ATSE

SUBMISSION TO THE

Australian Government Review of Australia's Space Industry Capability

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AUSTRALIAN ACADEMY OF
TECHNOLOGY AND ENGINEERING

SUBMISSION TO THE AUSTRALIAN GOVERNMENT REVIEW OF AUSTRALIA'S SPACE INDUSTRY CAPABILITY

The Australian Academy of Technology and Engineering (ATSE)[1] welcomes the opportunity to provide input into the Australian Government Review of Australia's Space Industry Capability.

ATSE's response to aspects of the Issues Paper is below, and draws on a number of ATSE's previous submissions and publications, and work of ATSE Fellows on this issue, including:

- *An Australian strategic plan for Earth observations from space* (co-authored with the Academy of Science), December 2008[2]
- Submission to the Draft Australia's Satellite Utilisation Policy, November 2012[3]
- Submission to National Earth Observations from Space Strategic Infrastructure Plan, January 2012[4]
- The Space Industry Innovation Council Report, 2012

These documents should be referred to for greater detail about ATSE's position on Australia's space industry.

In summary, ATSE urges the Review to consider the following key points:

- Australia has a critical need for secure, long-term satellite capability, involving both national strategy for access to international systems and operation of our own satellites
- National coordination is needed to facilitate collaboration between operators and users of national and international space infrastructure
- Australia should invest in its skilled workforce to fully realise the research, industry and export opportunities in the space sector
- A national space agency should be established to ensure Australia's position as a respected contributor to the global space industry
- Lead times in the Australian space industry are long, and viable national space programs require sustained public policy support and investment.

Australia's use of satellite data

A priority application of space science is satellite-based observation of the earth. Australia is a major user of satellite data for a range of earth observations from space (EOS). EOS are used in almost all

1 ATSE advocates for a future in which technological sciences, engineering and innovation contribute significantly to Australia's social, economic and environmental wellbeing. The Academy is empowered in its mission by some 800 Fellows drawn from industry, academia, research institutes and government, who represent the brightest and the best in technological sciences and engineering in Australia. The Academy provides robust, independent and trusted evidence-based advice on technological issues of national importance. ATSE fosters national and international collaboration and encourages technology transfer for economic, social and environmental benefit. www.atse.org.au

2 Available at: https://www.science.org.au/files/userfiles/support/reports-and-plans/2015/earth-observations-from-space.pdf

3 Available at: https://www.atse.org.au/content/publications/submissions/industry-innovation/australias-satellite-utilisation-policy.aspx?WebsiteKey=9cfd0302-4b41-4183-a5be-37628c955133

4 Attached

sectors of the Australian economy, providing a key source of information and supporting a range of essential services.

All levels of government use EOS for a range of responsibilities including monitoring of land, ecosystems, coastline, agriculture and fisheries management, environmental protection, transport, water resources, weather and climate, border protection, and in response to natural disasters. Satellites are also essential for high-speed, universal access to internet, telephone, and television services.

Positioning, navigation and timing (PNT) data from space is essential for efficiency of Australian road, sea, and air transport, for time stamping of financial transactions, and precision measurements for location-based services. Geoscience Australia is a major user of PNT data, and is responsible for Australia's fundamental National Positioning Infrastructure. Australia's current PNT needs are met by partnerships with the USA, China, and Japan, through Geoscience Australia.

Despite EOS and PNT satellite data being crucial to the nation's economy, environment, research, and security, Australia is fully dependent on other countries' satellites to obtain it. The majority of EOS and PNT satellite missions are prescribed by foreign governments and organisations, and Australia often has little influence on their capabilities in support of our essential data requirements. Australia's needs for satellite data are increasing rapidly, particularly with greater uptake of technology. We need to take maximum advantage of satellite data, either through a national strategy to secure long-term access to international EOS and PNT systems that will focus their capabilities on Australian needs, or by beginning to provide satellites for our own purposes and as a contribution to the global earth observation systems.

Australia's space capability strengths and weaknesses

Australia has expertise in the use of EOS for scientific research, monitoring and service provision, particularly for atmospheric science, oceanography, geology, hydrology, ecology, geophysics, and geodetics. However, there are some weaknesses in data storage and access, national planning, coordination and resourcing arrangement, and in capacity building that are limiting Australia's capability to fully utilise available space-based data.

