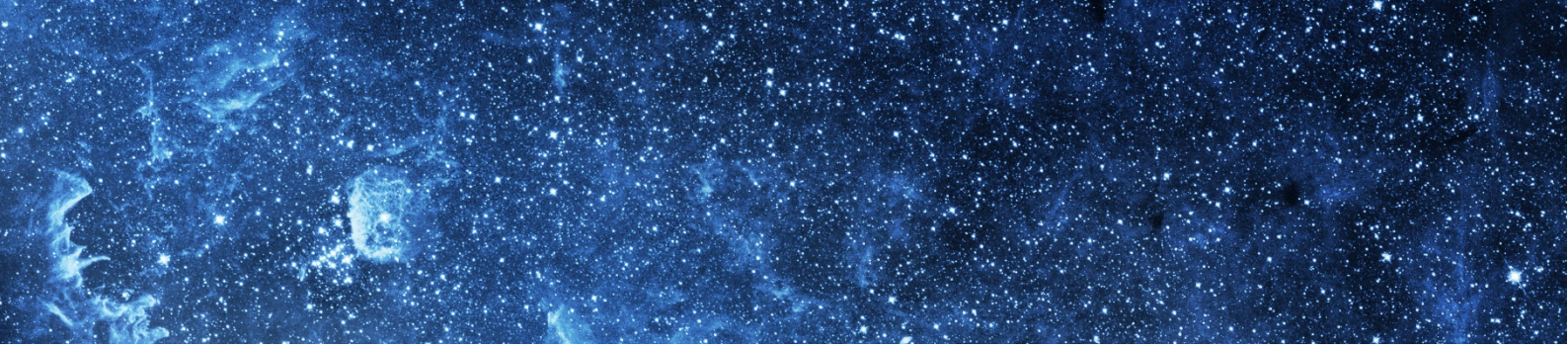


In Space Together

Reasons to Strengthen Australia-Japan Space Collaboration

Spring 2025



Executive Summary

Japan and Australia have consistently demonstrated their ability to achieve success through their enduring political, economic, and cultural ties. As global demand for space-based capabilities intensifies, the moment is ripe for Australia and Japan to deepen their collaboration in the space sector.

Australia's unique geographical position in the Southern Hemisphere, combined with its vast landmass and radio-quiet remote areas, offers significant advantages for supporting global space missions. This advantage, along with Australia's full cooperation and support, was highlighted during Japan's Hayabusa2 mission, where the Woomera Test Range served as the landing site for the asteroid sample return, showcasing Australia's value in space exploration.

The strategic, political, and environmental alignment between Australia and Japan, reinforced by shared regional security interests, provides a solid foundation for expanding their space initiatives. Through frameworks like AUKUS, Australia is poised to grow its capabilities in advanced technology and space situational awareness, complementing Japan's own advancements and strengthening their collective influence in the Indo-Pacific.

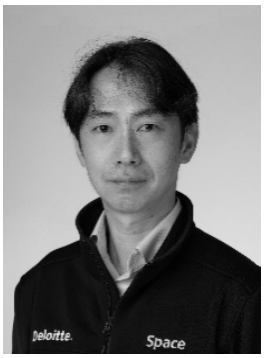
As the space market expands, driven by trends like technological innovation, frequent launches, and the need for resilient supply chains, both countries are well-positioned to seize these opportunities. Their robust policy frameworks, strategic investments, and dedicated funding initiatives make this the perfect moment for deeper cooperation. As space technologies become essential to sectors such as agriculture and mining, enhanced collaboration between Australia and Japan can drive innovation, bolster regional security, and promote sustainable development.

Four key factors drive the Australia-Japan space partnership: combining scientific and technological expertise to boost innovation and education, expanding global market access, strengthening regional security, and advancing environmental sustainability. These elements underscore the strategic benefits of their deepening alliance in the evolving space sector.

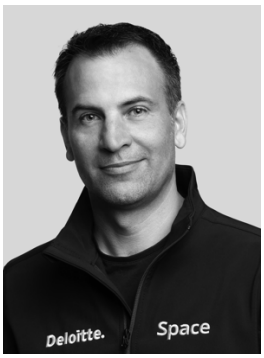
Effective collaboration in space technology also requires clear agreements on intellectual property rights, adherence to international space law, and compliance with technology transfer and export control regulations. Addressing language barriers, protecting confidential information, and aligning on international standards are essential for seamless cooperation.

By aligning their complementary strengths and shared goals, Australia and Japan are set to drive technological innovation, bolster regional security, and advance sustainable development in the Indo-Pacific and beyond.

Together, our nations can continue to unlock new frontiers in space exploration, fostering a future built on innovation, resilience, and shared progress.



Sosuke Nagayama
Partner | Deloitte Space



Jason Bender
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エグゼクティブ・サマリー

オーストラリアと日本は、その長きにわたる友好的な関係のなかで、政治的・経済的・文化的な強い結びつきが両国の思い描く未来の実現につながるということを様々な場面で示してきました。宇宙の開発や利用に対する需要が世界的に高まるなかで、両国には今、宇宙分野においてもこのような結びつきと協力関係をより一層深めていくことが求められているのではないでしょうか。

南半球に位置し広大な国土と広範な電波的不感地帯を持つというオーストラリアの地理的条件は、グローバルな宇宙ミッションに大きな恩恵をもたらします。オーストラリアによる全面的な協力や支援の下に遂行された日本の「はやぶさ 2」ミッションでは、多くの人がこの地理的優位性を目にすることになりました。ウーメラ実験場が小惑星サンプルリターンの着陸地点となったこのミッションは、宇宙探査におけるオーストラリアの価値の大きさを、人々に印象付けたと言えるでしょう。

国家の戦略、政治、環境、さらには安全保障の観点においてオーストラリアと日本の関心は共通するところが多くあり、これは両国の宇宙分野での協力を拡大するための強固な基盤になると考えます。AUKUS などの枠組みを通じてオーストラリアは先進技術と宇宙状況把握（SSA）のケイパビリティを高めており、これらが日本の技術革新と連携することで、両国のインド太平洋地域における影響力の向上にもつながっていくものと期待されます。

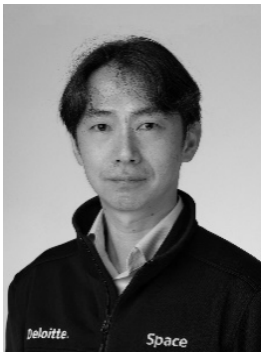
技術革新、打ち上げ頻度の増加、強靭なサプライチェーンといったトレンドが映し出すように、宇宙開発の舞台は拡大の一途を辿っていますが、強力な政策的枠組み、戦略的投資、宇宙分野に特化した資金調達イニシアティブをともに有する両国は、このような機会を形にしていくうえで非常によい関係にあると言えます。例えば、農業や鉱業などの分野で宇宙技術が不可欠となる中、オーストラリアと日本がより強力に連携しあえば、イノベーションをより活性化し、地域の安全保障を強化し、また持続可能な開発を大きく推進することができるのではないでしょうか。

両国の宇宙パートナーシップを推進するには 4 つの重要な要素があります。科学技術の粋を組み合わせてイノベーションと教育を促進すること、グローバル市場へのアクセスを拡大すること、地域の安全保障を強化すること、そして環境の持続可能性を高めることです。絶えず発展を続ける宇宙分野において両国がともに利益を得ていくためには、両国が戦略的にその協力関係を深めていく必要があります。

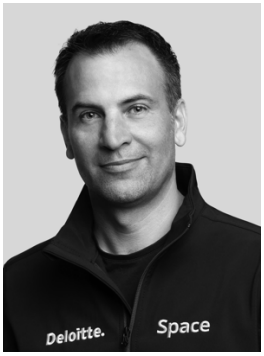
宇宙技術分野において効果的に連携するには、知的財産権、国際宇宙法の遵守、技術移転及び輸出管理規制の遵守に対する明確な合意も必要です。言語の壁に対処し、機密情報を保護し、国際基準に足並みを合わせることが、シームレスな協力のためには不可欠です。

オーストラリアと日本が互いにその強みを発揮し、意を同じくすれば、技術革新の推進、地域の安全保障の強化、インド太平洋地域及びその他の地域における持続可能な開発の推進は成されるはずです。

両国の歩みは、宇宙の新たなフロンティアを開拓し、イノベーションやレジリエンス、共創する進歩の上に、互いの未来を築いていくものになると信じています。



長山 聡祐
パートナー| Deloitte Space



ベンダー ジェイソン
パートナー | Deloitte Space

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Introduction

Beginning as "the distant mystery" back in the 1950s with the launch of the first satellite, space has evolved into an accessible realm, not just for a few pioneering nations but also for an increasing number of governments and commercial entities. These actors view space as a valuable opportunity, a potential risk, and the final frontier to explore for national interests and commercial gains. While space was once primarily seen as a platform for scientific advancements and a means of achieving national prestige, today, multiple countries and commercial players are investing in space initiatives, ranging from exploration to national security, with the goal of obtaining real and tangible returns.

