The Senate

Standing Committee on Economics

Lost in Space? Setting a new direction for Australia's space science and industry sector

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TABLE OF CONTENTS

Standing Committee on Economics

The current state of Australia's space science and industry sector

Terms of reference

On 19 March 2008, the Senate referred the following matter to the Senate Standing Committee on Economics for report no later than October 2008 with an interim report by 23 June 2008:

The current state of Australia's space science and industry sector, examining options to strengthen and expand Australia's position in fields that strongly align with space science and industry, giving consideration to any national strategic coordination requirements and taking into account findings and policy options of the National Innovation System Review, with particular reference to:

(a) Australia's capabilities in space science, industry and education, including:

  (i) existing Australian activity of world-class standard, and

  (ii) areas in which there is currently little or no activity but that are within the technical and intellectual capacity of the country;

(b) arguments for and against expanded Australian activity in space science and industry, including:

  (i) an assessment of the risks to Australia's national interest of Australia's dependence on foreign-owned and operated satellites,

  (ii) the potential benefits that could accrue to Australia through further development of our space capability,

  (iii) economic, social, environmental, national security and other needs that are not being met or are in danger of not being met by Australia's existing space resources or access to foreign resources,

  (iv) impediments to strengthening and expanding space science and industry in Australia, including limiting factors relating to spatial information and global positioning systems, including but not limited to ground infrastructures, intergovernmental arrangements, legislative arrangements and government/industry coordination, and

  (v) the goals of any strengthening and expansion of Australia's space capability both in the private sector and across government; and

(c) realistic policy options that facilitate effective solutions to cross-sector technological and organisational challenges, opportunity capture and development imperatives that align with national need and in consideration of existing world-class capability.

Lost in Space? Setting a new direction for Australia's space science and industry sector

Chapter 1

Introduction

Lost in space?

1.1 Australia had a long and illustrious association with 'space science'. The first Australians used the patterns of the stars to guide them to seasonal food sources. Captain Cook arrived here on the way home from a voyage to chart the transit of Venus, with the goal of improving navigational technology. When Governor Phillip founded the first European settlement, he brought with him the astronomer William Dawes. Australia was the fourth nation to build and launch a satellite from its own territory. The 'big dish' at Parkes played an important role in the Apollo missions and the discovery of the first quasar.[1]

1.2 But more recently Australia's involvement in space science and industry has drifted and the sense of purpose has been lost. The committee heard of the surprise expressed by some overseas observers that Australia has no space programme or agency and, other than for communications, is reliant on satellites owned by other countries.

1.3 The committee believes it is not good enough for Australia to be lost in space. It is time to set some clear directions. The Australian government should have a space policy and, like most other comparable countries, an agency to implement it. The global space industry generates global revenues of around US$250 billion per annum[2], and Australia should be playing a larger role.

1.4 Accordingly, the recommendations in the report's final chapter chart a course towards Australia regaining an important place in global space science and industry by gradually developing a dedicated space agency.

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1 This paragraph draws on Jeff Kingwell, 'International space year', *Year Book Australia 1992*, Australian Bureau of Statistics.

2 Space Foundation, *The Space Report 2008*, p. 14.

It's not (just) rocket science

1.5 To many people 'space science' means rockets taking people to the moon and beyond at vast expense. Manned space flight is indeed exciting and inspiring. The way it captured the popular imagination is attested to by the comments from witnesses (see especially paragraphs 5.19 to 5.29) and the lines from popular songs used to introduce many sections of this report.

1.6 However this report shows that rockets are only a small part of 'space science and industry'. The report does ***not*** propose to land an Australian citizen on Mars, although it would like to see an Australian contribution to such an international mission. Rather, Australia's involvement in space industry should be focused on niche areas. Australian scientists can expand their already important role in space tracking and various forms of astronomy and Australian firms can make more commercial use of data from satellites.

Conduct of the inquiry

1.7 On 19 March 2008, on a motion by a cross-party group of Senators Chapman, Hurley and Stott Despoja, the Senate referred the topic of space science and industry, and specifically the terms of reference given on page vii, to the Senate Standing Committee on Economics, for inquiry and report no later than October 2008 with an interim report by 23 June 2008. On 14 October the Senate extended the time for presentation of the final report to 12 November 2008.

1.8 The committee advertised the inquiry nationally and posted details on its internet site. In addition, it wrote to a number of organisations advising them of the inquiry and inviting them to make submissions. These included key stakeholders in space science such as the Commonwealth Scientific and Industrial Research Organisation (CSIRO), other government agencies such as the Bureau of Meteorology and Geoscience Australia, the Cooperative Research Centre for Spatial Information, and some of the Australian universities and private companies using satellites for communications or remote sensing data, or able to contribute components, software or other services to an expanded space sector. The committee received 88 submissions to its inquiry. These are listed at Appendix 1. Several supplementary submissions were also received.

1.9 The committee held six public hearings: in Canberra on 16 May, 29 July and 23 September 2008, in Adelaide on 23 May and 22 July 2008, and in Sydney on 1 August 2008. It also received a private briefing from the CSIRO. The witnesses who appeared at the public hearings are listed in Appendix 2.

1.10 Additionally, the committee had site inspections at the following places:

- Canberra Deep Space Communication Complex, Tidbinbilla, Canberra;
- Australian National University Advanced Instrument and Technology Centre, Mount Stromlo, Canberra;

- Electro Optic Systems Space Research Centre, Mount Stromlo, Canberra; and
- Optus International Earth Station, Belrose, Sydney.

1.11 Further publicity was given to the inquiry when the interim report was released on 23 June 2008, and when the chair of the committee, Senator Hurley, addressed the 10th Australian Space Development Conference in Adelaide on 23 July 2008. An indication of the space industry's interest in the inquiry was that this conference passed a resolution addressing questions in the interim report; see Appendix 4.

1.12 The Hansards of the public hearings, submissions, and the committee's interim and final reports, are all available on the committee's website at: http://www.aph.gov.au/Senate/committee/economics_ctte/space_08/index.htm.

1.13 The committee wishes to express its appreciation to all those who contributed to its inquiry by preparing written submissions, attending hearings as witnesses and hosting site visits. Their work has been of considerable value to the committee.

Outline of the report

1.14 The committee's interim report summarised what it saw as the key questions that need to be answered to assess in what ways, if any, the government needs to act to optimise Australia's capabilities in space science, industry and education. In this, its final report, the committee seeks to answer those questions and provide its conclusions and recommendations.

1.15 The report is structured around different aspects of space science and industry. The committee views the most important commercial aspect for Australia as 'looking down', the use of satellites for earth observation, described in Chapter 2. The next chapter is concerned with 'looking out', the domain of astronomers. Chapter 4 turns to 'going up', the potential for Australia as a launch centre. Chapter 5 discusses some of the roles of government in relation to space, covering support for research, education and assistance to space industry on economic and security grounds. The report concludes with a chapter on whether Australia needs a 'space policy' and an agency to implement it.

Chapter 2

Looking down

Wide uses of satellites

"Satellites gone up to the skies,
things like that drive me out of my mind"
Lou Reed, *Satellite of Love* (Lyrics: L. Reed)

"We take all the telescopes
And we turn them inside out
And we point them away from the big sky
Put your eye right up to the glass, now
And here we'll find the constellation of the heart"
Kate Bush, *Constellation of the Heart* (Lyrics: K. Bush)

2.1 The committee views the most important commercial aspect of space for Australia, as 'looking down', the use of satellites for earth observation. Examples illustrating this dependence include:[1]

- space derived data forms the backbone of modern weather forecasting and storm prediction services;
- satellites provide critical communications links, particularly to the many areas worldwide which do not have access to other forms of communications. They are often the only means of communication in disaster areas and constitute an essential element of disaster response and relief operations;
- timing signals from Global Positioning Satellites (GPS) are used to coordinate transactions in the global finance industry such as ATM withdrawals, credit card transactions and stock exchange transactions, and are used by the mobile phone networks to provide reference timing to coordinate mobile phone calls;
- navigation signals from GPS satellites provide essential positioning data for ships and aircraft and, increasingly, the trucking industry and recreational users. Flight navigation and air safety systems increasingly rely on satellite signals to maintain proper altitude, heading and separation for approach and landing;
- modern agriculture increasingly relies on satellite derived data for long term weather forecasts and navigation data for precision farming practices; and
- the majority of the variables needed to monitor the global picture of climate change can only be measured from space.

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1 Australian Space Industry Chamber of Commerce, *Submission 64*, p. 3.

2.2 One estimate is that global purchases of commercial satellite-based products and services amount to over US$ 100 billion, over half of global space revenue.[2] Many countries now have satellites, as shown by Table 2.1. The Australian involvement reflects the five satellites operated by Optus. Included among the surveillance satellites are 'radar satellites' which can see through cloud cover. The committee notes the increasing emergence in recent years of South East Asian countries into the international space community which is highlighted in Table 2.1

Table 2.1: Active satellites, by country

	Communications	Surveillance/military
United States	193	68
Russia/CIS	43	17
Japan	24	4
China	14	1
Luxembourg	13	0
India	11	0
Saudi Arabia	8	0
France	2	8
Canada	7	0
Australia	5	0
Indonesia	5	0
Israel	2	3
Netherlands	5	0
Spain	5	0
United Kingdom	3	2
Thailand	4	0
South Korea	3	0
Malaysia	3	0
other	29	1

Source: Space Foundation, *The Space Report 2008*, p. 67.

2 Space Foundation, *The Space Report 2008*, p. 6.

Global navigation

2.3 There is an increasingly wide range of applications for satellite-sourced information. This is especially true of the global positioning systems (GPS), which may account for nearly half global spending on satellite services.[3] The best known of these is the US-operated GPS. This is shortly to be joined by the European Galileo, a revamped Russian Glonass and China's Beidou. Australia should have access to all these systems which will give greater precision in establishing locations than just using one system.

2.4 The GPS are vital to the operation of the financial system. The timing signals are used to synchronise our national power grids, the time stamping of financial transactions and our mobile phone networks.

> the timing signals of those satellites are perhaps more pervasive than all of the navigation information…Were someone to deny that time signal, you would have an immediate consequence in the transaction and therefore potentially the economics of our finance industry.[4]

2.5 The committee heard warnings of the vulnerability of GPS systems:

> …jammers can be bought on the international market or constructed from readily available electronics parts to designs that are available on the internet. Australia has conducted no study on the magnitude of our risk exposure. We have no quantification of the risk of denial of GPS, no backup plans at national level, and no national approach to responding effectively to GPS interference events.[5]

2.6 On a more positive note, Professor Sinnott described the opportunities for Australian industry in making more use of GPS systems:

> There is a substantial but very distributed base in Australia's manufacturing industry, small to medium enterprises in the main, that seek to add value to what are a free good in terms of the signals raining down on us, in terms of getting better precision, making these systems work better indoors where a typical GPS receiver does not work too well and adding some bells and whistles in terms of added services such as telling you which restaurant you are closest to and functions like this. A most particularly important one, which I think will come to Australia—it is already in Europe and the US—is reporting where you are from a mobile phone call when you call emergency services.[6]

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3 Space Foundation, *The Space Report 2008*, p. 6. The Report suggests sales of GPS equipment grew by 20 per cent in 2007.

4 Mr Roger Franzen, Earthspace, *Committee Hansard*, 16 May 2008, p. 43. A similar point was made by Professor Donald Sinnott, *Committee Hansard*, 23 May 2008, p. 46.

5 Professor Donald Sinnott, *Committee Hansard*, 23 May 2009, p. 45.

6 Professor Donald Sinnott, *Committee Hansard*, 23 May 2008, p. 46.

Climate change

2.7 An important use of satellite data is monitoring changes in the climate due to the anthropogenic increase in carbon dioxide in the atmosphere. In the United Kingdom, space expenditure:

> is about to go up hugely because the UK sees its needs in climate and environment as really escalating in this century.[7]

2.8 A number of witnesses attested to the importance of satellites in progressing climate change science. The CSIRO noted that space science has resulted in existing projects taking on an international perspective.