Australia faces huge challenges in monitoring weather and climate over such a vast continent and will become increasingly dependent on space technology for reliable and sustained monitoring of climate variability and change.

Australia's EOS needs are currently addressed by a range of individual organisations and research groups, who have historically responded to opportunities and requirements as they arose, with only limited national coordination.

Similarly, there would be advantages in enhanced coordination across sectors on major ground station infrastructure. The Space Coordination Committee provides a basis for cooperation across Commonwealth agencies. However, a national space agency would provide a mechanism for broader cooperation across all levels of government and industry.

National coordination is especially important at the international level. Most countries now have a clear focal point for international cooperation, recognising that some individual agencies have direct international responsibilities. Cooperation with agencies across Asia is especially important for Australia. First, many of those countries have invested substantially in satellite technology and applications. Secondly, being geographically in the same hemisphere, Australia is able to take direct advantage of data from geostationary satellites of Asian countries. For example, the Japanese Himawari-8 satellite now provides earth observation data at 10-minute time intervals and at spatial and spectral resolutions that have previously only been available from polar-orbiting satellites.

Space industry opportunities

To ensure Australia has ongoing access to timely and consistent EOS data, and the capacity to translate this into essential information, a nationally coordinated approach is required to prepare infrastructure for greater utilisation of EOS data, and to strengthen links between organisations using EOS. Additionally, robust policies and strategies will be required to enable Australia to exert a greater influence on future satellite missions and to assist in ensuring the long-term sustainability of global cooperation on Earth observations, on which we heavily depend. Several developing countries surpass Australia in their contributions to EOS missions, and Australia cannot expect to continue to rely on the generosity and good will of other nations to provide satellite data. If Australia wants to be regarded as a real contributor to the global space industry, a national space agency should be established.

In addition to maximising satellite data for our national purposes by launching our own satellite missions, the establishment of a national strategic direction and position that exploits Australia's unique geographical advantages will stimulate industry development, and will promote the growth of a space skills base, reducing our reliance on other countries. The establishment of a national space agency will provide clear focus to seizing a more sizeable contribution of global space industry revenue via local industry efforts both upstream and downstream. The Space Industry Innovation Council noted that for every $1 million invested in space infrastructure, approximately $6 million of downstream services application revenue is generated, based on international experience.

Furthermore, a coordinated national approach is required to build and maintain Australia's EOS skilled workforce. Australia's scientific research is well respected internationally, and the strengthening of the EOS skill base could convert this expertise into an exportable product.

Australia will have significant opportunity to capture value from growth of the space sector, particularly in light of the predicted increase in technology that relies on satellite data, such as autonomous vehicles, the Internet of Things, greater uptake of artificial intelligence, and big data. A mature space industry in Australia would have been in a position to secure large contracts associated with National Broadband Network satellites. This would have further boosted the Australian space sector through increasing skills, jobs, and increasing space capabilities. These kinds of opportunities, which lead to significant local economic benefit, will continue to be missed and outsourced to foreign companies if Australia does not prioritise growth in the space sector with a coordinated national strategy.

Government leadership and investment in a space program will encourage industry investment in the space sector. For example, procurement of satellite capability by the Department of Defence has the potential to be a significant opportunity for Australia's space industry. Initial government contracts would attract major local defence engineering organisations, which would have flow on benefits for smaller local suppliers, including on the global stage. Without a stable, coordinated, and long-term space strategy from Government, Australian focus will remain on small niche capabilities, for which growth will be organic and slow only, rather than game changing in revenue terms.

A number of reports and submissions on Australia's space industry have been generated over the past few decades, including *A Space Policy for Australia* (the 'Madigan report'), which ATSE provided to government in 1985. The report set out the essential architecture for a viable sustained national space program and space industry. While there has been enormous progress in specific aspects of Australia's utilisation of space science and technology over the past 30 years, in many respects we have increasingly been left behind by the space age. The present situation is not sustainable for Australian space industry or for essential state-of the-art application of space technology. The main challenge for the Australian Government is implementing the key actions identified in the documents provided to them over the past decades, including coherent, sustained space policy, a national space agency, and space program.