As the space race heats up, space-related headlines dominate global news, highlighting the increasing importance of global collaboration in this frontier. In a rapidly expanding and complex space industry, addressing all the challenges by single nation alone has become less attractive option, or even unfeasible in many cases, for most of the countries. This is where the collaboration between Australia and Japan becomes crucial. By merging their complementary capabilities, these two nations can drive innovative solutions across technological, geographical, economic, and political spheres, making their partnership more relevant than ever.

This report aims to delve deeper into the reasons why Australia and Japan should collaborate in the space sector. By analysing the current market landscape, we will explore the potential benefits and opportunities such a partnership can offer. From technological advancements and economic growth to strategic geopolitical positioning and enhanced national security, this collaboration holds the potential of addressing critical challenges and unlocking new possibilities in the space industry.

This report is designed to benefit a wide range of stakeholders in the space industry. Policymakers and government officials will gain insights into the strategic advantages of fostering international partnerships. Industry leaders and business professionals will find valuable analysis on market opportunities and technological innovations. Academics and researchers can explore new avenues for collaborative projects and studies. Ultimately, this piece aims to inform and inspire all those invested in the future of space exploration and commercialisation, emphasising the critical role of Australia-Japan collaboration.

Through our teams in Australia and Japan, Deloitte Space hopes this article will foster further conversations among governments, corporations, universities, research institutions, and other related organisations in Australia and Japan.

Why Australia and Japan?

A History of Australian and Japanese Collaboration

The key to success in the space industry is collaboration. From research and development (R&D) of space technology to the operation of space initiatives, working across hemispheres enables the development of technologies and capabilities that would be impossible for either country alone.

In 2020, the Australian Space Agency and the Japan Aerospace Exploration Agency (JAXA) signed a Memorandum of Cooperation (MOC) to explore new opportunities in the space field. While this has cast a spotlight on the collaboration between the two nations, a look back at history shows that it is not the first instance of cooperation between Australia and Japan.

TABLE 1 | Summary of Historical Collaboration Between Australia and Japan in the Space Context

Year	Project	Description
1990-2000s	Development of the 'Cangaroo' Gamma-ray telescopes	The CANGAROO (Collaboration of Australia and Nippon for a Gamma Ray Observatory in the Outback) project was a joint venture between Australia and Japan to investigate cosmic gamma rays. The project involved the construction of gamma-ray telescopes in the Australian outback, where the clear skies and low light pollution provided ideal conditions for observations. Scientists from both countries collaborated on the design, construction, and operation of the telescopes, as well as the analysis of the data collected.
1996	Trials of the Japanese Automatic Landing Flight Experiment at Woomera	The Automatic Landing Flight Experiment (ALFLEX) took place at the Woomera Test Range in Australia. The location provided ideal infrastructure for the experiment, while Japan brought the technical expertise and the experimental vehicle, and it was conducted by the National Space Development Agency of Japan (now JAXA).
2002	Launch of Australia's FedSat	Federation Satellite (FedSat), an Australian research satellite built by the Australian Cooperative Research Centre for Satellite Systems (CRCSS), was launched in December 2002 from the Tanegashima Space Center (TNSC) in Japan using Japan's H-IIA launch vehicle.
2002 / 2005	NEXST-1 supersonic flight experiments at Woomera	The National Experimental Supersonic Transport (NEXST-1) aircraft flight experiment was conducted at the Woomera Test Range in Australia. Initiated by JAXA, the project aimed to test and validate technologies for next-generation supersonic aircraft. Australia provided the ideal testing environment and logistical support, while Japan led the project's technical aspects.
2010	Return of Hayabusa-1	When JAXA's Asteroid Explorer HAYABUSA's capsule returned to Earth, it landed in the Woomera Prohibited Area (WPA) in South Australia. Despite the restricted area being inaccessible to the public, the JAXA team was able to retrieve it thanks to the support of the Australian government.
2020	Return of Hayabusa-2	When JAXA launched HAYABUSA-2, the landing location was discussed and the WPA in Australia was chosen again. The Australian government once again supported Japan in this effort.

Case Study: HAYABUSA2

Hayabusa2 is a pioneering mission led by JAXA designed to explore the asteroid Ryugu. Launched in December 2014, the mission aimed to collect samples from the asteroid's surface and bring them back to Earth, providing valuable insights into the early solar system's formation and the building blocks of life. Selecting a suitable landing site for the sample return capsule was crucial to the mission's success.

In an interview article by Asahi Shimbun*, JAXA Institute of Space and Astronautical Science (ISAS) Deputy Director General Dr. Masaki Fujimoto and Hayabusa2's Project Sub-Manager Dr. Satoru Nakazawa discussed the specific requirements for the landing site. Australia was identified as one of the only countries meeting all these requirements:

Illustration by Akihiro Ikeshita

- Spacious and flat area with minimal population
- Located in the southern hemisphere (considering the orbital route of HAYABUSA-2)
- Easily accessible
- Land-based site (not ocean) because:
  - ✓ The capsule cannot be recovered if it sinks.
  - ✓ The technology to catch objects from space in mid-air remains beyond reach for practical use, even though NASA is actively developing it.
- Strong diplomatic relations with Japan and local cooperation:
  - ✓ The JAXA team needed to transport the sample back to Japan from Australia within 100 hours to prevent atmospheric contamination, under strict regulations concerning the importation of space-sourced materials. Australia was "extremely cooperative with the complicated procedures involved," according to the HAYABUSA-2 team.
  - ✓ Another example includes coordination with the local fishing boat association during the landing process to manage their schedules and prevent potential damages from falling objects. This negotiation was crucial as JAXA could not directly engage with local businesses in Australia.

As demonstrated by this case, establishing collaborative efforts in the space sector is not a task that can be accomplished solely by local companies. It necessitates the involvement and support of government entities, given the international nature of space activities which involve complex international regulations and considerations.

* [In Japanese] https://www.asahi.com/articles/ASP14226SNDRUHBI030.html

Space-related collaboration between Australia and Japan has spanned many years, including the sharing of scientific knowledge and human resources, as well as providing and utilising landing sites for spacecraft. While respecting the history of past collaborations and the bonds they have formed, we will explore what makes Australia and Japan ideal partners for future collaborations in the following section.

Compatibility of Australia and Japan

Australia and Japan have repeatedly demonstrated that their compatibilities across many areas make them effective collaborators. The vast and unique geographic and environmental conditions of Australia provide a strategic advantage in space exploration and research, important for the types of ambitious missions both countries can undertake.

Australia's Unique Geographical Position

Australia, the sixth largest nation in the world by land area, has a relatively small population of 27 million.[1] The majority of its population resides near the coast in a few large cities. The continent's unique position allows its sensors to observe parts of space that are not visible from the northern hemisphere. Its remote areas are exceptionally radio quiet, making them ideal locations for radio observatories and ground stations that support space science initiatives from the US, Europe, and Japan.

Additionally, the vast landmass and geographical diversity of Australia offer unique advantages for space exploration and research. The remote deserts provide optimal conditions for testing rovers and other space technologies designed for planetary exploration. This environment closely mimics the harsh conditions found on Mars and the Moon, facilitating rigorous testing and development.

Strategic and Political Alignment

A key factor in successful collaboration is the alignment of strategic, economic, and political interests between nations, such as a shared commitment to democracy, human rights, and the rule of law, along with common approaches to international security.

One illustrative example of Japan's commitment to shared strategic interests is the "Free and Open Indo-Pacific" (FOIP) strategy. This concept was unveiled by Prime Minister Abe in his keynote address at Tokyo International Conference on African Development (TICAD) VI in Kenya in August 2016, aiming to foster regional stability and prosperity by improving connectivity between Asia and Africa through a free and open Indo-Pacific region.

The three pillars of the FOIP strategy are:

1. Promotion and establishment of the rule of law, freedom of navigation, and free trade.
2. Pursuit of economic prosperity (e.g., improving connectivity).
3. Commitment to peace and stability.

As an inclusive vision, the FOIP strategy welcomes cooperation with allies and partners in the region. Australia, sharing similar values, aligns closely with Japan in this regard. Both countries focus their space development efforts on scientific, commercial, and peaceful purposes, highlighting their commitment to these shared principles.