> One of the big advantages that Australia has in climate monitoring is that we are forced in some ways to take a continental view in a lot of the work that we do. If you take, for example, the National Carbon Accounting System …that is a CSIRO model that we have developed jointly with the Department of Climate Change… [it] has been turned into the international forest and climate initiative. That initiative is trying to look at the world carbon emissions, particularly from forestry, which will be an important policy issue for other areas, such as discussions in Copenhagen…We are looking in continental areas at Australia's environment, water resources and carbon emissions…[8]

2.9 These views were shared by the private sector who advocated that an Australian investment in space infrastructure could assist with international co-operation in tackling climate change:

> The issues to do with water management and climate change are things that space based applications lend themselves to.[9]

> …future Australian space policy and budgets should be strongly linked to long-term strategic information needs of core government policy…our needs in relation to climate change should be top of the list…The current government's desire is to play a more active role in emissions trading and with foreign policy linked to climate change. Ideally some Australian contribution to space and associated ground infrastructure towards these goals should be planned to show, not only in words, that we are contributing, and to leverage some influence….[10]

2.10 Professor Harvey Butcher felt that Australia in particular needed to be more proactive in satellite programmes given the domestic priority of water management into the future:

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7 Mr Stephen Ward, Symbios Communications, *Proof Committee Hansard*, 1 August 2008, p. 34.

8 Dr James Moody, CSIRO, *Proof Committee Hansard*, 29 July 2008, p. 33.

9 Mr Kirby Ikin, ASICC, *Proof Committee Hansard*, 1 August 2008, p. 25.

10 Mr Stephen Ward, Symbios Communications, *Proof Committee Hansard*, p. 36.

> in the matter of adapting to climate change, managing the environment and so on, the kinds of satellites one has access to are few and far between, and it would behove us to become involved in some of these satellite programs.[11]

2.11 The committee heard that of the 42 elements of climate currently measured some 25 can only be measured by satellite:

> There are satellite constellations put up by Japan that measure precipitation. There are collaborations between Japan and the US that measure moisture to predict precipitation. There are other constellations put up by the Europeans that measure the amount of water that is on the earth's surface. There are all sorts of satellites aimed at scientific purposes that we are really only marginally benefiting from. If Australia decides to head down that path to better use space science to manage its resources and to increase its influence with other countries, particularly with respect to climate change, then whatever we do with climate change we have to be able to measure and monitor the impacts. If Australia is not pulling its weight it is going to be that much harder to convince other countries to take action against it.[12]

2.12 There is a risk that global warming could accelerate irreversibly were the polar ice caps to melt. There are concerns this may happen faster, and with a greater impact on sea levels, than envisaged in many scenarios.[13] There seems to be more attention paid to the Artic ice sheet than the Antarctic in this context. Australian scientists have expertise in the study of Antarctic ice, but the quality of their analysis will depend in part on the data available, and satellite data can make a valuable contribution.

2.13 When a carbon pollution reduction scheme is extended to cover rural emissions, there will be a need to assess these in remote locations to ensure an appropriate amount of permits have been purchased (or an appropriate amount of carbon tax is being paid). Satellites could play an important role in assessing this.

2.14 This is a new area in which Australian scientists and industry has the potential to develop expertise. The space science and industry experts assembled at a recent conference nominated the 'application of earth observation to weather and climate monitoring' as an area where Australia has a comparative advantage.[14]

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11 Professor Harvey Butcher, *Committee Hansard*, 16 May 2008, pp 52 and 56.

12 Mr Tony Wheeler, ASIBA, *Proof Committee Hansard*, 29 July 2008, pp 40-1.

13 Professor Ross Garnaut, *The Garnaut Climate Change Review*, 2008, p. 94.

14 See Appendix 3.

Other areas of monitoring through remote sensing

2.15 Geoscience Australia hosts the Australian Centre for Remote Sensing, which operates satellite ground station facilities at Alice Springs and Hobart to acquire data over Australia.

2.16 Among the applications to which monitoring by satellite is applicable are agriculture, mineral prospecting, weather, water, fire control, tsunami and marine ecosystems.

2.17 A major user is the Bureau of Meteorology. It stressed the importance of international cooperation:

> Through international agreements under the UN based World Meteorological Organisation, the WMO, Australia gains free access to more than $10 billion worth of data annually from more than 180 member countries in exchange for an Australian investment, through the bureau's observations programs, of around $100 million. The bulk of the $10 billion international investment is associated with space based systems, while Australia's contribution is largely surface based.[15]

2.18 There are areas where Australia could get more benefit from using satellite information:

> …there is a lot of data that is available. We use a lot of it but there is potential to harvest that a lot more and use it for a much wider range of applications… There is a lot of data in areas such as oceanographic monitoring, water resource monitoring, climate monitoring—environmental monitoring right across the range. But there are subsequent applications that you can get from those in terms of benefits through improved forecasting of rainfall for agricultural regions. I think there are a large number of specific application areas for which you could derive more value from that data.[16]

2.19 There is potential for using satellites for early detection of forest fires. In Canada:

> apart from just forest fire detection, we are looking at systems that can identify where a fire is likely to occur—where there is a high density of biomass and where it is particularly dry—so that you know where to focus your resources even in advance.[17]

2.20 Improved data will also be useful for earthquake prediction and contribute to early warning systems and aid relief in the event of natural disasters::

> …we will have better understanding of the earthquake risk because we will have better understanding of the deformation that is taking place on the

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15 Dr Susan Barrell, *Proof Committee Hansard*, 16 May 2008, p. 13.

16 Dr Susan Barrell, *Committee Hansard*, 16 May 2008, p. 16.

17 Mr Richard Kolacz, COM DEV, *Proof Committee Hansard*, 22 July 2008, p. 13.

> continent. Currently those rates of deformation are below the limits that we can detect, but when we improve it by an order of magnitude we will actually be in a position to measure some of those movements and have a better sense of which parts of the continent are actively mobile and which therefore have the potential to generate earthquakes... [18]

2.21 A concern for users is adequate access to the radio frequency spectrum.[19] The Australian Communications and Media Authority is forming a radiotelecommunications committee to examine this issue.

Mining and farming

2.22 Before too long it may be commonplace for mining operations to be controlled remotely from city offices. The University of Sydney's centre for Field Robotics is developing this technology.[20] Reliable satellite links are crucial for these operations. [21] There is similar scope for farming equipment such as harvesters to be controlled remotely, or operators to be assisted through satellite information.[22] There is also potential for remote farms to control stock movements with 'virtual fences'; collars fitted to the animals deterring them from straying.

2.23 Satellites are also an important source of information about rural production:

> We have not asked ourselves the questions, what is the value of the flow of all the satellite imagery that tells us what our wheat crops are going to be yielding next season? What is the value of that flow of information going to five other nations overseas who are predicting our wheat yields months before we know what they are going to be? It is good enough for them to do it and we do not do it. For example, from a simple trade based situation, we are putting ourselves at a significant disadvantage. There are many, many examples like that which will be borne out if we did a proper risk analysis.[23]

Inventory management and transport logistics

2.24 Satellites can help keep track of the movement of goods and therefore reduce inventory costs.

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18 Dr Chris Pigram, Geoscience Australia, *Committee Hansard*, 16 May 2008, p. 22.

19 Dr Chris Pigram, Geoscience Australia, *Committee Hansard*, 16 May 2008, pp 20–1.

20 *Australian Financial Review*, 2 June 2008, p. 33.

21 'Spatially enabling Australia', ASIBA October 2007, reproduced in *Submission 37*.

22 'Spatially enabling Australia', ASIBA October 2007, reproduced in *Submission 37*.

23 Dr Peter Woodgate, CRC for Spatial Information, *Committee Hansard*, 23 May 2008, p. 75.

Defence interests

2.25 The committee heard about the involvement of the Defence Science and Technology Organisation:

> DSTO has long been involved in applied Defence space support research and technology innovation in the operation of systems to access and exploit satellite communications, remote sensing and position, navigation and timing products.[24]

2.26 Defence also described their involvement with the US wideband global satellite constellation:

> Defence has signed an MOU with the US Department of Defence. The value of that is $927 million, and that covers the life of the system out to 2029. I will give you a little bit of background. The US has an authorised program to develop five satellites. Defence is funding the capital cost of the sixth satellite, the costs of launching the satellite and incremental costs associated with managing the construction of the satellite, the launch services and the operation of the satellite in the constellation of five others out to 2029…It will be a US manufactured and US launched satellite and it will be controlled from US facilities…[25]

Coastal surveillance

2.27 A Canadian witness described how satellites can be used in maritime surveillance and could assist with early detection of illegal operations in Australian waters:

> Canada, like Australia, has a requirement to achieve maritime surveillance, to understand what vessels are approaching our coasts out to a range of 1,000 nautical miles. So there is a requirement; there is a budget. We presented a solution to the government of Canada by which we could satisfy this with a small spacecraft platform. The way that I see it is that we are not looking to provide a space mission; we are looking to provide a solution to their problem but it just so happens that it involves the use of a space asset.[26]

Policy aspects

2.28 One witness from industry argued strongly for a more active focus by government on the sector, criticising the:

> lack of a national strategic policy for ongoing implementation of satellite navigation throughout Australia and for its future economic development. Today Australia spends several hundred millions of dollars on imported

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24 Ms Rebecca Skinner, Department of Defence, *Proof Committee Hansard*, 29 July 2008, p. 3.

25 Brigadier David Welch, Department of Defence, *Proof Committee Hansard*, 29 July 2008, p. 5.

26 Mr Richard Kolacz, COM DEV, *Proof Committee Hansard*, 22 July 2008, p. 3.

> satellite navigation products and services. This technology underpins transport, precision agriculture, mining, precise timing for telecommunications, e-commerce and, of course, the national defence network…So where is the national policy that ensures this vital enabling technology is managed in a coordinated and efficient manner in the best interests of the Australian nation? The truth of the matter is that there is no policy…Today our local industry is small and at typically Third World levels. All the navigation products in service today are imported. Simply put, with respect to satellite navigation, Australia takes the technology handouts from the rest of the world. With virtually no domestic industry, no coordinated policy and totally inadequate government funding to secure the science for growing a national skill set, I am wondering what national event it will take to wake this nation out of its current complacency.[27]

Is there a case for (more) Australian-owned satellites?

2.29 The only Australian-operated satellites are those owned by Optus.[28] Its tenth satellite will be launched in early 2009.

2.30 While Optus is now owned by Singapore Telecommunications Ltd, it points out its strong Australian linkages:

> Every Optus satellite is owned by a company registered in the Australian Capital Territory. The launch of every Optus satellite is subject to the issue of an overseas launch certificate by the Australian Government….Optus agreements to supply satellite capacity to the Commonwealth Government are governed by Australian law…Under the existing arrangements the Commonwealth has extensive powers to exercise legal and security control over the Optus satellite fleet and the associated ground stations... a number of specific agreements with the Commonwealth which, among other things, ensure that all decisions in relation to the satellite business are consistent with Australian national interest and Australian national security.[29]

2.31 A number of witnesses argued that Australia can afford to, and should, have its own satellites, or least share in the ownership of satellites. The main arguments involved reliable access to data and being able to access data in a timeframe that suits our unique purpose. Several witnesses pointed out the need for a risk analysis of our current investment to clearly highlight the benefits of our current involvement against the risks of being denied access to data..

> …you do not know exactly when you might be denied access. The best way for a country our size to try to cover the risk to some extent is to be actively involved with other nations in developing observing programs and make

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27 Mr Graeme Hooper, *Proof Committee Hansard*, 29 July 2008, p. 106.

28 Optus had taken over the formerly government-owned Aussat. *Submission 63*.

29 Mr Paul Sheridan, Optus Networks, *Proof Committee Hansard*, 1 August 2008, pp 44-6.

> some contribution, whether it is in terms of providing an instrument or part of an instrument so that we have some involvement in the game and therefore some influence as to what happens.[30]
>
> [Australia is] …totally dependent on external satellites for its defence, earth observatory, meteorological aspects and the growing needs across our whole sector. Therefore, it is a bit like totally outsourcing your most strategic asset and having somebody else make the decisions for you.[31]
>
> …we have become very, very trusting, if you like, of our ability to obtain what we need from elsewhere…[32]
>
> Australia needs to participate financially and collaborate in their missions and deploy sensors that are purpose-designed for Australian issues.[33]
>
> if we seek to have influence in the changing world of space…then we need to be a voice at the table and to do that we need to operate a couple of satellites.[34]

2.32 Not owning a satellite means Australia has no input into its capabilities:

> …without having an indigenous capability, we do not have the possibility of being part of programmes that are specifying and designing new systems that will be useful for Australia. We really can be limited by the products that we end up buying, basically.[35]

2.33 The Bureau of Meteorology commented:

> While Australia can exert some influence on internationally coordinated efforts through forums such as the WMO Space Programme, key decisions on mission payloads are, not unexpectedly, driven strongly by those that are making the investments. [36]

2.34 The Canadian Space Agency told the committee that it shares this view:

> By not owning a satellite, you are along for the ride and you get what is available… When you piggyback on somebody else's constellation, you are at the mercy of that programme.[37]

2.35 From a defence perspective, the Department noted:

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30 Professor Peter Dyson, *Committee Hansard*, 23 May 2008, p. 29.