ATSE would be pleased to recommend ATSE Fellows to provide the Expert Reference Group with further assistance. For further information, please contact Emily Finch, ATSE Research and Policy Officer, at emily.finch@atse.org.au or 03 9864 0920.

APPENDIX

Submission to
National Earth Observations from Space Strategic Infrastructure Plan (EOS-SIP)

by

The Australian Academy of Technological Sciences and Engineering (ATSE)

to

Geoscience Australia,
Bureau of Meteorology,
Australian Government

January 2012

The National Earth Observations from Space Strategic Infrastructure Plan

The Australian Academy of Technological Sciences and Engineering (ATSE)[1] welcomes the opportunity to respond to the call for submissions to the *National Earth Observations from Space Strategic Infrastructure Plan (EOS-SIP)*.

Executive Summary

The Academy of Technological Sciences and Engineering (ATSE) is pleased that the AAS-ATSE (2009) *Australian Strategic Plan on Earth Observations from Space*[2] has provided useful input in the preparation of the Framework for the Earth Observations from Space Strategic Infrastructure Plan. This submission highlights some key issues:

- Earth observations from space (EOS) are a key source of environmental information for Australia, supporting a range of essential services. The social and economic benefits of EOS are primarily associated with public-good applications.

- Co-ordination and co-operation are fundamental to effective and efficient EOS activities, enabled by collaborative ventures between government, industry and research organisations. The governance structure proposed by the Framework for the EOS-SIP should include a National EOS Advisory Council, to ensure effective national co-operation and co-ordination and a broad approach that will best recognise the continuing interactions and contributions of all parties, whilst promoting innovation.

- There is an urgent need for Australia to make clear its intention to contribute more strongly to the overall earth observation system. Australia should build further strategic international links with EOS agencies, particularly in Asia. The proposed National EOS Advisory Council should play a key role in ensuring transparency of international links and enabling informed decision making aligned with national priorities.

- Coordination and cooperation is needed across all sectors to optimise the acquisition and archive of EOS. The national costs and benefits of cloud computing and storage for EOS need to be assessed. A national strategic perspective is essential when investments are made in calibration and validation sites for satellite instruments; these sites are needed globally to ensure the quality of EOS products and form an important part of Australia's contribution to the overall international observation system.

- The value of EOS depends on ready access to the data. The potential contributions of cloud computing, as well as the National Computational Infrastructure, in supporting EOS applications should be investigated to eliminate barriers to the application of EOS datasets. A coordinated program of applications research funding is also needed to ensure that Australia maintains the critical mass of expertise needed to lead the way in finding new approaches to the extraction of value from space observation.

1 The Australian Academy of Technological Sciences and Engineering (ATSE) is an independent body of 800 eminent Australian engineers and scientists driving technological solutions for a better Australia. ATSE was established in 1976 with the mission to promote the application of scientific and engineering knowledge to the future benefit of Australia. ATSE is one of four learned national Academies, which have complementary roles and work together both nationally and internationally. www.atse.org.au

2 AAS-ATSE (2009) An Australian Strategic Plan for Earth Observations from Space. July 2009, pp122.

Introduction

The Academy of Technological Sciences and Engineering (ATSE) is pleased that the AAS-ATSE (2009) *Australian Strategic Plan on Earth Observations from Space* has provided useful guidance for the preparation of the Framework for the Earth Observations from Space Strategic Infrastructure Plan (EOS-SIP). The Australian Strategic Plan on Earth Observations from Space gives detail on each of the priority actions on which comment is sought.

Earth observations from space (EOS) are the most important and richest source of environmental information for Australia, as they support a wide range of essential services for the community. The ACIL Tasman (2010) report[3] estimates that the economic impact of EOS was $3.3 billion in 2008-09 and that the annual contribution to GDP will reach $4 billion by 2015. However, the sales of the commercial sector in EOS are around $30-40 million. Thus, while it is important to promote industry innovation in EOS, the major applications of EOS are through government agencies generally in the form of public goods. Critical contributions of EOS relate to

- climate change and variability
- water availability
- natural disaster mitigation
- safe and secure transport
- energy and resources security
- agriculture, forestry and ecosystems
- coasts and oceans
- national security.