For example, Australia and Japan both identified space situational awareness as one of their priority areas. They share a common understanding of the importance of monitoring and managing space debris for the safety and sustainability of space activities. Both nations recognise that space debris poses a significant threat to operational satellites, space stations, and astronauts, emphasising the need for mitigation efforts. JAXA has been actively researching ways to remove space debris, including the use of electrodynamic tethers and laser systems. Australia, with its unique geographical location and advanced radar and optical facilities, plays a crucial role in tracking space debris and predicting potential collisions. Furthermore, both countries are members of the Inter-Agency Space Debris Coordination Committee (IADC), an international governmental forum for coordinating activities related to space debris. These efforts illustrate a shared value and mutual commitment between Australia and Japan in addressing the challenge posed by space debris.

Space domain awareness (SDA), which is frequently used as a concept of integrating SSA-based metric observations and intelligence, is gaining importance and interest more from defence and national security globally. Australia and Japan are not exceptions. In addition, due to increasing national security needs, both countries have signed an Acquisition and Cross Servicing Agreement on defence logistics cooperation, and an Information Security Agreement on the sharing of classified information. These agreements stem from the 2007 Joint Declaration on Security Cooperation (JDSC), which was renewed in 2022. Through these initiatives, security and defence cooperation has become one of the important pillars of the bilateral relationship between Australia and Japan.

[1] Australian Bureau of Statistics, https://www.abs.gov.au/statistics/people/population

Beyond the strategic alignment, Australia and Japan also share a commitment to environmental sustainability and climate resilience. They both actively collaborating to achieve net zero emissions future through the Japan-Australia Partnership on Decarbonisation through Technology. [2]

Enhancing Strategic Capabilities through AUKUS

AUKUS, a trilateral security partnership between Australia, the United Kingdom, and the United States, was launched in September 2021 to strengthen defence and security cooperation, particularly in the Indo-Pacific region. It emphasises enhanced information and technology sharing, focusing on defence-related science and innovation.

The partnership consists of two main efforts: Pillar I, which facilitates Australia's acquisition of nuclear-powered submarines, and Pillar II, which focuses on joint capabilities in cyber, artificial intelligence, and quantum technologies. In December 2023, Pillar II expanded to include advanced space radar capabilities aimed at global monitoring of geosynchronous orbits, accelerating shared space capabilities development.

The AUKUS partnership, particularly Pillar II, indirectly benefits Australia in its collaboration with Japan. This trilateral alliance not only strengthens Australia's strategic position in the Indo-Pacific but also promotes a secure environment conducive to joint space initiatives. Additionally, the technological and strategic advancements fostered by AUKUS, such as in cyber capabilities and space situational awareness, can enhance Australia's contributions to shared projects with Japan, aligning with mutual goals for regional stability and technological progress in space realm.

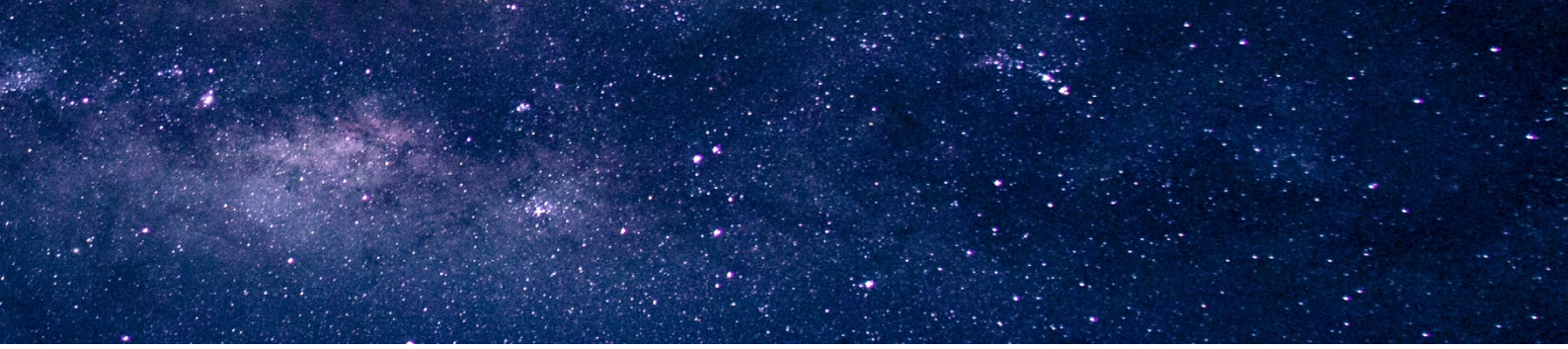
Space Debris:

As space activities intensify, the volume of debris left in orbit also increases. Space debris represents a significant threat to both manned and unmanned space missions. Scientific models estimate around 29,000 space debris objects over 10 cm, 670,000 over 1 cm, and more than 170 million over 1 mm in Earth's orbit*.

There are ongoing efforts to develop technologies and policies aimed at minimising the creation of new debris and mitigating the risks associated with existing debris. Furthermore, the concept of sustainability in space extends beyond debris management to include the responsible use of celestial resources, as nations and private entities increasingly explore the possibilities of space mining.

* The European Space Agency - https://www.esa.int/Space_Safety/Clean_Space/How_many_space_debris_objects_are_currently_in_orbit

[2] Japan-Australia Partnership on Decarbonisation through Technology, https://www.mofa.go.jp/files/100199970.pdf



Why Now?

Expanding Space Market

The global space market is undergoing a significant transformation, driven by an increasing number of private entities, evolving technologies, and a shift from government-led to commercial activities. The global space economy, valued at US $630 billion in 2023, is projected to surge to US $1.8 trillion by 2035 [3]. The Asia Pacific region, home to economic powerhouses like Japan and emerging markets such as Australia, is witnessing rapid advancements in this sector.

Japan has made remarkable strides in both the scientific and commercial sectors. JAXA, the country's space agency, has spearheaded numerous space explorations and break-through of multiple technological challenges by working closely with industrial companies. According to a report by Society of Japanese Aerospace Companies (SJAC), the Ministry of Economy, Trade, and Industry (METI) aims to double Japan's space industry market size from 4.0 trillion yen (US $27 billion) in 2020 to 8.0 trillion yen (US $54 billion) in the early 2030s[4]. Meanwhile, Australia, although a relative newcomer to the space industry, has demonstrated immense potential and ambition. Established in 2018, the Australian Space Agency aims to triple the nation's space economy to AUD 12 billion (US $8.1 billion) and create 20,000 jobs by 2030[5].

Major Trends

The space industry is undergoing rapid transformation, driven by technological innovation, and changing market dynamics. Here are some of the key trends reshaping the landscape of space exploration and commercialisation:

- **Innovation in Technology / Participation of Startups:** Following the Cold War, the space sector has transitioned significantly. The deregulation and opening up of space technologies to the private sector have led to a proliferation of private space businesses and stimulating innovation in the space industry. As a result, numerous startups have entered the space industry, expanding its development beyond traditional governmental confines.
- **Mass Production and Cost-effective, Frequent Launches**: Rocket launches have become more frequent and cost-effective, particularly in the United States and other developed nations. This trend is revolutionising how we access space, making it more routine and accessible.
- **Increased Importance of Supply Chain**: The space industry's growth has brought about a new emphasis on resiliency and stableness of supply chains. This trend underscores the importance of partnering with countries that share similar values and objectives. Purchasing behaviours within the industry would be affected and tackling larger and more complex challenges through enhanced ecosystem engagement may be required. By fostering a shared supply chain, nations and companies can leverage collective expertise and resources to drive innovation and growth.
- **Growing Reliance on Space Technologies by Adjacent Industries**: Sectors like mining, agriculture, and environmental management are increasingly dependent on space-based technologies for real-time data, precision mapping, and resource monitoring. The integration of satellite communications, Earth observation, and navigation systems has become critical for optimising operations and boosting productivity in these industries, further driving demand for space capabilities.
- **International Collaborations**: International cooperation in space activities enhances global security and stability by fostering peaceful relations and reducing the risk of conflict, while also addressing global challenges such as climate change and disaster management through shared satellite data and technology. Collaborative efforts promote the sustainable use of space, ensuring that space traffic, debris, and resource management are handled responsibly for future generations. Additionally, these partnerships accelerate scientific and technical advancements by enabling the exchange of expertise and innovations, benefiting all participants, and reducing redundancy.