31 Mr Warwick Watkins, Australian Space Consortium, *Proof Committee Hansard*, 29 July 2008, p. 37.

32 Mr Shaun Wilson, Engineers Australia, *Proof Committee Hansard*, 29 July 2008, p. 95.

33 ASIBA, *Submission 37*, p. 6.

34 Mr Brett Biddington, *Proof Committee Hansard*, 29 July 2008, p. 47.

35 Professor Alexander Grant, Institute for Telecommunications Research, *Committee Hansard*, 23 May 2008, p. 5.

36 Dr Susan Barrell, *Proof Committee Hansard*, 16 May 2008, p. 14.

37 Mr Jocelyn Dore, Canadian Space Agency, *Proof Committee Hansard*, 22 July 2008, pp 6-7.

> Noting Australia's strong alliance arrangements with the US, we maintain unique access and support from US space systems. Additionally, continued assured access to the support provided under the alliance is critical to the ADF's ability to operate independently as part of an international coalition or in a leadership role in a regional force. This access to allied space systems has largely met Defence's needs, in particular for intelligence and more recently for satellite communications. The higher operational tempo of recent years and consequent demand for space products has highlighted that assured access to allied systems may not necessarily be guaranteed in all circumstances and is subject to host nation priorities.[38]

2.36 Canada is reducing its dependence on the US:

> they have begun focusing on some specific areas where they need to develop their own capability. Some of those areas are related to the remote-sensing capabilities. Their needs, I guess, may be slightly different to those of the US, in the sense that their focus is north, around the Arctic region, and on issues associated with global warming.[39]

2.37 As shown in Table 2.1, many Asian economies, smaller than Australia, have significant satellite programmes:

> … they are now building and flying substantial satellites (eg Korea, Taiwan, Thailand, Malaysia and Singapore), and using the experience to develop industrial capability and professional skills.[40]

2.38 On the other hand, aiming for self-sufficiency is generally very inefficient. It was argued to the Committee that Australia is not self-sufficient in many other important areas:

> I am sure you all have Microsoft Office on your desktops. This is made by a company in Seattle; 98 per cent of computers in Australia are dependent on a foreign company for their applications software. Every commercial aeroplane that flies in Australia is built not in Australia.[41]

2.39 Most agencies seemed to think the prospect of being locked out of access to date was remote:

> I think the risk of losing international collaboration and access to international satellites across the board is very low.[42]
>
> It has not been a problem for us to date and I do not foresee it will be in the future.[43]

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38 Ms Rebecca Skinner, Department of Defence, *Proof Committee Hansard*, 29 July 2008, pp 2-3.

39 Group Captain Davison, Department of Defence, *Proof Committee Hansard*, 29 July 2008, p. 7.

40 Dr Bruce Middleton, former head of Australian Space Office, *Submission 87*, p. 2.

41 Dr Michael Green, Department of Innovation, Industry, Science and Research, *Committee Hansard*, 16 May 2008, p. 9.

42 Dr Susan Barrell, Bureau of Meteorology, *Committee Hansard*, 16 May 2008, p. 17.

2.40 However, while the risk of being denied access to satellite data is not necessarily large, it would have severe consequences if it eventuated.

Benefits of collaboration

2.41 Some witnesses therefore argue there were better uses of funds in collaborative approaches:

> …we would see the ideal investment, if the cost-benefit analysis took us that way, in sensors and instruments, not in satellites themselves. Through the collaborative arrangements we have, particularly with Japan, the United States, China and Korea, who are about to launch a geostationary satellite in a year or so, there would certainly be some capacity, I would hope, to collaborate in designing an instrument—perhaps a hyperspectral instrument—that would sit for example on a Japanese satellite which is very conveniently located …to the north of Australia. That would potentially allow us to get a lot more detailed information about the atmospheric profile, temperature and humidity and really understand a lot more about the atmosphere above Australia. Investments like that would be very worth while.[44]

2.42 The committee heard of the potential for cooperative projects, sharing satellites with Canada:

> if we do a fifty-fifty mission…when the satellite is flying over Canada looking for forest fires, we are using it and operating it. When it is flying over Australia, for example, looking for fires, you have 100 per cent control and operation.[45]

> an incline LEO constellation of 10 to 15 satellites which would provide continuous coverage of both poles, north and south. To us, northern coverage is certainly important. But there may be some benefits for a country like yours which has an interest in the Antarctic.[46]

2.43 An alternative to ownership of satellites is making some important contribution to their operation, so that access will be maintained. One witness referred to this as having 'skin in the game'.[47] The committee heard of two examples:

> At that time there was pressure from the Japanese to contribute to the cost of their operating the GMS satellite. The bureau solved that very cost effectively, I think, by providing them with ground support from Melbourne

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43 Dr Chris Pigram, Geoscience Australia, *Committee Hansard*, 16 May 2008, p. 30.

44 Dr Susan Barrell, Bureau of Meteorology, *Committee Hansard*, 16 May 2008, p. 17.

45 Mr Richard Kolacz, COM DEV, *Proof Committee Hansard*, 22 July 2008, p. 9.

46 Mr Jocelyn Dore, Canadian Space Agency, *Proof Committee Hansard*, 22 July 2008, p. 6.

47 Mr Brett Biddington, *Proof Committee Hansard*, 29 July 2008, pp 46-8; and his booklet *Skin in the Game: Realising Australia's National Interests in Space to 2025*, Kokoda Papers, no. 7, May 2008.

> at their cost, and that support was essential for the satellite to maintain its position and attitude.[48]
>
> We have a very good in-kind type of relationship with the United States Geological Survey where, as their satellite passes over Australia, we receive data about the health of the satellite—its telemetry data, what it is doing. We then give that straight back to them, which gives them an increased knowledge of how their satellites are going when they are in that part of the world they cannot see. They value that very highly. They value the fact that we give them the data and that we are very reliable and competent, and that comes back to us as a better deal on access to the satellite.[49]

2.44 Australia is, literally, well-placed for downloading data from satellites, allowing us to 'earn our keep' in joint satellite projects:

> Where we sit … equidistant from Europe and the Americas, makes us an ideal place for ground stations… no matter where the earth is in terms of its daily rotation, one of those ground stations is always in contact with the satellites being supported. [50]

Cost of satellites

2.45 Launching objects into space is generally expensive:

> If you want to send something up into space through the space shuttle, you have to allow approximately its weight in gold for the value of getting it up there.[51]

2.46 However, there are ways of launching small satellites cheaply. The committee was impressed by the initiative of some students at the University of New South Wales building a satellite within a budget of about $30 000 by using volunteer labour and off-the-shelf components, and being allowed free use of some testing facilities by the university and some businesses.[52] The Canadian Space Agency has small satellite programmes planned in the near future in which Australia could collaborate.

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48 Dr John Boyd, *Proof Committee Hansard*, 29 July 2008, p. 80.

49 Dr Adam Lewis, Geoscience Australia, *Committee Hansard*, 16 May 2008, p. 31.

50 Mr Brett Biddington, *Proof Committee Hansard*, 29 July 2008, p. 48.

51 Professor Richard Morgan, Centre for Hypersonics, *Proof Committee Hansard*, 29 July 2008, p. 17.

52 They also referred to a team of ten amateurs who over two years in the early 1970s built and launched a satellite; Mr Anthony Wicht, *Proof Committee Hansard*, 1 August 2008, p. 5.

Militarisation of space and space debris

"And now I'm mad about space junk
I'm all burned out about space junk"
Devo, *Space Junk*, (Lyrics: G. Casale, R. Mothersbaugh)

2.47 The Department of Defence warned:

> As space becomes more accessible, it will also be more congested and contested, and there is a growing demand for access to specific orbital planes in both low earth orbit and geosynchronous orbit. Access to, and utilisation and disposal of, satellites from these orbits will require increasingly careful monitoring. The destruction of, or interference with, satellites providing space services can adversely affect other national applications. As space utilisation increases, space debris will also become a growing threat to satellites.[53]
>
> We are very reliant on a lot of our space capabilities in support of national security, and they do come under threat from space debris... Most of the threat is to low earth orbit satellites and that is where most of the debris is concentrated at the moment.[54]

2.48 Concerns about both the militarisation of space and about space debris were heightened in January 2007 with China's test of an anti-satellite weapon on an aging weather satellite. The impact created a cloud of debris, perhaps accounting for about a quarter of the current space junk in orbit.[55]

2.49 Defence expressed their concern about the test from a geostrategic viewpoint:

> …the development of new and disruptive capabilities such as the anti-satellite missile (tested in January 2007) could create misunderstandings and instability in the region.[56]

2.50 However they did not make any public comment on its effect on satellites.[57] The Department flagged that the deployment of weapons in space will be addressed in the Defence White Paper, due with the Government by the end of the year.

2.51 Some witnesses expressed opposition to weapons testing in Australia:

> I think all of us who are in what might be called broad space science would view our primary objective as the peaceful use of space, whether it be on

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53 Ms Rebecca Skinner, Department of Defence, *Proof Committee Hansard*, 29 July 2008, p. 3.

54 Group Captain Dennis Davison, Department of Defence, *Proof Committee Hansard*, 29 July 2008, p. 10.

55 *Orbital Debris Quarterly News*, NASA, Vol. 12, Issue 1, January 2008; *The Economist*, 19 January 2008.

56 *Australia's National Security: Defence Update 2007*.

57 Response from Department of Defence to question taken on notice on 29 July 2008.

> economic, social or environmental grounds. I think any weaponisation or perceived weaponisation of space would have concerned me as an individual, let alone the community. I think there is a clear view that outer space is to be used for peaceful purposes.[58]

2.52 Another witness had concerns about the militarisation of space and Australia's (indirect) involvement in it:

> The US air force has the stated policy to ultimately destroy any space capability—and that can include ground stations anywhere in the world—that the US government determines is inimical to its national interests. As a close ally to the United States, it should occur to us to have a view on that, on whether or not that is a good thing to do, bearing in mind also that we host in this country both facilities and research which is important to the future of that relationship and which, indeed, can be expected to have impact on the sorts of capabilities that the US air force would draw on to impose or inflict its policies, should that unfortunate event ever happen.[59]

2.53 A submission refers to a United States Government commission which argued that the US needs to 'develop the capability for power projection in, from and through space'; a State department official claiming 'our Government will continue to consider the possible role that space-related weapons may play in protecting our assets'; and the US being the sole opponent at the United Nations to resolutions aimed at preventing an arms race in outer space.[60]

2.54 It has been suggested that the destruction of ten satellites could create enough space debris to start a 'chain reaction' of debris destroying satellites and creating more debris, potentially ending satellite usage for decades.[61]

Conclusion

2.55 The committee opposes any moves towards militarising space. It wants the government to call for a halt of any weapons testing, particularly tests that would result in the creation of further space debris.

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58 Professor Andrew Parfitt, *Proof Committee Hansard*, 29 July 2008, p. 104.

59 Mr Brett Biddington, *Proof Committee Hansard*, 29 July 2008, p. 46.

60 Women's International League for Peace and Freedom, *Submission 84*, pp 9, 25 and 26.

61 The claim is attributed to the US Centre for Defence Information; T. Allard, 'Battle lines in the final frontier', *Sydney Morning Herald*, 25 April 2008, p. 31.

Chapter 3

Looking out

3.1 Australia has built a strong reputation for the work of its astronomers in 'looking out' (or 'listening out') to the distant universe and tracking and communicating with space objects closer to Earth. This aspect of space is predominantly the domain of scientists, with few commercial applications.

3.2 The range of activities, and the enthusiasm for them, was demonstrated to the committee by a CSIRO scientist:

> The looking-up lens is about expanding the frontiers of science. One of those areas is the radio astronomy area…where we are asking some of those fundamental questions: what is the origin of magnetism; are Einstein's laws fully correct; and where is the dark matter coming from? Some of these are going to have the next Nobel prizes in them, and that is fantastic.[1]

Astronomy

"Jupiter and Saturn, Oberon, Miranda and Titania.
Neptune, Titan, stars can frighten"
Pink Floyd, *Astronomy Domine* (Lyrics: S. Barrett)

"A good friend of mine studies the stars,
Venus and Mars are alright tonight"
Wings, *Venus and Mars* (Lyrics: P. McCartney)

"Images of broken light which dance before me like a million eyes
That call me on and on across the universe"
The Beatles, *Across the Universe* (Lyrics: J. Lennon/ P. McCartney)

"You ate our chips, and you drank our Coke
Then you showed me Mars, through your telescope"
Supergrass, *Grace*, (Lyrics: G. Coombes, R. Coombes, D. Goffey, M. Quinn)

3.3 Astronomy is an important part of space science and one in which Australia excels. The appointment of ANU astronomer Professor Penny Sackett as Chief Scientist should ensure astronomy continues to be given due consideration within government.