Government use of EOS occurs at local, state and commonwealth levels. Table C1 of the ACIL Tasman (2010) report lists a wide range of government programs that are dependent on EOS. The list shows that many of the projects are collaborative, which is a good sign of the sharing of expertise across agencies The collaboration extends across government, industry, universities and commonwealth research-providing agencies. Most importantly, the list shows that state governments are involved in a large number of these programs.

It should also be especially noted that EOS provide a powerful means of promoting Australia's international interests and objectives under the various United Nations and other environmental conventions; such as those on climate change, desertification and the ozone layer through, for example, the role of the Global Climate Observing System (GCOS) in climate monitoring and the Global Forest Observation Initiative (GFOI) in carbon accounting.

In summary, the social and economic benefits from the application of EOS are very substantial and are well documented. While national benefit clearly is derived from industry innovation of EOS, most of the benefit is associated with essentially public-good applications across all levels of government, universities and commonwealth research-providing agencies.

3 ACIL Tasman (2010) The economic value of earth observation from space. Report prepared for CRC for Spatial Information and Geoscience Australia, September 2010, pp88.

This ATSE submission reiterates and emphasises some of the key points made in the Australian Strategic Plan on EOS (2009) on the following key issues:

- coordination and cooperation
- assuring access to future EOS
- ground infrastructure and communications
- extracting value for EOS
- sustained capability.

Coordination and cooperation

The national benefits from EOS come from generally collaborative programs across government, industry and research sectors. It follows that coordination and cooperation are the key to the effective and efficient activities related to EOS. Indeed, a leading recommendation of the Australian Strategic Plan (2009) is that:

> "A high level, cross-portfolio EOS advisory council should be established with the active involvement of the national EOS provider agencies, the learned academies and the EOS user community to advise on national priorities for EOS operations, research, education and applications across all sectors and all levels of government."

The current formal mechanisms for coordination and cooperation appear to consist of the Space Industry Innovation Council (SIIC) and the Australian Government Space Forum (AGSF). These groups are supported by the Space Policy Unit in the Department of Innovation, Industry, Science, Research and Tertiary Education (DIISRTE)[4].

The SIIC is established to provide strategic advice to the Minister on innovation priorities, and it has membership from industry, universities and the commonwealth government. As noted earlier, the work of this Council is nationally important and it promotes opportunities for commercial services based on EOS. However, it does not address the major investments in EOS or the needs of the major EOS user communities.

The AGSF is established with the role of information sharing across commonwealth government agencies. Membership is voluntary, it has no executive authority, and it will *inter alia* identify issues that would benefit from a collaborative approach.

It is clear that the current arrangements do not provide the degree and scope of coordination and cooperation envisaged in the Australian Strategic Plan. Given the range of agencies with substantial involvement in EOS, the establishment of a National EOS Advisory Council is imperative to provide a continuing basis for effective and efficient national coordination. For example, the investment of state agencies in EOS would suggest that a mechanism for continuing interaction between them and commonwealth agencies and universities should be promoted.

The Framework for the EOS-SIP, developed by Geoscience Australia (GA) and the Bureau of Meteorology (BOM), has three components of coordination and cooperation:

4 http://www.space.gov.au

- develop & implement a governance structure
- establish agreements and trusted partnerships to promote best practice
- engage with the EOS community.

The second and third components suggest that the proposed but unspecified governance structure may fall short of a National EOS Advisory Council. In particular, the second component may suggest that GA and BOM will determine best practice in the handling and application of EOS which will then be promoted to other agencies. The implication could be that planning for EOS infrastructure is very similar to the development of the National Plan for Environmental Information (http://www.environment.gov.au/npei), which has the narrower aim of ensuring national consistency in the provision of environmental information. Such a centralised approach may not best recognise the continuing and active contributions of other agencies across a broad range of applications of EOS, especially in sectors such as land and resource management involving state governments. It may also not optimise the promotion of innovative applications of EOS by government, industry and research sectors.