[3] McKinsey & Company, Space: The $1.8 trillion opportunity for global economic growth, https://tinyurl.com/vda6wr64
[4] The Asahi Shimbun, "Japan to create 1-trillion-yen fund to bolster space business", https://tinyurl.com/4vvy28jm
[5] The Australian Space Agency, https://tinyurl.com/yvrxcby5

Elements of Space Activities and Actions of Australia and Japan

As described in Deloitte Australia's, "Building the Space Nation[6]" report, organisations operating in the space environment resemble a complex and evolving ecosystem, characterised by multiple interdependent systems. Organised around a shared vision for the future, this ecosystem acts as a magnet to draw in organisations and present opportunities for cooperation and collaboration across seemingly unconnected networks. In order to activate the nations' space activities, the following paragraphs are examples of actions being taken by members of the space ecosystem.

From Government: Establishing Funds

- **AU – Advancing Space Capabilities**: The Australian Space Agency plays a central role in coordinating national efforts in space exploration and technology development, including Earth Observation (EO) technologies. Since its establishment in 2018, the Australian Space Agency has facilitated multiple government grants to support the growth of the space sector, including the Space Infrastructure Fund, which involved an investment of AUD 19.5 million. Additionally, the AUD 150 million Moon to Mars initiative supports Australian businesses and researchers in joining NASA's Artemis program. Currently, there are several government programs designed to build capabilities in priority areas identified by the government, and the space sector, as a technological enabler, may be eligible for support through these initiatives.

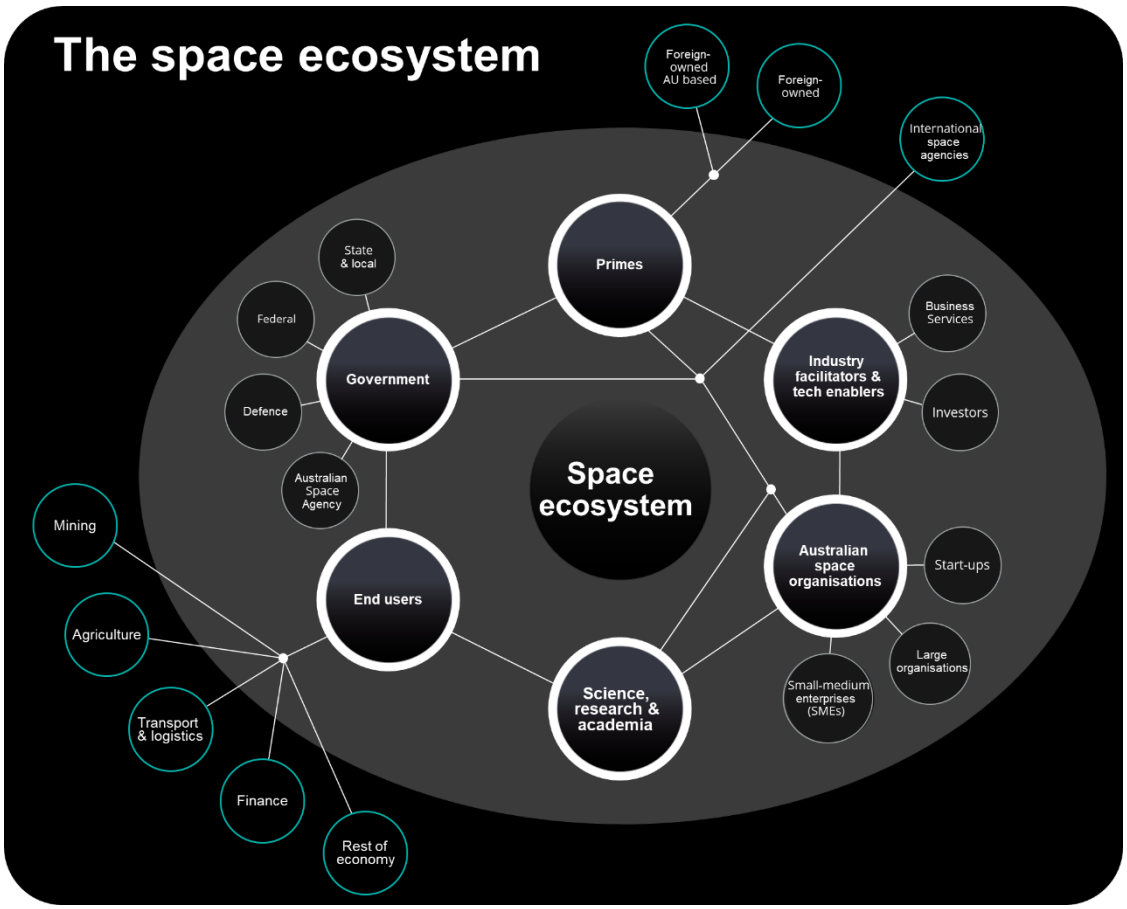


FIGURE 1 | The Space Ecosystem, Source: Building the Space Nation

[6] Deloitte Australia, Building the Space Nation, https://www.deloitte.com/au/en/Industries/technology/perspectives/building-space-nation.html

- **JP – Innovation in Technology**: In November 2023, Japan's Cabinet announced its first-ever space funding scheme to accelerate domestic space technology development. The 10-year Space Strategy Fund aims to raise approximately USD 6.5 billion (1 trillion yen) through contributions from the Ministry of Education, Culture, Sports, Science, and Technology (MEXT), the Ministry of Internal Affairs and Communications (MIC), and the Ministry of Economy, Trade, and Industry (METI). Managed by JAXA, the fund outlines a strategic 10-year plan focused on key priorities, including the mass production of solid motors, strengthening satellite constellation supply chains, and developing advanced batteries for deep space exploration. This initiative is designed to provide long-term, yet flexible, support to private companies and universities, promoting technology development and commercialisation in the space sector. JAXA issued its first call for proposals in July 2024, with funding expected to be awarded by the end of the year.

From Government: Policy, Law, and Regulatory Framework Updates

- **AU – Updates on Space Laws**: In 2018, Australia updated its space law framework by enacting the Space (Launches and Returns) Act, which replaced the previous Space Activities Act of 1998. This new legislation offers a more streamlined approach to the licensing and regulation of space activities, enhancing the efficiency of both commercial and research space missions.
- **JP – Updates on Space Laws and Policies**: Following the establishment of the Basic Space Act in 2008, Japan introduced two significant regulations in 2016: the Space Activities Act and the Satellite Remote Sensing Act. These laws were designed to create a licensing framework for non-governmental space launches and the use of high-resolution satellite data, reflecting the growing role of non-governmental space activities in Japan. The goal was to provide streamlined regulations that stimulate the country's commercial space sector. While the Space Activities Act and Satellite Remote Sensing Act may require updates or new provisions to address areas such as licensing for re-entry vehicles, spaceports, range control, and on-orbit services like active debris removal or commercial space station modules, these frameworks currently offer much-needed predictability for conducting business in space. In addition, Japan's national space policy, the Basic Plan on Space Policy, has undergone four updates since its inception in 2009. The latest revision, announced in February 2023, emphasises the integration and protection of defence space architectures to address the evolving geopolitical dynamics in the Indo-Pacific region. Although the establishment of the Strategic Space Fund is not explicitly mentioned in the Basic Plan, it is implied as a crucial step toward bolstering Japan's commercial space industry and advancing its technological capabilities.

From Primes, Government, and End Users: Creating Demand and Supplying in Market

- **AU - Development of Capabilities**: Australia is developing its launch capabilities to reduce reliance on international launch services. Companies like Southern Launch and Equatorial Launch Australia are developing spaceports to support growing global and regional demand for access to space and returns. Gilmour Space is working to achieve affordable and efficient launch solutions for small and medium-sized payloads. In addition, EO and remote sensing are becoming significant components of Australia's space activities. Investments in these technologies are aimed at improving environmental monitoring, disaster management, and resource management. The demand for space-enabled services, such as satellite communications, EO, and satellite navigation, is on the rise. These services are crucial for various industries including agriculture, mining, and disaster management. Australia is leveraging its strengths in these areas to drive productivity and innovation across multiple sectors.
- **JP – Public – Private Partnership and National Security**: The increased need for national security has accelerated the public-private relationship of certain space functions in Japan, notably through the operation of information gathering satellites by Japan's Self-Defence Forces. This shift was facilitated by the amendment of the Basic Space Law in 2008, which allows space utilisation to "ensure the security of the country." Further emphasising this shift, Japan's cabinet office released the "Space Security Concept," which outlines a space architecture for national security. This includes a significant role for EO satellites, increasingly vital in responding to climate change, security, and socioeconomic environmental shifts. The concept of satellite constellations is featured prominently, with the Ministry of Defence securing budgets and establishing a new procurement method known as "anchor tenancy." This contract type between the government and private companies involves the government committing to purchase products and services in a manner that supports the development and stabilisation of new and emerging industries and markets.