3.4 One expert witness opined:

> There is no doubt that Australian radio and optical astronomers, along with their facilities, are highly regarded internationally, and in these fields,

1 Dr James Moody, CSIRO, *Proof Committee Hansard*, 29 July 2008, p. 31.

> Australia does have a natural geographic advantage, both in terms of 'wide open spaces' and a privileged view of the galactic centre.[2]

3.5 Australia has a 10 per cent stake (through the Australian National University and Astronomy Australia Ltd) in the Giant Magellan Telescope currently being constructed in the Andes. When completed around 2016 it should produce images up to ten times sharper than the Hubble Space Telescope.

Square Kilometre Array

3.6 The Square Kilometre Array (SKA) is a giant radio telescope designed to do leading edge radioastronomy. The CSIRO is the lead agency in Australia's bid to host the facility. Australia has made the final two in the selection process and the DIISR sounds confident about Australia's prospects:

> …I think we have a very compelling case. We have committed in the last year to hosting a demonstration instrument, which will be a significant instrument in its own right. It was discussed as part of ministerial and prime ministerial visits to Europe recently. I am not sure that there is more that we could do at this stage. [3]

3.7 The DIISR commented:

> …it will be an extremely high-tech instrument that will potentially provide a lot of opportunities for high-tech Australian companies to participate. Our assessment is that, given that the infrastructure is largely sophisticated radio antennas and a range of supercomputing, visualisation and other application software—which are areas where we do have leading-edge capability, particularly in antennas and ground station technology—we think there is quite a good opportunity for Australia to benefit from that project. [4]

3.8 If the Australian bid is successful the telescope will be constructed between 2012 and 2020 at a total cost of $1.8 billion. Around half the array will be located at the core site at the Murchison Radio-Astronomy Observatory, within a 260km radius radio-quiet area around 300 kms north-east of Geraldton, which will be built regardless of the decision on the SKA.[5]

3.9 The Joint Committee on Public Works is to report soon on the project, having held a public hearing in Geraldton about it.

3.10 There is general enthusiasm about the potential of the project and praise for the support governments were showing:

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2 Dr John Boyd, *Submission 82*, p. 4.

3 Dr Michael Green, DIISR, *Committee Hansard*, 16 May 2008, p. 12.

4 Dr Michael Green, DIISR, *Committee Hansard*, 16 May 2008, p. 12.

5 Western Australian Department of Industry and Resources, *Submission 85*, pp 5-6.

> One cannot predict what the SKA might produce, only that it will almost certainly produce fantastic technologies that we have not imagined yet. [6]
>
> I commend government for the effort and the support that has been provided to the SKA project through the Pathfinder investment initially, and I think the Western Australian government is also to be congratulated…SKA, for Western Australia but, indeed, for the entire continent, represents an investment in knowledge which is stunning.[7]
>
> applauding the large investment already being made by the Australian Government in the Australian SKA Pathfinder project as well as the leadership role Australia is taking in the international SKA project and noting the considerable scientific, economic, educational, social and broader national benefit which the SKA project is expected to confer, [the Australian space community] recommend that the Australian Government considers increasing its support for the SKA project, specifically through programmes and processes which encourage and enhance early Australian industry involvement.[8]

3.11 The committee heard some suggestions for worthwhile science that would also bolster the case for the SKA being located in Australia:

> If we have a good understanding or the world-best understanding of the ionosphere and space weather, that would be a good argument for basing it [the SKA] here rather than in South Africa…[9]

Space tracking

"We're space trackin' round the stars
Come on, let's go space trackin'"
Deep Purple, *Space Trucking*, (Lyrics: I. Gillan, R. Blackmore, J. Lord, I. Paice, R. Glover)

Oh man! Wonder if he'll ever know
He's in the best selling show, Is there life on Mars?
David Bowie, *Life on Mars*, (Lyrics: D. Bowie)

3.12 Australia has a distinguished record of involvement in tracking and processing information from spacecraft. The 'big dish' at Parkes had an important role in the Apollo missions in the 1960s. In 2008 the Phoenix Mars Lander has been transmitting data back to Earth using the Deep Space Tracking Station at Tidbinbilla, near Canberra. As noted in the previous chapter, Australia has geographical advantages for this activity.

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6 Mr Brett Biddington, *Proof Committee Hansard*, 29 July 2008, p. 49.

7 Mr Brett Biddington, *Proof Committee Hansard*, 29 July 2008, p. 48.

8 Appendix 4.

9 Professor Iver Cairns, National Committee for Space Science, *Proof Committee Hansard*, 29 July 2008, p. 83.

3.13 CSIRO said of the Tidbinbilla centre:

> That $24 million activity is funded entirely by NASA. That is very high profile and, as you have seen, very busy, and it is mission critical in supporting the $20 billion worth of assets that the international space community—mainly NASA—has for exploring the solar system.[10]

Conclusion

3.14 The committee commends the work of Australian astronomers. Astronomy has had significant support from governments, with the SKA application being successfully developed to the stage where Australia is on the final shortlist of two sites. Astronomers seem to have been successful in applying for 'lumpy' grants for occasional large projects such as the SKA; and the CSIRO and universities have provided recurrent funding. While astronomy would benefit from more government attention to space, it is not the major focus of recommendations in this report.

10 Dr Miriam Baltuck, CSIRO, *Proof Committee Hansard*, 29 July 2008, p. 32.

Chapter 4

Going up

4.1 As noted in the introduction, Australia was an early leader in rocketry. At its peak, Woomera in South Australia was the world's second most heavily used launch site, after Cape Canaveral and launched Australian, European and American rockets.[1]

Should Australia be a launch site?

"Set the controls for the heart of the sun,
The heart of the sun"
Pink Floyd, *Set the Controls for the Heart of the Sun*, (Lyrics: R. Waters)

"For here am I sitting in a tin can
Far above the world
Planet earth is blue
And there's nothing I can do"
David Bowie, *Space Oddity*, (Lyrics: D. Bowie)

4.2 The committee has heard conflicting views about the current state of the Woomera rocket range. One view is that the Woomera facilities are now far from world-class for rocket launching:

> …there would be considerable investment required to resurrect any role that it might aspire to...[2]
>
> As far as using space is concerned, it would require some significant investment in infrastructure to bring it back to the sorts of things [rocket launches] that it was doing in the fifties.[3]
>
> a fair bit of investment is needed to bring some of the communications and telemetry and some aspects of the launching facilities into the modern era.[4]

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1 Senate Standing Committee on Transport, *Communications and Infrastructure, Developing Satellite Launching Facilities in Australia and the Role of Government*, April 1992, pp 1 and 6.

2 Dr Michael Green, DIISR, *Committee Hansard*, 16 May 2008, p. 3. An even more sceptical view was expressed by Hendrik Gout, 'Lost in Space – the Woomera rocket fizzer', *Independent Weekly*, 13 January 2007.

3 Air Vice Marshal Geoffrey Brown, Department of Defence, *Proof Committee Hansard*, 29 July 2008, p. 14.

4 Professor Boyce, Australian Hypersonics Network, *Proof Committee Hansard*, 29 July 2008, p. 21.

> I think things like launch capability are now closed off to us; it is just too competitive for us to compete.[5]
>
> Do I see Woomera as a potential space launch site in the future? The answer is: it could be, but I do not believe that is where Australia should be investing its money…[6]

4.3 On the other hand, the South Australian government describe Woomera as 'an active space launch site'.[7] Others also praised it:

> The Woomera test range is a facility that is unique in the world. It is unfortunately literally gathering dust, but it is a test range that many countries would love to have. It is a capability that Australia can really build on uniquely to its own interests.[8]
>
> …they, fortunately, kept Woomera going, we still have that facility and the DSTO have facilitated us flying scramjets…the great space centre at Woomera…[9]
>
> …for the purpose of testing systems and testing re-entry capabilities Woomera is fantastic. The fact that it is a land range means the rest of the world look at it in envy and they would like to come for many flight experiments… one of the big advantages is that you can recover the bits of an experiment after the experiment has happened and from the damaged bits you can work out what happened.[10]
>
> Woomera is perhaps one of Australia's most important strategic military and security assets because it is the world's largest land based test range.[11]

4.4 A possible reconciliation of these views is that Woomera is currently not suitable for large scale launching of orbital payloads (for which launch sites closer to the equator are desirable) but suitable for smaller suborbital launches and testing. The Australian Space Research Institute has been a regular user of the Woomera rocket range since 1993 giving students the opportunity for involvement in over 100 small-scale launches using 'sounding rockets'.[12]

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5 Mr Matt Miller, SMS, *Committee Hansard*, 23 May 2008, p. 28.

6 Mr Brett Biddington, *Proof Committee Hansard*, 29 July 2008, p. 52.

7 South Australian Government, *Submission 79*, p. 3.

8 Dr Andy Thomas, *Committee Hansard*, 23 May 2008, p. 21.

9 Professor Richard Morgan, Centre for Hypersonics, *Proof Committee Hansard*, 29 July 2008, pp 16-8.

10 Professors Russell Boyce and Raymond Stalker, *Proof Committee Hansard*, 29 July 2008, p. 22.

11 Mr Brett Biddington, *Proof Committee Hansard*, 29 July 2008, p. 52.

12 Mr Gary Luckman, *Proof Committee Hansard*, 16 May 2008, pp 33–4. The rockets were donated to the Institute by the Australian Government on the condition that ASRI use them to promote space science and engineering. The rockets were military rockets that had ended their useful life, and were modified to launch payloads.

4.5 At various times, Darwin, Christmas Island and Cape York have been suggested as possible Australian launch sites, as all are closer to the equator, but nothing eventuated.[13]

Space elevator

4.6 The Indian Ocean off Western Australia has been identified as an ideal location for a 'space elevator'; a thin carbon nanotube connecting a barge to a space station, along which supplies could be carried up. Construction could draw on the WA oil industry's expertise in constructing offshore platforms, as well as its material resources. NASA is currently investigating the feasibility of the project. [14]

Should Australia be researching/designing propulsion systems?

"And I think it's gonna be a long long time
Till touch down brings me round again to find
I'm not the man they think I am at home
Oh no no no I'm a rocket man
Rocket man, burning up his fuse up here alone"
Elton John, *Rocket Man* (Lyrics: B. Taupin)

"Hey, wish that was me up there--
It's the biggest rocket I could find,
And it's holding the night in its arms"
Kate Bush, *Rocket's Tail* (Lyrics: K. Bush)

4.7 Australian engineers have had some success in this area. The DIISR commented:

> Professor Allan Paul, with his hypersonic scramjet research, has been successful in winning quite a large contract from the Americans to further develop that work...[15]

4.8 Scramjets are supersonic combustion engines with potential aerospace applications. They do not have to carry most of their propellent as they can draw oxygen from the atmosphere. Australian research is being conducted under the Australian Hypersonics Initiative, bringing together the University of Queensland, ANU, Australian Defence Forces Academy, the Defence Science and Technology

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13 Senate Standing Committee on Transport, *Communications and Infrastructure, Developing Satellite Launching Facilities in Australia and the Role of Government*, April 1992, especially Chapter 4; Dr Michael Green, DIISR, *Committee Hansard*, 16 May 2008, p. 4; J. Laing, 'Go for launch!', *Australasian Science*, March 2002; M. Dapin, 'Fantasy Island', *The Age*, 9 August 2008.

14 Western Australian Department of Industry and Resources, *Submission 85*, pp 17-8.

15 Dr Michael Green, DIISR, *Committee Hansard*, 16 May 2008, p. 2.

Organisation and the state governments of Queensland and South Australia. Hypersonics refers to speeds about five times the speed of sound (ie mach 5).[16]

4.9 An ANU team has recently developed two revolutionary designs for rocket engines; an ion engine and a plasma engine.[17] The work has attracted interest from the European Space Agency.

4.10 The committee heard of their potential:

> Scramjets are the potential means of reducing this cost. DSTO are pioneering the way in flight testing them. The first application will be like unmanned missiles and, if that is successful, we can look at a high-speed cruise around the world. You could maybe have an hour's transit time between continents. You could have return trips between continents that revolutionise the way we do business. Following on from that, maybe 20 years down the track, we could look at developing scramjets that could give you partial access to space—reusable vehicles with much lower running costs.[18]

4.11 Asked about the timetable for different types of scramjets, the scientists replied:

> There is the unmanned mach 7 one. Maybe we could do that in about five years. If you then look at making it as a transport for intercontinental travel it would be maybe another five to 10 years after that. If you are actually looking at part of a boost system to orbit—it all depends on the funding of course—it would be in the 10- to 20-year time frame…[19]

Australia as a base for space tourism

"Fly me to the moon, let me sing among those stars
Let me see what spring is like, on Jupiter and Mars"
Frank Sinatra, *Fly Me to the Moon,* (Lyrics: B. Howard)

"But somewhere in a private place
She packs her bags for outer space…
I would fly to the moon and back if you'll be,
If you'll be my baby
Got a ticket for a world where we belong"
Savage Garden, *To the Moon and Back*, (Lyrics: D. Hayes, D. Jones)

4.12 There has been increasing discussion about the prospects for space tourism. Some market research suggests space tourism revenues could be around $700 million

16 *Submissions 36, 39 and 49* give more detail.