The establishment of a National EOS Advisory Council should provide the basis for continuing interaction between all the active users of EOS. It would recognise and promote innovation, while promoting national cooperation and coordination.

Assuring access to future EOS

Both the Australian Strategic Plan (2009) and the ACIL Tasman report (2010) note the vulnerability of Australian access to EOS owing to our free-rider status in the international EOS system. That is, Australia is entirely dependent upon other countries for basic EOS data, and Australia makes little contribution to the space-based infrastructure needed to acquire those data. There is an urgent need for Australia to make clear its intention to contribute more strongly to the overall earth observation system. This intention can be made most effectively and efficiently by Australia joining other satellite-operating countries in the provision of space hardware, such as remote sensing instrumentation. Australian links with overseas EOS agencies tend to be in USA and Europe. However, in recognition of the growing contributions of Asia to EOS as well as to the global economy, strategic links with countries such as China may be appropriate for optimising long-term returns. On the other hand, such links are likely be more challenging in the short term.

The National EOS Advisory Council would provide the platform for the development of national priorities for the strengthening of international and regional links. At present the links to overseas agencies vary from the AGSF, which is the formal contact point for international queries, to individual researchers with contacts in overseas space agencies seeking Australian involvement in international EOS programs. The National EOS Advisory Council should ensure the transparency of all overseas contacts and would allow informed decisions to be made on national priorities. It would provide an important focus for support of an active Australian role in international EOS coordination bodies, such as the Group on Earth Observations (GEO) through which Australia has the opportunity to influence initiatives such as international data access policies.

Ground infrastructure and communications

Both the Australian Strategic Plan (2009) and the ACIL Tasman (2012) report note the wide range of satellite instrumentation providing EOS data for Australian agencies. Moreover, the number and range of satellite missions will increase over the next decade; for example, China is launching new missions to cover meteorology, oceanography, earth resources, and environmental and disaster monitoring. In addition to the ever-expanding overseas sources of EOS, we have EOS users in Australia ranging from the national operational agencies of GA and BOM, through national research organisations such as CSIRO and AIMS, to individual university researchers. As noted earlier, state government agencies are major users of EOS in Australia. With multiple sources and users of EOS, the number of potential pathways between sources and users is vast and potentially inefficient. Moreover, as the size of EOS datasets increases as the spatial and temporal resolution of instrumentation is enhanced, the multiple copies of large datasets stored by different users is another source of potential national inefficiency.

Coordination and cooperation is needed across all sectors to optimise the acquisition and archive of EOS. As global communications expand, the balance between direct read-out from a specific satellite and transmission through the global communications network will evolve and impact on the investment in ground station infrastructure. A key issue in Australia is the cost of both national and international communications: high communications costs can lead to inefficiencies such as the archiving of multiple copies of large datasets at different sites. Indeed the international move towards cloud computing and storage is significantly effected by communications costs; the national costs and benefits of cloud computing and storage for EOS needs to be assessed.

The national infrastructure for EOS includes the operation of calibration and validation sites, which are needed globally to ensure the quality of EOS products. These sites, when directly linked to the relevant international observation programs, become part of the Australian contribution to the overall international observation system; that is, they tend to offset our free-rider status. It is therefore important that a national strategic perspective is taken when investments are made in calibration and validation sites for satellite instruments.

The Framework for the EOS-SIP appropriately includes the development of a rolling plan for EOS infrastructure. Given the expanding sources of EOS and the growing applications of EOS, the rolling plan will depend upon continuing liaison to ensure that the overall national investment in infrastructure to acquire, archive and access EOS is efficient and effective. The National EOS Advisory Council would provide the forum for such liaison.

Extracting value for EOS

The value of EOS is dependent upon ready access to the data. The evolution of both national space policies and international communications is tending to facilitate access to EOS, but formal agreements are likely to continue to be needed for at least high-resolution data. National coordination will be needed to ensure that access to EOS datasets is both easy and efficient. For large datasets, it will be important to minimise the overall national cost of acquisition and archive through appropriate data sharing arrangements.