From Science, Research, and Academia: Advancing Education

- **AU - Education and Research Contributions**: Australian universities and research institutions are pivotal in advancing space science, focusing on areas such as Earth observation (EO) for environmental monitoring, satellite technology, and planetary science. Institutions like the Australian National University (ANU) and the University of Sydney are actively engaged in space-related research and innovation, contributing to developments in data analysis, remote sensing, and space exploration.
- **JP – Advancing Research in Space Technologies**: Japanese universities and research institutions, including the University of Tokyo and Tohoku University, are central to space innovation, with a focus on satellite technology, space robotics, and planetary exploration. These institutions also play a significant role in global climate monitoring efforts through satellite-based research and development. JAXA's partnerships with these academic institutions strengthen Japan's capabilities in EO and data analysis, aligning with its broader goals of promoting environmental sustainability and addressing climate change.

The figure below shows space infrastructure and launch facilities across Australia.

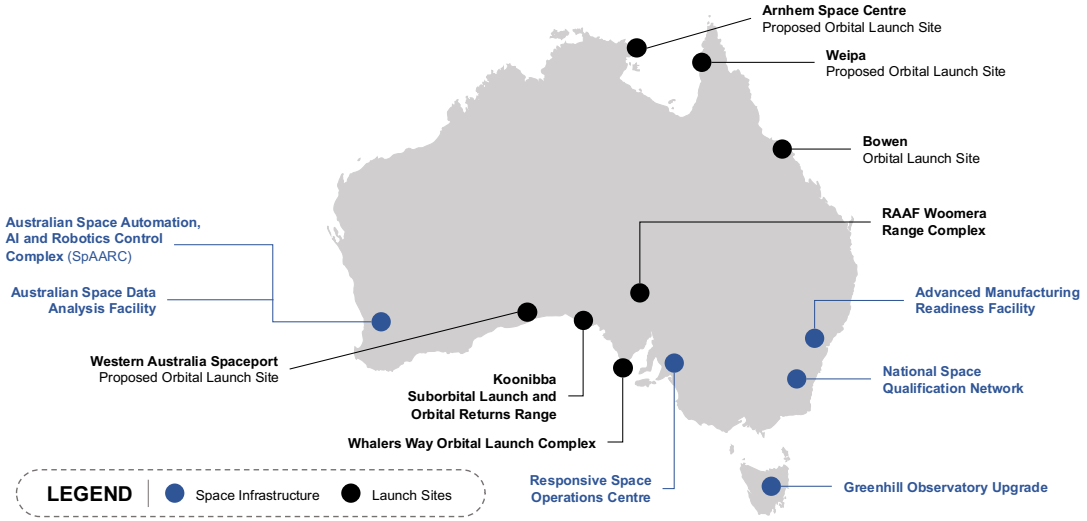


FIGURE 2 | Space Infrastructure & Launch Facilities in Australia

Western Australia

- **Australian Space Data Analysis Facility (ASDAF)**: This facility focuses on space data analysis, supporting the processing and utilisation of data from various space missions and satellites.
- **Fugro SpAARC (Space Automation, AI, and Robotics Control Complex)**: This company specialises in the automation and control of space robotics and AI systems, contributing to advancements in robotics and automation for space applications.
- **Western Australia Spaceport**: Planned to serve as a commercial spaceport.

South Australia

- **Saber Astronautics Responsive Space Operations Centre (RSOC)**: This centre provides mission control capabilities, supporting the responsive operations of space missions, including satellite management and space situational awareness.
- **Koonibba Test Range**: Rocket testing facility, primarily used for suborbital launches and testing of space payloads.
- **Whalers Way Orbital Launch Complex**: Commercial spaceport and rocket-launching facility.

Tasmania

- **University of Tasmania Greenhill Observatory Upgrade**: This upgrade enhances the observatory's capabilities for space observation, contributing to space situational awareness and astronomical research.

New South Wales

- **Advanced Manufacturing Research Facility:** This facility focuses on research in advanced manufacturing techniques essential for developing space hardware and technology.

Australian Capital Territory

- **National Space Qualification Network (NSQN)**: This network facilitates the qualification of space payloads and technologies, ensuring they meet the rigorous standards required for space missions.

Queensland

- **Bowen Orbital Spaceport**: A launch site designed to support low to mid inclination equatorial orbits.
- **Weipa Spaceport**: A proposed multi-use spaceport.

Northern Territory

- **Arnhem Space Centre**: A commercial launch site supporting polar and equatorial orbits. In December 2024 it announced that it will be relocating to Queensland.

The figure below also shows space infrastructure and launch facilities across Japan:

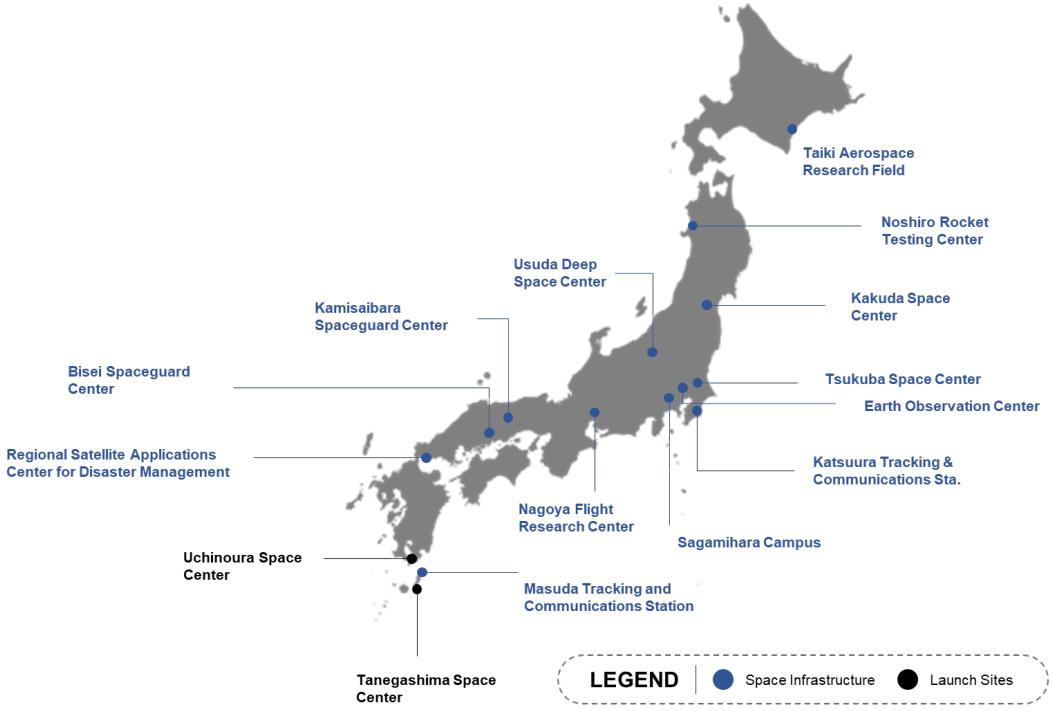


FIGURE 3 | Space Infrastructure & Launch Facilities in Japan

Taiki Aerospace Research Field: Focuses on rocket and satellite research, suborbital launches, and aerospace testing.

Noshiro Rocket Testing Center: Used for the development and testing of rocket engines and components.

Kakuda Space Center: Specialises in liquid rocket engine development and testing for Japan's space programs.

Tsukuba Space Center: A central hub for JAXA operations, including satellite development, astronaut training, and mission control.

Earth Observation Center: Focuses on satellite-based Earth observation for climate monitoring and disaster management.

Katsuura Tracking and Communications Station: Supports satellite tracking, command, and control operations.

Sagamihara Campus: Hosts research and development facilities, supporting planetary exploration missions and space science.

Bisei Spaceguard Center: Specialises in space debris observation and research to protect Earth's orbital environment.

Nagoya Flight Research Center: Engages in aerospace research, including flight dynamics and vehicle development.

Uchinoura Space Center: Launch site for smaller rockets like Epsilon, used for scientific and satellite missions.

Tanegashima Space Center: Japan's main launch facility for large rockets, such as the H-IIA, deploying satellites into space.

Masuda Tracking and Communications Station: Offers tracking and telemetry services for space missions.

Regional Satellite Applications Center for Disaster Management: Supports disaster response by leveraging satellite data for monitoring and management.

Usuda Deep Space Center: Provides communication support for deep space missions, including interplanetary probes.

Kamisaihara Spaceguard Center: Observes Near-Earth objects (NEOs) and tracks potential asteroid threats.

Reasons to Collaborate

Overview

Previous discussions have highlighted the strong compatibility between Australia and Japan, supported by expanding needs in the space sector. By combining their strengths, both nations are well-positioned to pursue ambitious space missions and drive innovation.