17 ANU, *Submission 13*, p. 3.

18 Professor Richard Morgan, Centre for Hypersonics, *Proof Committee Hansard*, 29 July 2008, p. 18.

19 Professor Richard Morgan, Centre for Hypersonics, *Proof Committee Hansard*, 29 July 2008, p. 21.

in 2020.[20] The Australian company, Grollo Aerospace, has expressed an interest in offering space tourism experiences.[21]

4.13 The scramjet technology potentially could be employed for tourism. The South Australian Government suggested 'the Woomera site remains a favourite location for…the establishment of a space base for space tourism.'[22]

4.14 Dr Andy Thomas thought Australia was well-placed, but it would not happen soon:

> …Australia provides an ideal forum for many of these high altitude parabolic flights, which is what most of them are... However, the market is still small, so I think it will be quite some time before it would be buoyant enough to have operations in Australia as well as the other planned operations, for example, that in New Mexico that Richard Branson is supporting, and so on. But, ultimately, that could happen.[23]

4.15 The potential for space tourism may be limited by the danger it currently involves:

> Between about 50 and 100 space launches end in disaster—they do not get there or they do not come back. If you are talking about manned space flight, that means we really have to look at the lunatic fringe if we want to get people to fly in space. Those sorts of risks are equivalent to the risks that extreme sportsmen take. Normal people do not do it…The market will not develop until it costs in the order of a few thousand dollars to get into space and you know you are going to come back alive…[24]

Conclusion

4.16 While not opposed in principle to Australia regaining its role as a launch site if a commercial venture wishes to do so (whether for satellites or tourists), the committee does not see this as likely, nor as something the government should be supporting with taxpayers' money.

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20 Cited by Australian Hypersonics Network, *Submission 36*.

21 Grollo Aerospace, *Submission 54*, p. 1.

22 South Australian Government, *Submission 79*, p. 9. Woomera was also supported as a potential space tourism site by Dr Andy Thomas, *Committee Hansard*, 23 May 2008, p. 21.

23 Dr Andy Thomas, *Committee Hansard*, 23 May 2008, p. 21.

24 Professor Richard Morgan, Centre for Hypersonics, *Proof Committee Hansard*, 29 July 2008, pp 16-8.

Chapter 5

Government and space research and industry

Government and space research

International comparison of Australia's space research

5.1 Comparing expenditure on space science and industries across countries is difficult. As the OECD comments:

> …the space sector is one of the least developed in terms of robust, internationally comparable statistics and data...[in particular] disentangling the space sector from the larger aerospace sector remains a challenge in most countries.[1]

5.2 It is notable in the OECD's international comparison that Australia is excluded from many tables due to lack of data. However, the data presented in Table 5.1 is consistent with the general view that Australian government support for space research is comparatively low.[2]

Table 5.1: Government outlays on space research and development (percentage of total government outlays on R&D, 2004)

United States	17.4	United Kingdom	2.3
Belgium	11.1	Hungary	2.3
France	11.0	Norway	2.2
Italy	8.7	Denmark	2.0
Japan	7.1	Finland	1.9
Germany	5.4	Czech Republic	0.9
Canada	4.7	Sweden	0.7
Spain	4.1	Greece	0.6
Netherlands	4.1	Austria	0.3
Switzerland	4.0	Portugal	0.2
South Korea	3.8	Australia	0.2

Source: OECD, *The Space Economy at a Glance 2007*, p. 40.

1 OECD, *The Space Economy at a Glance 2007*, pp 13-4.

2 The available data also suggests that Australian business R&D on space is a similarly small proportion of their total R&D; around 0.2 per cent, compared to an OECD average of around 8 per cent; OECD, *Space 2030: Exploring the Future of Space Applications*, 2004, p. 180.

5.3 The Productivity Commission estimates that less than 1 per cent of Australian government support for science and innovation is directed towards 'exploration and exploitation of space'.[3] The Report on the Review of the National Innovation System has recommended increased investment in the space science sector as a priority sector for growth in Australian innovation and industry.

Australian space research diffused across universities

5.4 Particularly given the shortage of funding, it may be better to concentrate on a few elite schools which could then afford better equipment and have more, formal or serendipitous, exchange of views and collaborations. For example, at present there are fifteen Australian universities teaching astronomy.

5.5 Asked about the merits of concentrating expertise in fewer centres of excellence, some academics were generally supportive:

> …when we had the Cooperative Research Centre for Satellite Systems, we had a concentration like that, and it was extremely beneficial.[4]

> I think there is certainly benefit in having some nodes…One of the main things that the National Committee for Space Science actually put forward was actually a National Institute for Space Science.[5]

5.6 Of course, there may be less agreement if the discussion reached the specific stage of deciding which university schools to close. This is particularly likely if offering space science attracts better students to the university.

Australian Research Council funding

5.7 Some evidence presented to the committee was critical of the attitude of the Australian Research Council (ARC) towards space science:

> We all apply to ARC, which is very difficult to work with from a user's point of view. Even if you are successful in ARC, you very rarely get funding that is of an international level. That means that it is very difficult for all of us to compete in an international business like space science or my own business of astrophysics.[6]

> When a discipline falls below a certain 'critical mass' in Australia, it is regarded as a 'backwater' and finds it very difficult to convince Australian

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3 The proportion was 0.6 per cent in 2005-06; Productivity Commission, 2007, *Public Support for Science and Innovation*, p. 29.

4 Professor Alexander Grant, Institute for Telecommunications Research, *Committee Hansard*, 23 May 2008, p. 8.

5 Professor Peter Dyson, *Committee Hansard*, 23 May 2008, p. 28.

6 Professor Roger Clay, *Committee Hansard*, 23 May 2008, p. 86.

> Research Council assessor panels (of necessarily non-experts) that the work is worth doing, however well it is regarded internationally.[7]

5.8 The ARC denied that they discriminated against projects involving international projects, but they are reluctant to fund projects extending more than five years.[8] Annual funding by the ARC for space-related projects has been around $10-15 million in recent years.[9]

Should there be a space cluster?

5.9 There are often argued to be synergies in bringing together related expertise. A 'cluster' is 'a geographic concentration of interconnected companies, specialised suppliers, service providers, firms in related industries, training institutions and support organisations within a local area or region. One mark of a successful cluster is that its value as a whole is greater than the sum of its parts'.[10]

5.10 Clusters may develop because of the availability of some key resource or position,[11] become established where the item produced was first invented,[12] grow around a university[13] or spin off from another cluster.[14] Some clusters develop in a particular location for no obvious reason but, once established, act as a magnet for skilled people in that industry, and supporting industries, and so remain a prime location.[15]

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7 Professor Paul Cally, *Submission 1*, p. 5.

8 Mr Len Marsden, Australian Research Council, *Proof Committee Hansard*, 29 July 2008, pp 6-7.

9 Mr Len Marsden, Australian Research Council, *Proof Committee Hansard*, 29 July 2008, p. 58.

10 House of Representatives Standing Committee on Economics, Finance and Public Administration, *Australian Manufacturing: Today and Tomorrow*, July 2007, p. 133.

11 For example, Sweden developed expertise in speciality steel products due to its iron ore deposits and in timber products due to its forests.

12 For example, over five centuries after Gutenberg invented the printing press, around half the world's printing presses were still being manufactured in central Germany.

13 For example, Silicon Valley (headquarters to leading IT companies such as Apple, eBay, Google and Yahoo!) developed near the Californian universities, as did Silicon Fen around Cambridge.

14 For example, Basel's success as a cluster for the pharmaceuticals industry partly reflects its former importance in the dye industry.

15 For example, Hollywood has such a concentration of actors, writers, directors, cinematographers, producers, costume and set designers, lighting specialists and so forth that it remains the leading centre for film production despite relatively high costs.

5.11 The literature suggests clusters can take considerable time to develop but are then long-lasting.[16] In some cases, once clusters have emerged, governments have encouraged them by funding more educational facilities and supporting infrastructure. But some attempts by governments to create clusters have been less successful.[17]

5.12 The space industry thought a space cluster would be particularly beneficial for small- and medium-sized companies, which often drive innovation. Accordingly, they

> endorse the space cluster, including tertiary education partners, as a method of fostering and supporting the development, trialling and maturation of new technologies and products which a space industry may be expected to generate.[18]

5.13 The BLUEsat students are helped in developing their skills in satellite building due to the proximity of some industries whose facilities they use.[19]

5.14 In principle, with modern communications there could be a 'virtual cluster'. But there still appear to be advantages from physical proximity in the cross-pollination of ideas. One pivot for a cluster would be a Cooperative Research Centre, such as the one that operated for Satellite Systems from 1998 to 2005.[20]

5.15 A cluster in Adelaide could develop around the Institute for Telecommunications Research at the University of South Australia, research centres at the University of Adelaide and a number of Adelaide-based companies and benefit from relative proximity to Woomera. The South Australian government regards the state as 'the natural home of Australia's space effort'.[21] Adelaide hosted a nine-week international course by the International Space University in 2004.[22]

5.16 A cluster in Canberra could develop around the Acton Black Mountain area which houses the ANU and CSIRO. Also in the Canberra region are the relevant Australian government departments, Mount Stromlo and the Deep Space Tracking Centre at Tidbinbilla.

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16 Michael Porter, 'Clusters and the new economics of competition', *Harvard Business Review*, November 1998.

17 Michael Porter, the Harvard academic regarded as the leading writer on clusters, concludes 'government policy will be far more likely to succeed in reinforcing an existing or nascent cluster than in trying to promote an entirely new one, however tempting that might be for national prestige', *The Competitive Advantage of Nations*, Free Press, New York, 1990, p. 655.

18 Appendix 4.

19 Mr Anthony Wicht, BLUEsat, *Proof Committee Hansard*, 1 August 2008, p. 3.

20 The Centre is discussed further in Chapter 6.

21 *Submission 79*, p. 1. A similar view is put in *Submission 88*, p. 3.

22 Australian Alumni of International Space University, *Submission 86*, p. 3.

5.17 Arguments could be mounted for adding Sydney and/or Melbourne (and perhaps a site in Western Australia for radio astronomy if the SKA proceeds) but Australia is too small to have a large number of space clusters.

Space science as an inspiration for students and others

5.18 Space seems to capture the public imagination in ways that most other science struggles to do. Almost everybody over fifty can remember what they were doing when Neil Armstrong took that one small step onto the lunar surface. Many younger people have used the internet to share in watching the pictures beamed from Mars as probes explore the Martian terrain. As the lyrics cited in the earlier chapters illustrated, space science has permeated popular culture in ways that other science does not. There is much unexplored territory in the deep sea, with new lifeforms to discover.[23] However, this gets much less public attention. (How many songs are there about exploration of the deep sea?[24] Or about nanotechnology? Or the Higgs Boson?)

5.19 While interest in western countries has perhaps waned with the (temporary?) suspension of flights outside earth orbit, space still interests the general populace. The chair of Young Engineers Australia explained:

> I do a lot of speaking engagements at schools…When I go out there, I use space as a tool to engage. It is the one time when, even if I am talking to underprivileged people or people from a lower socioeconomic audience, you can hear a pin drop. They are absolutely spellbound by the possibilities.[25]

5.20 Space seems particularly to captivate children:

> Any of us who have had children knows that space, astronomy and dinosaurs are the things that seem to grab all of the kids' attention.[26]
>
> …students at schools are very excited about space.[27]
>
> …dinosaurs and space bring children into science and engineering...[28]

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23 Professor Tim Flannery, 'The beautiful deep', *New York Review of Books*, reprinted in *Australian Financial Review*, 22 February 2008, pp R3-4.

24 Perhaps "Yellow Submarine" and "Octopus's Garden" by the Beatles would count.

25 Ms Anntonette Joseph, *Proof Committee Hansard*, 1 August 2008, p. 17.

26 Mr Roger Franzen, Earthspace, *Committee Hansard*, 16 May 2008, p. 43. At least for some, these passions endure. 'When asked at enrolment, first year students enrolling in geosciences state that their thee main interest areas are "volcanoes", "dinosaurs" and "space" '; School of Geosciences, Monash University, *Submission 19*, p. 2.