Australia continues to be recognised for its innovative applications of EOS. As the datasets grow owing to enhanced spatial and temporal resolution, computational capacity

becomes a limitation on the implementation of applications. The potential contributions of cloud computing, as well as the National Computational Infrastructure, in supporting EOS applications should be investigated.

The National EOS Advisory Council would provide the forum for reaching agreement on coordination for data access and archive at both international and national levels. It would also provide the forum for the sharing and promotion of innovative applications of EOS.

There is also a need for a coordinated program of applications research funding to ensure that Australia is able to maintain the critical mass of EOS expertise needed to support Australia's historical geographically-imposed role of leading the way in finding new approaches to extraction of value from space observation.

Sustained capability

Sustaining the national capability in EOS requires continuing investment in both the infrastructure and education. In particular, the investment in infrastructure needs to be underpinned by ensuring that Australia has the skills required to maintain the infrastructure and to use the EOS data. The Australian Strategic Plan appropriately recommended that a national framework should be developed to establish and maintain a critical mass of strategic research and education expertise in Australian universities to underpin the operational EOS systems, services and applications in industry and government agencies.

Conclusion

Coordination and cooperation: Earth observations from space (EOS) are a key source of environmental information for Australia, supporting a range of essential services including water, energy and agriculture to transportation and national security. The social and economic benefits of EOS are primarily associated with public-good applications across all levels of government, universities and commonwealth research-providing agencies. Coordination and cooperation are fundamental to effective and efficient activities related to EOS, enabled by collaborative ventures between government, industry and research organisations.

Assuring access to future EOS: There is an urgent need for Australia to make clear its intention to contribute more strongly to the overall earth observation system, for example, by joining other satellite-operating countries in the provision of space hardware, such as remote sensing instrumentation. Australia should build strategic links with EOS agencies in Asia, particularly China, to complement the existing links with USA and Europe.

Ground infrastructure and communications: Australian agencies receive EOS data from a wide range of satellite instrumentation; the number and range of satellite missions will increase over the next decade. The multiple users of EOS information range from state and commonwealth government to research organisations to individual researchers. The number of sources of EOS information is growing as is the spatial and temporal resolution of EOS, resulting in the potential for national inefficiency in the multiple copies of the same large datasets stored by different users. Coordination and cooperation are needed across all sectors to optimise the acquisition and archive of EOS. The national costs and benefits of cloud computing and storage for EOS need to be assessed.

Extracting value for EOS: The value of EOS depends on ready access to the data. The

potential contributions of cloud computing, as well as the National Computational Infrastructure, in supporting EOS applications should be investigated to eliminate barriers to the application of EOS datasets that are growing, due to enhanced spatial and temporal resolutions. There is also a need for a coordinated program of applications research funding to ensure that Australia is able to maintain the critical mass of EOS expertise needed to support Australia in leading the way in finding new approaches to the extraction of value from space observation.

Sustained capability: Continuing investment in infrastructure and education are required in order to sustain the national capability in EOS.

A National EOS Advisory Council: This submission recommends that the governance structure proposed by the Framework for the EOS-SIP go further and proposes a National EOS Advisory Council be established. The role of the proposed National EOS Advisory Council would be to enhance current governance arrangements and ensure effective national co-operation and co-ordination, particularly between state and commonwealth agencies and universities to provide the basis for continuing interaction between all the active users of EOS whilst recognising and promoting innovation in the application of EOS by government, industry and research sectors.

The proposed National EOS Advisory Council should ensure transparency and coordination of international links, from formal international queries to individual researchers, thus enabling informed decision making aligned with national priorities.

The proposed National EOS Advisory Council should provide the forum for continuing liaison to ensure that the overall national investment in infrastructure to acquire, archive and access EOS is efficient and effective. This is particularly important in ensuring that a national strategic perspective is taken when investments are made in calibration and validation sites for satellite instruments because the operation of these sites is of international importance to ensure the quality of EOS products.

Further Information

For further information please visit www.atse.org.au or contact Harriet Harden-Davies, Senior Policy and Project Officer, ATSE via email harriet.hardendavies@atse.org.au or telephone 0398640926.