Factors Influencing Entry into the Space Industry

While there are numerous reasons why organisations and companies choose to venture into the space field, here are some key factors driving their involvement:

- **Scientific Discovery**: To deepen our understanding of the universe and uncover the secrets it holds.
- **Technology Advancement**: To develop technologies that enhance everyday life, such as improvements in satellite communications and GPS systems.
- **Economic Gain**: To explore new economic opportunities, including space tourism and the commercialisation of space-derived products.
- **National Security & Diplomacy**: To enhance national security through improved EO capabilities, which also play a crucial role in global diplomacy.
- **Environmental Monitoring & Climate Change**: To leverage satellite technologies for tracking and addressing environmental changes, aiding in climate change mitigation, disaster response, and resource management.
- **Human Survival**: To consider the long-term sustainability of human life, exploring options for mitigating potential disasters or climate change effects on Earth by considering other planets as potential habitats.
- **Pure Ambition/Aspiration**: Beyond practical considerations, the sheer drive to achieve and explore new frontiers plays a fundamental role in the human pursuit of space exploration.

Various Ways to Collaborate

In today's interconnected space economy, the potential methods for collaboration are vast and multifaceted. Countries and companies can join forces in a myriad of ways to achieve common goals and drive mutual growth, as outlined below:

- **Joint Ventures**: This model provides an excellent platform for combining resources, expertise, and market access. In joint ventures, parties share ownership, operational responsibilities, and ultimately, the rewards of their collective efforts.
- **Partnerships and Alliances**: These allow entities to work together while maintaining their individual autonomy. Such arrangements can lead to synergistic outcomes that exceed what each party could achieve alone.
- **Research-to-Business Collaboration**: Connecting research institutions with commercial enterprises is essential for turning innovative ideas into market-ready solutions. Such collaboration can speed up the development of new technologies, fostering quicker adoption and integration within the space sector.
- **Government to Government (G to G) Collaborations**: These serve as conduits for policy alignment, diplomatic cooperation, and large-scale initiatives that can shape the course of nations.
- **Government to Business (G to B) Collaborations**: These collaborations can help foster innovation, stimulate economic growth, and address societal challenges. Governments can support businesses through funding, policymaking, and creating conducive environments for their operation and growth.
- **Business to Business (B to B) Collaborations**: These can be powerful tools for businesses to expand their market reach, enhance their product or service offerings, and improve their competitive stance. This model is particularly effective in sectors where innovation and adaptability are keys to success.

Key Reasons for Collaboration: Achieving Greater Impact Together

We have identified four main reasons that highlight the value of collaboration. Each of these reasons is explored in detail in the subsequent sections:

1. Complementing Scientific and Technological Expertise and Increasing Educational Opportunities
2. Gaining Global Market Access and Commercial Opportunities
3. Strengthening National and Regional Security and Diplomacy – Elevating International Influence & Presence
4. Advancing Environmental Sustainability and Climate Resilience through Space-Based Solutions

Case Study: The Australian National Beamline Facility at the KEK Photon Factory

The Australian National Beamline Facility (ANBF) at the High Energy Accelerator Research Organisation (KEK) in Tsukuba, Japan, represents a successful collaboration between Australia and Japan in the scope of scientific research and technology sharing.
Established in 1992, the ANBF provided Australian scientists access to KEK's advanced synchrotron radiation facilities, enabling high-quality research in materials science, biology, environmental science, and other fields. The infrastructure was designed and built in Australia at ADFA in Canberra and the CSIRO then Division of Materials Science and Technology in Melbourne and managed in Japan by three young scientists from ANSTO: Richard Garrett, David Cookson and Gary Foran.
This partnership emerged from Australia's recognition of the need for advanced synchrotron facilities. The Australian Synchrotron and ANSTO were instrumental in setting up and managing the ANBF, while KEK offered critical infrastructure and support. The collaboration had led to numerous high-impact scientific publications and patents, underscoring the facility's contribution to scientific advancements. Joint research projects had facilitated technological advancements and knowledge exchange, enhancing the capabilities of both nations. The partnership also offered valuable training and educational opportunities for Australian researchers and students at KEK.
In 2007, the Australian Synchrotron was officially opened in Melbourne and after more than twenty years of service, the ANBF was retired in 2013 and its iconic instrument, an in-vacuum diffractometer dubbed “Big Diff”, was brought back to Australian shores where it was displayed at the Australian Synchrotron as a reminder of the early days of synchrotron science in Australia.
The ANBF marked a pivotal moment in Australia's scientific relationship with Japan, fostering high-profile collaborations in synchrotron and neutron science. This partnership facilitated the establishment of regional Asia-Oceania networks in these fields, strengthening ties and advancing research capabilities for both nations.

Reason #1:

Complementing Scientific and Technological Expertise and Increasing Educational Opportunities

Australia and Japan both possess unique strengths in the space sector that have fostered their individual growth and capabilities. By combining these strengths, both nations have the opportunity to leverage and build on each other's expertise to accelerate innovation. It is widely acknowledged that diverse teams are better equipped to solve complex problems and are ultimately more innovative.

Japan's involvement in space development dates back to 1950s and has since established its advanced status in the field by sending its own spacecraft to the Moon and asteroids. This early involvement has enabled Japan to develop a comprehensive range of space technologies and infrastructure, although it does not yet include manned transport rockets.

Japan currently faces challenges in scaling its space products, primarily due to limited demand. Historically, these products have been manufactured as bespoke items, resulting in slower adoption of mass production compared to countries like the United States, where cost reduction and lightweight technology have advanced. While limited testing capabilities and site availability are contributing factors, they are just one aspect among several broader challenges that Japan faces in scaling its space industry.

Components used in space products must withstand the extreme conditions of outer space, including radiation, vacuum, and high temperatures. However, Japan has a limited number of radiation testing facilities, and the high cost of using these resources poses a significant barrier to small businesses seeking to enter the space market. To advance its space development, Japan could focus on creating a more accessible ecosystem that encourages broader industry participation, enabling businesses to manufacture space products and equipment at scale and at lower costs.

Meanwhile, Australia is emerging as a significant player in the space sector with its rapidly growing industry. Contrary to popular belief, Australia has a long history of involvement in space, well before the establishment of the Australian Space Agency. The country's journey into space began with the establishment of a Minitrack station at Woomera in 1957 and a Baker-Nunn camera observatory in 1958. A decade later, Australia launched its first sovereign satellite, the Weapons Research Establishment Satellite (WRESAT), from Woomera in 1967.

Despite these early achievements, Australian space companies and organisations have exciting opportunities to collaborate with international launch service providers including Japanese ones, given the limited domestic options. This global engagement enables Australian entities to establish strong international partnerships, access advanced technologies, and benefit from the expertise of established launch providers worldwide. In return, Australia offers state-of-the-art testing facilities as mentioned in the previous section. One of these facilities is the National Space Qualification Network (NSQN), which conducts space environmental testing and evaluates prototype spacecraft. The NSQN possesses world-class capabilities and advanced instrumentation, providing the highest level of mission assurance prior to launch. These facilities offer comprehensive testing services, including thermal vacuum testing, vibration testing, pyroshock testing, electromagnetic interference/compatibility testing, low Earth orbit (LEO) atomic oxygen interaction testing, and access to a large cleanroom for assembly and integration activities. All testing facilities in Australia are open to both national and international customers, fostering a collaborative environment that enhances the global space industry.

To further strengthen and complement the collaboration between Australia and Japan in the space sector and considering that nearly 1 in 60 people in Australia study Japanese language[7], it would be beneficial to consider the establishment of advanced educational opportunities such as exchange and internship programs between the two countries for high school and university students. Such proposed programs would enable students to gain hands-on experience in different aspects of space technology and operations, exposing them to diverse methods and practices.

High school students could be offered summer programs or short-term exchanges focusing on STEM (Science, Technology, Engineering, Mathematics) education and space science. These programs could include visits to space facilities, participation in space camps, and collaborative projects that encourage innovation and creativity.

University students could benefit from semester-long exchange programs where they attend courses at partner institutions and participate in collaborative research projects. These exchanges would be enriched by internships at leading space agencies and companies in both countries, providing practical experience and professional networking opportunities. More opportunities for internships and jobs after school in both Japan and Australia may ultimately help

[7] Consul-General of Japan in Sydney's Newsletter, https://www.sydney.au.emb-japan.go.jp/document/CGKiya_20newsE.pdf

ease the issue of Japan's students not entering the space sector after graduation. According to research[8], only 20-30% of students who complete aerospace engineering at the University of Tokyo work in aerospace-related jobs. This example highlights the lack of human resources in Japan's space sector. Similar situation exists in Australia; a recent Policy Advice Paper by Engineers Australia[9] highlights a desperate shortage of adequately trained engineers and scientists required to support the efforts of establishing a sovereign space industry.