27 Professor Peter Dyson, *Committee Hansard*, 23 May 2008, p. 32.

28 National Committee for Space Science, *Submission 41*, p. 2.

5.21 The importance of getting children interested early was emphasised by some witnesses:

> Anything that turns the kids on and gets them started down that path is desirable. My understanding of the education theory is the earlier you do it, the better, and the more chance you have of retention. We would love to see anything that gets them excited happen.[29]

5.22 The Australian space industry is of the opinion that:

> …a persistent view among science educators, reinforced by strong anecdotal evidence that space inspires interest in the broader physical sciences, engineering, mathematics, technology and innovation.[30]

5.23 However, as befits scientists, they suggest this hypothesis be tested:

> [we] encourage the Australian Government to test this assertion with quantitative research and to gather the experience of science educators around the world. [31]

5.24 Space science was seen as an important motivator for encouraging study of science and engineering by a number of individual witnesses:

> It is essential that we draw more of our young people into the engineering and science fields at universities, and then we must keep them in Australia. Space technologies and sciences are well known to excite and motivate young people into these fields. During the 10-year Apollo moonshot program, the US saw its largest ever influx into engineering and the sciences. It is a good example of what space can do.[32]

5.25 The committee has heard stories of the inspirational role that space played in driving people to scientific careers:

> Seeing the achievements of the space programme had a profound influence upon me and was one of the reasons why I became a professional engineer.[33]

5.26 A group of university students warned that:

> [While] there is an enormous amount of enthusiasm in the general public and among students studying in science and engineering towards almost anything to do with science; student enthusiasm is dampened because of a

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29 Dr Chris Pigram, Geoscience Australia, *Committee Hansard*, 16 May 2008, p. 31.

30 Appendix 4.

31 Appendix 4.

32 Mr Peter Nikoloff, Auspace, *Proof Committee Hansard*, 29 July 2008, p. 67.

33 Dr Gregory Seil, *Submission 2*, p. 1.

> lack of a space industry in Australia to give a clear future for people skilled in space engineering and related fields.[34]

5.27 A contrary view about the inspirational role of space science was put by Dr Michael Green from DIISR:

> …there is no evidence that I have seen to support that particular claim…it would be a very expensive science awareness initiative. Arguably, if you want to raise the interest of people in science, there would be more cost-effective ways of doing it than funding a space programme.[35]

5.28 Responding to this, Professor Dyson said:

> …there is a perception that space is extremely expensive, and it can be, but I do not think it has to be. I think the proposals put forward in the National Committee for Space Sciences [decadal] plan has a range of projects going from a few million up to tens of millions of dollars.[36]

5.29 An initiative to boost the interest of the community, and school students in particular, in space is the Victorian Space Science Education Centre.[37] It also helps with the professional development of teachers.

5.30 Given the expense, it is not practicable to aim at 'landing an Australian on the moon'. But it would be inspiring to have a recognisable Australian component in an international mission, such as the 'robot arm' of the space station which was contributed by Canada and is branded accordingly.

Australian education and a space future

5.31 Some witnesses questioned whether the teaching of science and mathematics in Australia's high schools is providing an adequate basis for tertiary study of space-related fields. They noted fewer students are studying physics.

> Our school education in mathematics and science is not preparing students to come to university to do some of the difficult undergraduate physics that is required to prepare them for that work. That has been a trend for quite a few years.[38]

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34 Bluesat University of New South Wales Student Satellite Project, *Submission 51*, p. 1.

35 Dr Michael Green, DIISR, *Committee Hansard*, 16 May 2008, pp 6-7.

36 Professor Peter Dyson, *Committee Hansard*, 23 May 2008, p. 32. A similar argument has been made by Dr Andy Thomas. The National Committee for Space Science argue that the research projects proposed in the decadal plan would cost less than a dollar per Australian a year; *Submission 41*, p. 3. The projects envisaged in the decadal plan are listed at paragraph #.#.

37 See *Submissions 4* and *44*.

38 Professor Roger Clay, *Committee Hansard*, 23 May 2008, p. 86.

> …post primary students in Australia generally did not sustain any enthusiasm for science beyond their second year after entering junior high school.[39]
>
> …the number of students wishing to take on the hard sciences have reduced. I believe that reflects a whole manifest of situations, but this is one area. If there is no clear signal from government and industry combined that this is an area of influence and importance for the nation, then you are not going to get people wanting to invest in that from an educational perspective…[40]

5.32 One response has been the Government's initiatives to encourage more science and maths students by designating tertiary studies in these fields as priority areas, with a concomitant reduction in the level of HECS.

5.33 There is also concern about a 'brain drain' of space scientists from Australian universities. These 'technogees' are leaving Australia as they do not see adequate research and employment prospects here:

> Having significant dealings with many of the students involved in our operations, I would have to say that a significant proportion either do not continue their activities in an aerospace related field or they go overseas. There is very little opportunity for graduates from those sorts of environments to gain a work career in aerospace in Australia.[41]
>
> …like many of my university peers, my aspiration is to work within the Space industry. In Australia, this ambition is near unachievable, partly due to the ongoing failure of Australian government policy. As such, I am currently preparing to move with my family to Europe for the prime reason of working in the Space industry.[42]
>
> I am an Australian (with a PhD in space engineering from the University of Queensland) but owing to the state of Australian space activity…I have worked in the UK and in Germany for the last decade…[43]

5.34 Professor Clay lamented:

> Space science is not as fashionable as it used to be and it is more difficult than a lot of other areas.[44]

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39 Ms Jeanette Rothapfel, *Submission 45*, p. 1.

40 Mr Warwick Watkins, Australian Space Consortium, *Proof Committee Hansard*, 29 July 2008, p. 37.

41 Mr Cameron Boyd, Australian Space Research Institute, *Proof Committee Hansard*, 16 May 2008, p. 35.

42 Mr Mark Ramsey, *Submission 43*, p. 2.

43 Dr Sean Tuttle, *Submission 50*, p. 1.

44 Professor Roger Clay, *Committee Hansard*, 23 May 2008, p. 86.

5.35 Another challenge is for Australians getting on-the-job training. Optus is doing a good job in providing on-the-job training, some of which now qualifies for a certificate from an educational institution.

5.36 There have been 49 Australians who have taken the Masters course at the International Space University in Strasbourg. Around a quarter of these have stayed overseas to work. The alumni would like Australia to provide scholarships for study there, noting that many other governments provide them for their students.[45]

Government and space industry

5.37 Providing better education in science and engineering is probably the main contribution the government can make to bolstering the Australian space industry. One question posed in the *Interim Report* was whether there was a case for further support.

The economic case for government assistance

5.38 The case for government financial support for space industry requires evidence that there are 'positive externalities' from the space industry. In other words, the space industry needs to be able to demonstrate that there are benefits generated for other parts of the economy from the sector's activities that do not accrue to the space sector itself. This would imply that without assistance the amount of private sector involvement in space would be less than socially optimal.

5.39 Otherwise, especially in an economy suffering from skill shortages, assistance to space programmes will have the effect of redirecting resources away from areas where they would be more productive.

5.40 Some would reject this economic paradigm. Asked what he would like as a present for NASA's 50th birthday, its head replied 'an understanding that not everything that is worthwhile can be justified in terms of immediate dollars and cents on the balance sheet.'[46] Some witnesses questioned whether the economic approach is adopted in other countries:

> …there really is no level playing field in space. Most countries feel that space technologies, in particular space capabilities, are strategically too important to leave to the market. The sector is generally characterised by what the Europeans call 'juste retour', where the governments try and invest as much as they can in their own countries. So, if we do not have a space programme, it is difficult to develop a competitive space industry. If a significant space presence for Australia is desired, I do not think it will

45 Steering Committee of the Australian Alumni of the International Space University, *Submission 86*, p. 1.

46 *The Economist*, 26 July 2008.

> happen without government investment, certainly not in the foreseeable future.[47]
>
> I know of no country that justifies its national expenditure on space purely on economic grounds.[48]

5.41 Those space advocates accepting the economic argument point to the potential spin-offs from a space programme. While there are anecdotes about inventions that arose from the US space programmes, the committee is not aware of any definitive study on the size of benefits accruing to other parts of the economy from space activity. A recent OECD report commented:

> The many derived space-based services have positive impacts on economies and societies, although at this stage, they are more qualitative than quantitative…In Norway, the "spin-off effect" of space programmes on space firms has been measured at 4.4, that is for every million kroner of government support, space sector companies have on average attained an additional turnover of 4.4 million kroner…Although this impact measure may vary widely depending on the country and level of specialisation, it is indicative of possible increased competitiveness due to space involvement.[49]

5.42 Professor Butcher reports similar calculations:

> I know that in the Netherlands…the government has concluded that…for every dollar the government invests in the space industry, in space activities, there are $3½ worth of economic activity generated, not always directly related to space but indirectly as well. In the United States I think it is over a factor of four. [50]

5.43 The Australian Space Industry Chamber of Commerce highlighted the broad science and technical skill base that is enriched by the space science sector:

> The challenges involved in getting into space and deriving data from that vantage point requires the participation of many industries. Manufacturing, high temperature materials, advanced chemistry, information processing, telecommunications, computing, data processing, project management, finance and legal are examples. Future space ventures will rely heavily on new and emerging technologies such as nanotechnology, robotics and biotechnology and health technologies. Nations are recognising that an investment in space can be a catalyst to stimulating innovation across the spectrum of existing and emerging high technology industries.[51]

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47 Professor Harvey Butcher, ANU, *Committee Hansard*, 16 May 2008, p. 51.

48 Dr Bruce Middleton, former head of the Australian Space Office, *Submission 87*, p. 1.

49 OECD, *The Space Economy at a Glance 2007*, p. 15.

50 Professor Harvey Butcher, Australian National University, *Committee Hansard*, 16 May 2008, p. 52.

51 Australian Space Industry Chamber of Commerce, *Submission 64*, p. 4.

5.44 The potential spin-off benefits are not limited to technical skills or scientific discoveries that turn out to have other applications. They include broader skills. Professor Colin Norman described space science as 'character building'.[52] In a similar vein were comments that:

> The spin-off benefits from space technology are various, ranging from the personnel development and managing complex systems through to the actual technological systems that they are involved in.[53]
>
> …there is the question of whether one can solve some of our major climate problems, water problems and so forth without the expertise gained from organising large projects with many, many people and from different sectors and so on. That kind of effort is one that the space industry and the military have spent a lot of time worrying about, so there is a lot of experience in how to do that in the space industry…You want people who can do things—people who can manage technology, who can manage big projects and who know how to marshal industry and do things of a considerable magnitude. That is what space trains you to do.[54]

5.45 Notwithstanding the Free Trade Agreement, there are still difficulties in Australian firms selling in the US:

> It is still very hard. Even though there is free trade there are ITARS restrictions and so on. There are still a whole lot of other barriers …It is very hard to break into the market and they are very protective of their industry... We would go into the softer markets—the Canadas, the UKs and countries like that—the allies where, I guess, there are fewer barriers for us.[55]

5.46 As well as the specific funding for the Square Kilometre Array (see Chapter 3) and CSIRO space projects, and ARC grants (above), there are general support programmes for research and development, such as the tax concessions and grants, which the space industry can access along with other manufacturers.

5.47 DIISR claims that over $30 million has been provided for space industry development programmes since 1996 under the AusIndustry suite of programmes.[56] In addition, there are space-related services the government provides because they are a 'public good' such as information gleaned from satellites.[57]

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52 Professor of Physics at Johns Hopkins University, *Submission 25*.

53 Mr Cameron Boyd, *Committee Hansard*, 16 May 2008, p. 36.

54 Professor Harvey Butcher, Australian National University, *Committee Hansard*, 16 May 2008, pp 53 and 58.

55 Mr Peter Nikoloff, Auspace, *Proof Committee Hansard*, 29 July 2008, pp 71-2.

56 DIISR, *Submission 7*, p. 2.

57 The Bureau of Meteorology and Geoscience Australia both characterised much of their work in this way; *Committee Hansard*, 16 May 2008, pp 19 and 20.

5.48 The long-term, and innovative, nature of space projects may make it harder for them to attract finance. This problem is not unique to the space industry. Renewable energy companies, for example, face the same problem.

5.49 The Canadian Space Agency spoke of their success as a space exporter:

> about 50 per cent of the $2.5 billion in revenues that space activities bring to Canada is due to export. Canada is probably the world leader in that department… All of that would not have been possible without firstly having a long-term space program and secondly having a well-understood funding envelope which can be sustained and used to encourage industry to identify niche markets, gain the knowledge and expertise and then hopefully commercialise what they are good at... there are also advantages in having a space agency that helps with the funding and helps with the R&D costs, which are quite extensive. It also ensures that the government users and the public good are looked after.[58]

5.50 While most discussion of space industry (much like discussion of industry in general) focuses on manufacturing, there have also been some successes in space services:

> …GIO was generating $175 million a year in space insurance services, all export revenue, that no-one in the broader business community or within the government was really aware of…[59]

5.51 The recent Cutler Report highlighted space in its overview:

> In terms of stimulating complementary private sector innovation, the following areas deserve attention: resource industries, **space and astronomy**, finance and risk management, and marine industries.[60] [emphasis added]

5.52 It went on to comment:

> Space and astronomy are natural areas for Australian specialisation for three reasons: (i) Australia's geographical size and vast areas of extremely low population density mean that it is an ideal site for space research free of radio-interference. The success of Australia's bid to host the Square Kilometre Array (SKA) telescope would consolidate Australia's position as a key node in global research systems. (ii) Australia is already an important southern hemisphere node in global space surveillance systems. (iii) Australia has an increasing interest in access to satellite facilities to support remote monitoring and sensing capabilities for climate monitoring, agricultural production management, security monitoring, and remote sensing networks (such as national water and weather observatories and

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58 Mr Jocelyn Dore, Canadian Space Agency, *Proof Committee Hansard*, 22 July 2008, p.5.

59 Mr Kirby Ikin, Australian Space Chamber of Commerce, *Proof Committee Hansard*, 1 August 2008, p. 26.

60 Cutler Review Panel, *Venturous Australia: Building Strength in Innovation*, August 2008, pp xvi-ii.

> emerging requirements around carbon monitoring). Australia has little involvement in the satellite infrastructure to support these strategic areas of application deployments based on satellite facilities. This is a putative area for more significant international collaborations.[61]

The security case for government assistance

5.53 Alternatively it could be argued that on military or security grounds Australia needs to do more than the private sector would undertake on its own initiative. For example, while the Australian defence forces can buy satellite information from foreign satellite operators, it might be argued that there is an unacceptable risk that these data may not be available in a period of international tensions. This could build a case for having Australian-owned and operated satellites even if during more normal times this is less cost-effective.[62]

5.54 Dr Andy Thomas told the committee:

> I believe Australia must control its defence assets, and that is only possible if the country can maintain and operate the assets that it owns and those assets which support national security. That can only be achieved if Australia can build the satellite systems and the ground based support systems, and communication networks that it needs for its own unique applications, and possibly even maintain the technical infrastructure to be able to launch these systems to the required orbital planes on demand. That is a basic capability that does not exist in Australia at present...[63]

5.55 Another aspect of security concerns is that in some cases they interfere with international collaborations. A witness gave this example of where such barriers lead to a case for government support for Australian research:

> …the major limiting factor for that sort of environment is our national treaty obligations with the Missile Technology Control Regime and the US ITAR, International Traffic in Arms Regulations. That limits the transfer of that sort of technology to ensure that missile systems and weapons technology is not proliferated across many nations. These limits stop us from being able to interact across international borders, for fear that we may be proliferating these technologies. That almost drives a need to have indigenous and internal development of these technologies to ensure that not only do we not proliferate but we also have the skills to be able to utilise and provide an informed audience to those sorts of applications in future.[64]

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61 Cutler Review Panel, *Venturous Australia: Building Strength in Innovation*, August 2008, p. 146. This passage has a footnote reference to this committee's interim report.

62 This argument is made, for example, by Mr Ralph Buttigieg, *Submission 3*.

63 Dr Andy Thomas, *Committee Hansard*, 23 May 2008, p. 15.

64 Mr Cameron Boyd, Australian Space Research Institute, *Committee Hansard*, 16 May 2008, p. 36.

5.56 The Department of Defence is currently developing a White Paper and 'the impact of space systems on the Australian Defence Force's ability to contribute to Australia's security will also be addressed in this major policy statement.'[65] Defence told the committee that:

> Defence's demands for space capabilities are expected to increase over coming years. Notably, greater access to space systems underpins the modernisation of the ADF, especially in relation to the network-centric warfare construct that seeks to enhance operational effectiveness through precision engagement, enhanced situational awareness, global connectivity and synchronisation. Additionally, more than 50 per cent of Defence's major capability development projects for the period 2006-16 have a dependency on services that are derived from space. Furthermore, while still at the early stages, Defence is committed to ensuring its space capability is underpinned by the development of staff space expertise.[66]

65 Department of Defence, *Submission 70*, p. 5.

66 Ms Rebecca Skinner, Department of Defence, *Proof Committee Hansard*, 29 July 2008, p. 3.

Chapter 6

Space policy and agency

The Australian government's current involvement in space

6.1 A complete picture of how much Australia spends on space services has not emerged from the inquiry, but it is a significant amount, perhaps approaching a billion dollars. One witness suggested:

> We had studies in the nineties which suggest that Australia was spending somewhere between $500 to $800 million per year on space services.[1]

6.2 There is also no single definitive figure on how much the public sector spends on space. Some examples include the following: the Department of Defence is contributing $927 million as a proportionate partner in the US military Wideband Global SATCOM constellation; the Jindalee Over the Horizon Radar cost approximately $1.8 billion; spending on the SKA and related projects already exceeds $100 million; and Australia contributes around $100 million per annum to gain access to meteorological data. The Department of Defence say that more than half of their major capability projects for the period 2006 to 2016 have a critical dependency on services that are derived from space.[2]

6.3 The CSIRO spent $56 million on space and astronomy in 2007-08. This comprised advanced aerospace ($24 million), earth observation ($10 million), navigation and communication ($1 million) and radioastronomy ($21 million).[3]

6.4 The Department of Innovation, Industry, Science and Research (DIISR) is responsible for Australia's space policy (or lack thereof). It only has a very small amount of resources devoted to the task:

> It is not a full-time job for me by any means. I have about one and a half people who help me with space matters.[4]

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1 Mr Kirby Ikin, Australian Space Industry Chamber of Commerce, *Proof Committee Hansard*, 1 August 2008, p. 27. This is consistent with the Madigan Report's forecast that 'by 1995 Australia's annual expenditure on space services will be between $370m and $500m.; Australian Academy of Technological Sciences, *A Space Policy for Australia*, June 1985, p. 3.

2 Department of Defence, *Submission 70*, p. 2.

3 CSIRO, answer to question taken on notice at public hearing on 29 July 2008.

4 Dr Michael Green, Director, Space Licensing and Safety Office, DIISR, *Proof Committee Hansard*, 1 August 2008, p. 61.

6.5 This limited resourcing reflects the decentralised approach to space policy:

> agencies of the Commonwealth have their own operational responsibilities in the space arena. The Bureau of Meteorology has responsibility for securing access to weather data. Geoscience Australia has responsibility for maintaining a range of ground stations that can downlink Landsat and a range of other information and distributing that to appropriate agencies and to the private sector. Defence obviously has its defence related responsibilities, including national security remote sensing and defence communications.[5]

6.6 Among the agencies currently involved in space science and industry are:

- Department of Defence, including the Defence Science and Technology Organisation, Defence Imagery and Geospatial Organisation, and Australian Hydrographic Service;
- Department of Broadband, Communications and the Digital Economy, including the Australian Communications and Media Authority;
- Department of Innovation, Industry, Science and Research;
- Commonwealth Scientific and Industrial Research Organisation, including the Office of Space Science and Applications, the Division of Marine and Atmospheric Research and the Canberra Deep Space Communications Complex;
- Department of Climate Change;
- Department of the Environment, Water, Heritage and the Arts, including Australian Antarctic Division;
- Bureau of Meteorology, including the Ionospheric Prediction Service ;
- Geoscience Australia; and
- Office of Spatial Data Management.

6.7 DIISR also chairs the Australian Government Space Forum, which brings together representatives from various government departments and agencies to

5 Dr Michael Green, DIISR, *Proof Committee Hansard*, 16 May 2008, p. 3. The decentralised approach is set out in the November 2006 document *Australian Government Space Engagement: Policy Framework and Overview*, attached to *Submission 7*.

exchange information about twice a year.[6] However, it does not include academics or industry representatives, so it only has a restricted focus. It does *not* provide a forum for the broader space community to give feedback to the government agencies.

6.8 On the science side, the Australian Academy of Science created its National Committee for Space Science (NCSS) specifically for monitoring space science developments. (Like the Australian Bureau of Statistics, the Academy distinguishes space science from astronomy). The NCSS also aims to facilitate international links to the wider space science community through international bodies such as the Committee on Space Research (COSPAR). The NCSS is comprised predominantly of academic scientists, so also does not form a bridge between academia, industry and government.

6.9 Over the last two years the NCSS has been developing the first Decadal Plan for Australian Space Science, which seeks to outline the collective vision and aspirations of the space science community in Australia. A draft was released for public comment on 29 February 2008.[7] It proposes research projects which the NCSS regards as very high value, low expense and with a high multiplier benefit. Over the next 10 years it involves investment in new projects costed at around $120 million; less than 60 cents per Australian a year.

A brief history of space policy in Australia and reviews thereof

6.10 A recurring theme raised in submissions and by witnesses is that Australia does not have a well articulated space policy and this state of affairs is stunting the growth of the space industry as well as causing the country to miss opportunities. However, the evidence received by the committee suggests that the current decentralised policy has been formulated in response to previous policies. Therefore, a brief consideration of the different approaches to space that Australia has taken in the recent past can provide some context to Australia's current approach.

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6 The Forum's terms of reference are included in an attachment to *Submission 7*. As at February 2008, its membership comprised DIISR; CSIRO; the Australian Research Council; Geoscience Australia; Office of Spatial Data Management; Defence Space Engagement; Broadcasting Division of Department of Broadband, Communications and the Digital Economy; Australian Communications and Media Authority; Department of Infrastructure, Transport, Regional Development and Local Government; International Organisations and Legal Division of Department of Foreign Affairs and Trade; Emergency Management Australia; Public International Law Branch of Attorney-General's Department; Office of International Law; Bureau of Rural Sciences; Corporate Strategies Division of Department of Environment, Water, Heritage and the Arts; IPS Radio and Space Services; and the Bureau of Meteorology.

7 The plan is discussed by the Australian Academy of Science (*Submission 38*). It is commended by the Universities of Sydney (*Submission 18*), Tasmania (*Submission 20*), La Trobe (*Submission 24*) and Newcastle *(Submission 53),* as well as by the Geological Society (*Submission 30*) among others. The plan is reproduced in *Submission 41* and a summary is given in Appendix 3.

The Madigan Report

6.11 In July 1984, the Hon. Barry Jones MP, Minister for Science, invited the Australian Academy of Technological Sciences to prepare a report on space science and technology for Australia. The Academy established a Working Party under Sir Russel Madigan which delivered its report in June 1985.

6.12 The Madigan Report concluded, in words that could well be used today:

> …our space potential is fragmented and dispersed, and requires to be drawn together and fostered under a national space policy. [8]

6.13 There was optimism about Australia's potential, believing that the country had the technological capacity and could develop the required industrial capacity. However, the report warns:

> It is not possible for the private sector, from its own resources, to develop a space industry which will carry the rest of Australia on its back into the space age. The commitment to a space programme must be a government decision, not a commercial one. [9]

6.14 A contemporary participant told the committee:

> the guiding principle behind the Madigan report was not space as such but that a space capacity would be a driver for high-tech industry in a broader sense…the training of engineers and the general increase in capacity. It was part of the Barry Jones 'sunrise' industry strategy.[10]

Response to the Madigan Report

6.15 The Madigan Report made 16 recommendations, many of which were subsequently taken up by the government. However, the government did not agree with the recommendation to establish an independent statutory authority to advise it on space policies and priorities. Instead, it announced the formation of an Australian Space Board as a non-statutory body reporting directly to the Minister for Industry, Technology and Commerce.[11]

6.16 Neither did the government concur with the level of funding recommended in the Madigan Report. The Report had concluded:

> An effective programme could be set up for a total expenditure of $100 million over the first five years, leading perhaps to an annual expenditure of

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8 Australian Academy of Technological Sciences, *A Space Policy for Australia*, June 1985, p. 1.

9 Australian Academy of Technological Sciences, *A Space Policy for Australia*, June 1985, p. 2.

10 Dr John Boyd, former deputy director of the Australian Space Office, *Proof Committee Hansard*, 29 July 2008, p. 75.

11 *An Integrated National Space Program*, Report by the Expert Panel, 15 June 1992, p. 7.