Such educational exchanges would not only enhance the skills and knowledge of students but also build a strong foundation for future collaboration in the space sector between Australia and Japan. By investing in the next generation of space professionals, both countries can ensure sustained growth and innovation in their respective space industries.

[8] [In Japanese] https://www8.cao.go.jp/space/comittee/27-kiban/kiban-dai28/pdf/sankou1-3.pdf
[9] Growing and Sustaining Australia's Space Engineering Capability and Competency, Engineers Australia, https://www.engineersaustralia.org.au/sites/default/files/2024-02/Space-Policy-Advice-Paper.pdf

Reason #2:
Gaining Global Market Access and Commercial Opportunities

Both Australia and Japan already enjoy significant global market access, with established relationships with major space agencies such as NASA and the European Space Agency (ESA). Australia also maintains strong alliances with New Zealand and the UK, while Japan collaborates extensively with other International Space Station (ISS) partners. By intensifying collaboration on space missions, both nations can further enhance their global market access in several ways:

- **Market Awareness**: Collaborative efforts will enable Australia and Japan to access a wider global market for space-related products and services, improving specific market awareness and access in both countries.
- **Expanded and Diversified Service Lineup**: Through collaboration, Australia and Japan can diversify their offerings, providing a broader range of services to meet global customer needs. This diversification not only increases their activity in the global space market but also allows them to share costs and mitigate risks associated with space projects.
- **Access to New Markets**: Joint, successful collaborations can capture the interest and attention of other countries and organisations, leading to potential partnerships and opening doors to new markets.
- **Increased Investment Opportunities**: Collaborative projects often attract attention from investors looking for promising ventures in the growing space sector. By showcasing successful joint initiatives, both countries can attract more significant investments, which can fund further research, development, and commercial activities.

Japan is already Australia's second-largest trading partner, its second-largest export market, and third-largest source of imports[10]. Given these strong economic relationships, further collaboration in the space sector has the potential to unlock new commercial opportunities for industries within both Australia and Japan. One promising area for such collaboration involves tapping into the Asian market for rocket launching by leveraging Japan's technology alongside Australia's facilities. Asia is witnessing a significant increase in demand for space services, driven by rising investments in satellite deployment, space exploration, and technological advancements. Countries like China, India, South Korea, and emerging space nations in Southeast Asia are actively expanding their space capabilities. This surge in demand presents a substantial opportunity for reliable and cost-effective launch services. By combining Japan's cutting-edge rocket technology with Australia's advantageous geographic location and state-of-the-art testing facilities, the partnership can effectively tap into this growing market, offering competitive and comprehensive solutions to meet Asia's increasing needs.

In addition to tapping into the Asian market, this collaboration between Australia and Japan has the potential to open up larger markets in the US and Europe. Both regions boast well-established space industries with a high demand for advanced technologies and reliable launch services. By presenting a united front, Australia and Japan can significantly enhance their appeal to these markets, offering integrated services that cater to a diverse range of space missions. The strategic alliances and technological expertise from both countries can help secure contracts and partnerships with major players in the US and European space sectors. Leveraging the combined capabilities of Australia and Japan will not only attract interest from these new markets but also strengthen their positions in existing ones, creating a more robust global presence in the space industry.

[10] Australia's Chief Scientist, Australia and Japan – enduring partners in science, https://www.chiefscientist.gov.au/news-and-media/australia-and-japan-enduring-partners-science

Reason #3:

Strengthening National and Regional Security and Diplomacy – Elevating International Influence and Presence

Australia and Japan's strategic geographic locations and shared diplomatic values create significant opportunities for collaboration to enhance the monitoring capabilities of both nations and their surrounding areas. A prime example is the Quasi-Zenith Satellite System (QZSS), Michibiki, a four-satellite regional satellite navigation system developed by the Japanese government. This system, designed to enhance the United States-operated Global Positioning System in Asia-Oceania, predominantly focuses on Japan. Its unique "infinity sign" orbit over Japan provides comprehensive coverage, which could be expanded to include Australia. This expansion would facilitate the sharing of critical data between Australia and Japan, significantly enhancing security and surveillance capabilities under initiatives like Ocean Surveillance of the Indo-Pacific. Such collaboration would not only strengthen regional security but also elevate the international stature of both countries within this strategic corridor.

Furthermore, the AUKUS Pillar II alliance, while not including Japan as a member[11], aligns with the shared strategic interests of maintaining a free and open Indo-Pacific. The collaboration between Japan and Australia in space development supports the broader objectives of AUKUS, particularly in enhancing space situational awareness, protecting critical space infrastructure including cyber, and ensuring the resilience of space-based systems. These technological and strategic advancements fostered by AUKUS would also contribute to enhance space domain awareness capabilities in both nations.

Both Australia and Japan, alongside AUKUS partners, are committed to upholding a rules-based international order in space. This commitment includes adherence to norms and principles promoting responsible behaviour, such as preventing the weaponisation of space and ensuring the safe and sustainable use of space resources. With these shared values, Australia and Japan are ideally positioned as compatible partners for collaboration in space initiatives, further stabilising and securing the Asia-Pacific region. As countries increasingly prioritise domestic production of equipment, forming an alliance between Australia and Japan presents a strategic advantage. By creating a relationship where both nations complement each other's technologies and supply chains, they can enhance their respective capabilities and resilience. This alliance would facilitate the sharing of expertise, resources, and innovation, leading to the development of cutting-edge technologies and more robust supply chains.

For instance, Japan's advanced technological expertise in satellite and space systems can be complemented by Australia's strategic geographic location and growing space infrastructure. This partnership can lead to the co-development of technologies and systems that enhance national security, such as satellite communications, navigation, and EO systems. Collaborating on supply chains ensures that both countries can maintain a steady and secure supply of critical components and materials, reducing reliance on external sources and enhancing overall security.

Further collaboration could involve joint efforts in environmental monitoring through satellite constellations and data sharing. Jointly developed constellations could provide expansive coverage of both Australia and Japan. By combining resources, the two nations can deploy a larger number of satellites equipped with diverse sensors, improving monitoring accuracy and environmental management.

Integrating data from multiple sources and sensors across both countries can significantly enhance monitoring capabilities, providing a comprehensive understanding of regional dynamics. As the collaboration progresses, a common data-sharing platform could be established to efficiently process large volumes of data.

Such collaborative initiatives not only demonstrate the commitment of both nations to sustainable development and disaster management but also strengthen their diplomatic relationship and inspire further cooperative ventures. Ultimately, this partnership could amplify the global voice of both Australia and Japan, showcasing their united strength and innovative capabilities on the international stage.

[11] At the time of writing this report, Japan is being considered for co-operation in the AUKUS alliance.

Reason #4:

Advancing Environmental Sustainability and Climate Resilience through Space-Based Solutions

Australia and Japan's collaboration in space holds significant potential to drive environmental sustainability and climate resilience in the Asia-Pacific region. Both nations recognise the importance of using space-based technologies to monitor, analyse, and respond to pressing environmental challenges such as climate change, natural disasters, and resource management. By leveraging satellite constellations and EO systems, they can provide detailed data on climate patterns, land use, deforestation, and ocean conditions, enabling more informed decision-making.

Joint initiatives could focus on the development of satellite systems specifically designed for environmental monitoring. These satellites can be equipped with advanced sensors to track greenhouse gas emissions, assess the impact of climate change on ecosystems, and support disaster response efforts. By combining Japan's technological expertise in satellite manufacturing with Australia's strategic geographic advantages and expanding space infrastructure, both countries can co-create robust space-based solutions that improve environmental management and disaster preparedness.

The CSIRO's AquaWatch[12] program, which aims to monitor the quality of inland and coastal waters through satellite and ground-based systems, exemplifies Australia's commitment to using space technologies for environmental monitoring. Collaboration between Australia and Japan in such initiatives could expand the reach of AquaWatch, enhancing data collection and analysis capabilities to better manage water resources and support ecosystem health in both countries and beyond.

According to the World Economic Forum (WEF)[13], there is an urgent need for greater collaboration in the EO sector to establish shared standards that align with regional and global environmental goals. Australia and Japan are well-suited to contribute to this effort, combining their technological strengths and innovative approaches to support progress in environmental sustainability.

Ultimately, their partnership in space-based environmental initiatives will not only reinforce their strategic alliance but also amplify their leadership on the global stage. By advancing climate resilience and sustainability through innovative technologies, Australia and Japan can position themselves as key drivers of a more secure and sustainable future.

[12] AquaWatch Australia - https://www.csiro.au/en/about/challenges-missions/aquawatch
[13] World Economic Forum, Amplifying the Global Value of EO 2024, https://www3.weforum.org/docs/WEF_Amplifying_the_Global_Value_of_Earth_Observation_2024.pdf

What to Consider When Collaborating

When collaborating across hemispheres, there are several important factors to consider. Below are key points to pay attention to when developing, manufacturing, and delivering space technology in an international partnership.

FIGURE 4: Space Products Life Cycle considerations

Intellectual Property Rights: It is important to clearly agree in advance on the ownership and usage rights of the technology and knowledge generated by joint research. This includes intellectual property rights such as patents, copyrights, and trademarks.

Space Law: International space law applies to space activities. This includes the Outer Space Treaty, the Rescue Agreement, the Liability Convention, the Registration Convention, and the Moon Agreement. These provisions limit activities in space, regulate the use of space resources, and define the responsibilities of countries.

Compliance with National Policies: Each country has its own space-related policies and regulations, which have become increasingly complex as space development advances globally. Adhering to these policies is essential when entering the global market. Moreover, it's important to consider that satellites and vehicles traverse multiple countries, requiring respect for the regulations of all nations they encounter.

Language Difference: Since Japanese is the first language for most Japanese people, language differences can pose challenges. These differences may require additional time and resources for language training or hiring translators and could lead to misunderstandings of nuances or terminology.

Technology Transfer Regulations: Many countries strictly regulate the transfer of advanced technologies for reasons of national security, often including space technologies such as missile and satellite technologies. Therefore, it is essential to comply with relevant technology transfer regulations when conducting joint research.

Export Control: The international transportation of related equipment and parts must comply with export and import control regulations. These regulations vary by country, so it is important to check the specific laws and guidelines of each country involved.

Confidential Information Protection: If confidential information of researchers or data involving individuals is transferred internationally as a result of joint research, it is necessary to comply with the confidential information protection laws of each involved country.

International Standards: International standards for space equipment ensure compatibility, safety, and reliability. Different standards adopted by each country for the same type of equipment or systems can cause compatibility issues. Aligning them after a project or mission has started can result in additional costs and time. Therefore, it is important to address the scope and apply common standards among companies and agencies participating in the collaboration.

Technology Acquisition Approaches: When procuring technology from the private sector to solve space-related challenges, the Japanese government typically presents both the problem and a specific technological solution, seeking companies capable of realising this solution. In contrast, the Australian government presents only the problem, allowing companies, including startups, to propose their own technological solutions. Recently, Japan has been shifting towards the Australian model to enhance the involvement of companies, including startups with advanced and unique technologies. However, there are still differences in the approaches as described above.

Deloitte's Involvement in Space

The opportunities ahead—and above

The space ecosystem is changing. What once was a domain accessible only to government entities or billionaires, space now affects nearly every aspect of life on Earth. Earth observation for defence and climate monitoring, satellite-based positioning for navigation, research and development for pharmaceuticals, robotics for brain surgery, and global communications: We all depend on space.

As government and commercial entities enter or expand their presence in the space frontier, new challenges will likely arise in their business operations. Success, from a business perspective, may not come easily—consultancies may play a valuable role in helping companies prepare for the challenges and competitors they will face in the new space market.

For more than 175 years, Deloitte has advised clients through industrial and technological revolutions. And Deloitte Space—Deloitte's cross-business and cross-industry focused offering—is ready to help you lead this new revolution.

Enabling the ecosystem of space

Deloitte offers a unique depth and breadth of space experience with a globally connected space practice footprint in more than 15 countries, with clients ranging across the civil, defence, and commercial sectors. Our team of scientists, technologists, and advisers has launched rockets, deployed satellite remote-sensing systems, implemented global telecom solutions, managed ground operations, analysed the commercial space economy, and secured billions in investment for innovators both big and small. Moreover, our space professionals have collaborated with a range of space-focused organisations across multiple government sectors, as well as more than 85% of Fortune 500 companies.

We also offer specialisation in both global and geographic-specific space subjects to help our clients carve out new opportunities wherever they are.

Our mission

We aim to build a space ecosystem that is:
- Responsible and safe
- Sustainable and efficient
- Inclusive, equitable, and accessible
- Economically viable

Deloitte Space serves clients in three dimensions.

Space as a mission

Governmental organisations whose missions are aligned to space. From cybersecurity threats, space assets, and ensuring the modernisation of critical information technology systems (both terrestrial and in orbit) to processing immense volumes of complex data, government organisations leveraging space capabilities can face unique operational challenges. Deloitte offers world-class end-to-end solutions and services to help modernise and secure systems and networks, enhance and connect data platforms, streamline and secure supply chains, and envision and execute innovative organisational strategies.

Space as a business

Commercial organisations in the business of space. Space-focused companies may face a complex set of challenges, including rapidly changing regulatory and competitive environments, technology requirements, and evolving supply chains and ecosystems. Deloitte provides a variety of services to established and emerging organisations in the business of space, with a focus on aerospace, defence and tech, media, and telco, helping them identify market opportunities, define and execute transformation initiatives, deploy modern platforms and digital capabilities, optimise supply chains and create resilience, embed next-generation manufacturing capabilities, and develop the appropriate capabilities to help them thrive and grow, whether it be organically or inorganically via M&A. Deloitte also provides a comprehensive portfolio of cyber, tax, financial advisory, and assurance services to help organisations manage, improve, and report on the performance of their space-related endeavours.

Space as a growth opportunity

Commercial organisations whose business could benefit from the space industry Space and the data and services it provides present opportunities to governments and private-sector companies around the world in nearly every industry—e.g., energy and resources, telecommunications, life sciences, and defence. Deloitte's cross-industry team of advisers, technologists, and scientists can help organisations identify, assess, and approach space innovation, space-related data, and commercialisation opportunities with confidence. Also, as an increasing number of assets are deployed into orbit, Deloitte is helping companies respond to the growing need for in-space servicing, assembling, and manufacturing (ISAM) by pioneering applications supporting robotics, digital engineering and digital twin capabilities, and necessary standards.

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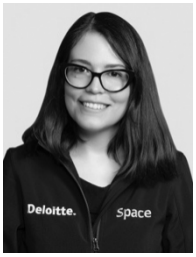
Ryo is a partner at Deloitte Tohmatsu Space & Security LLC. and he leads privatization of PPP business in infrastructure and government industry for over 15 years for not only space and defence but also metro, water/wastewater, airport, toll road, venue, hospital, etc. In terms of space field, he advises government organization such as Cabinet Office, JAXA and METI, and space companies including startups.



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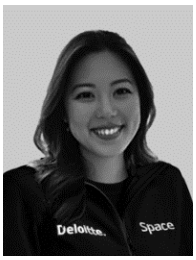
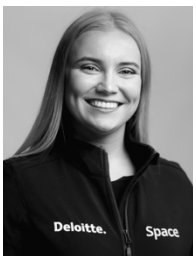
Director | Deloitte Space

Geraldine, a PhD qualified research scientist and engineer, is Director of Space Systems at Deloitte Space. Geraldine is currently helping drive Deloitte's national space-industry innovation agenda and engagements. Her expertise includes business, technology, scientific and engineering advisory for the space sector and its value chain, from manufacturing of space subsystems and payloads to space operations and downstream applications.



Marie Fujimoto
Manager | Deloitte Space

Marie is a Manager at Deloitte Consulting in Tokyo, specialized in defining strategies for complex challenges and driving their execution through global and cross-functional collaboration with Deloitte Australia, US, and UK. Her expertise is in the technology field, specifically introducing new technologies such as Generative AI/AI/Machine Learning and automation to her clients in several different industries including aerospace, heavy industry, and government agencies.



Chantel Rodighiero
Senior Consultant | Deloitte Space

Chantel is a Space Systems Engineer with a background in both Mechanical & Aerospace Engineering and Physics. She has experience in the areas of space engineering, engineering design, and systems engineering. She brings her technical space knowledge and systems engineering background along with the Deloitte Space team to deliver robust systems engineering approaches and methodologies.

Nahid Alemi Kermani
Senior Consultant | Deloitte Space

Nahid is an aerospace engineer working as a space systems engineer in Deloitte Space. She has background in aircraft structure, project management, systems engineering. With extensive experience in developing and delivering complex aerospace projects, she has successfully executed numerous high-stake endeavours for various clients, including the Australian Defence Force. Through her role in various projects, Nahid was able to cultivate a strong relationship with the client, prioritising their needs and project requirements, and ultimately delivering optimal outcomes.

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