> some $60 million depending on the extent to which an initial review shows that expectations are being realised.[12]

6.17 Instead it was decided to provide $5.25 million for the National Space Program in the 1986-87 Budget with future years' monies to be considered in each year's budget context. The actual budget funding for the programme appears in Table 6.1.[13] It never approached the amounts envisaged in the Madigan Report.

Table 6.1

Major R&D Granting Programs and other Support for the National Space Program through the Budget ($m)							
1986-87	*1987-88*	*1988-89*	*1989-90*	*1990-91*	*1991-92*	*1992-93*	*1993-94*
5.0	3.2	5.4	2.4	5.5	5.7	5.4	5.4
1994-95	*1995-96*	*1996-97*	*1997-98*	*1997-98*	*1998-99*	*1999-2000*	*2000-01*
9.0	2.7	1.7	0.7	0.5	1.5	-	-

6.18 A contemporary witness recalled:

> A small budget like that, particularly as we had to ramp it up with great difficulty through successive budgets and so on, made it very difficult to do any long-term strategic planning.[14]

6.19 The Government established the National Space Program in 1986, under the direction of the Board, around a number of space related projects administered by the Department of Science and Technology. The Board was initially supported by an ad hoc secretariat in the department, but in 1987 the Australian Space Office (ASO) was established as a unit within the Department of Industry, Technology and Commerce. The ASO provided secretariat support to the Board and had carriage of day to day running of the programme.[15] The Board acted as an advisory and supervisory body reporting directly to the Minister. It consisted of a Chairman and up to five members appointed by the Minister, with the head of the ASO being an ex-officio member.

6.20 The former deputy director of the ASO recalled:

> …we were always facing a lack of concerted support at the higher levels in departments and among ministers... there certainly was a lack of general enthusiasm for it, apart from being undermined in some quarters.
>
> There were three main agencies with space interests. Defence is the big one. Then there was the Bureau of Meteorology and …the Australian Centre for Remote Sensing…They were supportive in the sense of saying, 'Go for it.

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12 Australian Academy of Technological Sciences, *A Space Policy for Australia*, June 1985, p. 1.

13 Department of Innovation, Industry, Science and Research, *Submission 7*, p. 3.

14 Dr John Boyd, former deputy director of the Australian Space Office, *Proof Committee Hansard*, 29 July 2008, p. 78.

15 For information about the work of the ASO and the Board, see Dr John Boyd, *Submission 82*.

> You've got a space programme—do what you want, but don't expect us to pay for any of it and also don't tell us what to do.'[16]

The Academy of Science report

6.21 A review of space policy was undertaken by a committee appointed by the Academy of Science, with some support from the ASO. Its March 1989 report concluded:

> In the world's most advanced industrialised nations, space science drives technology development…The longer Australia postpones entry into space, the more costly it will become.[17]

6.22 On funding, it recommended:

> The recommendations of the Madigan report on space science should be implemented, specifically the recommendations on Commonwealth funding of a space program over five years of up to $100 million and the formation of an independent space authority.[18]

6.23 The Academy's review did not appear to have had any significant impact on government policy.

The Bureau of Industry Economics Report and the Curtis Review

6.24 The Madigan Report had recommended that the national space programme should be reviewed at the end of the fourth year of operation to enable the government to review its strategy and long-term commitment and provide the basis for industry planning and allocation of resources.

6.25 The Bureau of Industry Economics (BIE) carried out an economic evaluation of the National Space Program (NSP) and reported in May 1992. It adopted a narrow economic focus, admitting that it had 'placed little value on a space program per se, though some clearly disagree with this position'. It concluded that:

> Overall, however, the BIE has not found evidence to support a conclusion that the NSP's industry development activities will enhance welfare either through efficiency gains (a more efficient long term allocation of resources) or through externalities (spill-over benefits to the rest of the community).[19]

6.26 It accordingly recommended:

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16 Dr John Boyd, *Proof Committee Hansard,* 29 July 2008, pp 76-8.

17 Australian Academy of Science, *Ready for Launch: Space Science in Australia,* p. 5.

18 Australian Academy of Science, *Ready for Launch: Space Science in Australia,* p. 8.

19 Bureau of Industry Economics, *An Economic Evaluation of the National Space Program,* Research report no. 43, p. 97.

> …that industry development objectives for the space sector be delivered through the existing range of industry assistance programs.[20]

6.27 In parallel with the BIE evaluation, the Government had commissioned an expert panel review of the National Space Program (the Curtis Review), also asking it to comment on the BIE report. After eight public hearings, the review reported in June 1992 and observed:

> A view strongly put was that Australia does not have a strategic plan for space-related activities.[21]

6.28 The panel's own view was that while the development of the National Space Program and the performance of the Australian Space Board/Office had not been beyond criticism, overall they gave a good account of themselves and, with minor exceptions, provided value for money.[22] The panel considered that this was all the more true when the limitations and constraints of the organisational and financial arrangements were taken into account. The panel made numerous recommendations covering policies, priorities and their corresponding budgetary requirements, together with the necessary administrative arrangements.

6.29 In commenting on the BIE report, the Curtis Review agreed with a number of the BIE's views, but it did not favour the BIE's recommendation for decentralised administrative arrangements and funding.

6.30 The government generally accepted the Expert Panel's recommendations and established the Australian Space Council under the *Australian Space Council Act 1994* which replaced the Australian Space Board. The Act defined the functions of the Council, with the main emphasis being to:

- inquire into, and report to the Minister on, such matters affecting the application of space-related science and technology by the Australian public and private sectors as are referred to the Council by the Minister; and
- recommend to the Minister a national space policy (the National Space Program) that encourages the application of space-related science and technology by the Australian public and private sectors.

Abolition of the Australian Space Office

6.31 In 1994, the Australian Space Council produced a 'Five Year Plan' which was adopted by the minister.[23] However, funding for the space programme was withdrawn

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20 Bureau of Industry Economics, *An Economic Evaluation of the National Space Program*, Research report no. 43, p. 98.

21 *An Integrated National Space Program*, Report by the Expert Panel, June 1992, p. 85.

22 *An Integrated National Space Program*, Report by the Expert Panel, June 1992, p. xi.

23 Dr John Boyd, *Submission 82*.

in 1995 and the ASO and Australian Space Council were abolished in 1996. The *Australian Space Council Act 1994* was repealed in 1999.[24]

Cooperative Research Centre for Satellite Systems

6.32 In 1998, a Cooperative Research Centre in Satellite Systems was established. It carried out research and development, education, training, operations and commercial activities relating to space technologies, particularly in the field of low-cost satellite missions. Its first major project was the scientific and engineering satellite Federation Satellite 1 (FedSat).

6.33 The CSIRO Office of Space Science and Applications undertook development of the programme and FedSat was launched into orbit in December 2002. The Centre ceased operations in December 2005 after its funding was not renewed in the 2004 CRC Selection Round. The Department of Defence assumed responsibility for the satellite until its signal failed in 2007.

6.34 Its former CEO described the Centre as follows:

> Largely due to the profile of the key mission of the CRC for Satellite Systems, which was the FedSat small satellite, it is sometimes forgotten that the CRC was actually set up to ensure that Australia had relevant capability for affordable access to space and to the skills effectively to use and acquire space services as a system, whether they be in the space segment or the ground segment. Out of the total $90 million or so in cash and in kind that was applied to the CRCSS over eight years, $25 million or so was applied to FedSat, and the remainder was successfully purposed to the broader goals.[25]

6.35 Elaborating on FedSat, he remarked:

> It was the first satellite mission in 30 years that Australia actually conducted. It was launched from Japan under a bilateral government agreement to celebrate the Centenary of Federation; although, being launched in December 2002, it was a little bit late…it was a microsatellite with four primary payloads—it actually achieved some quite significant science and technology outcomes, and it did succeed in actually building for a time a capacity, a capability and connections with international agencies for a price tag that, in the space business, was quite small.[26]

6.36 As noted below, with the abolition of the ASO, the Centre became in some ways a de facto representative of the Australian space industry.

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24 Department of Innovation, Industry, Science and Research, *Submission 7*, p. 3; and Dr John Boyd, *Submission 82*.

25 Professor Andrew Parfitt, *Proof Committee Hansard*, 29 July 2008, p. 99.

26 Professor Andrew Parfitt, *Proof Committee Hansard*, 29 July 2008, p. 100.

The Chapman Review

6.37 In 2005, Senator Grant Chapman convened a Space Policy Advisory Group. It prepared a report which called for a national space policy, assigned to a specific agency, which among other things would:

> …periodically review our critical national space interests, reduce our vulnerability to disruption or denial of space data and services…[27]

6.38 A brief response from the Government indicated they were not intending to change the decentralised policy.

The case for a whole-of-government 'space policy'

6.39 Most witnesses told the committee that Australia's decentralised approach falls short of what is required as a 'space policy'. Some typical views are:

> We do not believe that the current arrangements are satisfactory and that a far more proactive approach by government is necessary to underpin and sustain Australia's capability in this increasingly vital sector.[28]

> … Australia is very absent in the area of space science. It does not have an effective policy on space science generally and has not had one at all for many years. There is no policy for developing and articulating the strategic framework for space science,…[29]

> …we certainly support a more coordinated approach, a coordinating mechanism.[30]

> We need a policy that properly addresses the long-term requirements of Australia in this area. It needs to set a vision for Australia and it needs to have the right policy settings. It is vital that that be developed at the same time as the right suite of market drivers to ensure that we, as a nation, can have a prospering private sector in this area.[31]

> …we have no effective whole-of-government mechanism for addressing the wide-ranging implications for our national security of the now fast-moving developments in space-related strategic policy, international relations or technology — issues which most other comparable economies have long since taken up as a matter of national priority. [32]

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27 *Space: A Priority for Australia*, December 2005, p. 4.

28 Australian Space Industry Chamber of Commerce (ASICC), *Submission 64*, p. 21.

29 Mr Warwick Watkins, Australian Space Consortium, *Proof Committee Hansard*, 29 July 2008, p. 36.

30 Mr Shaun Wilson, Engineers Australia, *Proof Committee Hansard*, 29 July 2008, p. 96.

31 Dr Peter Woodgate, CRC for Spatial Information, *Committee Hansard*, 23 May 2008, p. 75.

32 Senator Grant Chapman, *Space: A Priority for Australia*, December 2005, p. 1.

6.40 The ANU's Professor Butcher advocates a 'space plan' which would be:

> …a national sector plan…not a government plan or a plan from CSIRO but a plan which all stakeholders—industry, government and universities—would consider to be their own.[33]

6.41 Submitters put it to the committee that in the space sector, government has a critical role in industry coordination and policy leadership, in consultation with industry. However, this role is not articulated in the government's key Space Engagement document.[34] This only recognises—as does the Australian Government Space Forum—the need for coordination between government agencies. The Australian Space Industry Chamber of Commerce makes the following points in relation to the role of government:

- only governments can set priorities and targets for national civil space infrastructure, such as satellite systems, environmental monitoring, remote communications and Earth observation;
- only governments can ensure continued funding for long term programmes and for infrastructure that extends beyond the scope and duration of ad hoc and generic science and technology funding programmes;
- only governments can formulate policy positions and represent a country internationally in issues such as the future of international law in space, non-proliferation of space weapons, orbital debris and the exploitation of resources in space;
- only government scan enter inter-governmental agreements for cooperation and collaboration with other countries; and
- only government agencies with appropriate skills and charters can represent a country's national interests (including the interests of industry) in international space-related deliberations and forums.

6.42 The Chamber states that the lack of a clear and focussed Australian government space policy designed to use Australian capabilities for the good of the nation and underpinned by sufficient funding and commitment, is a significant limiting factor in the advancement of Australian space science and industry.

6.43 Other industry witnesses attributed some of the decline in Australian capabilities to the lack of a policy:

> In late 2007 EADS Astrium… made the decision to shut down Auspace based on the limited Australian industry opportunities…and also because, with no whole-of-government strategy or policy fostering this sector, they

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33 Professor Harvey Butcher, Australian National University, *Committee Hansard*, 16 May 2008, p. 52.

34 Department of Industry, Tourism and Resources, *Australian Government Space Engagement*, Policy Framework and Overview, November 2006.

> could not justify maintaining this level of capability in Australia... key specialists leaving the industry.[35]

6.44 The South Australian government called for a white paper, suggesting:

> In developing the white paper, the Australian Government should rely heavily on the 2005 Chapman Report, *Space: a Priority for Australia*, which to date has been inadequately considered.[36]

6.45 This emphasis on the role of government was consistent with the views put to an earlier Senate committee:

> The majority of contributors to the inquiry saw a prominent role for government in the development of launching services and the space industry in general…Most witnesses felt that if Australia was to become more active in space industry matters…[governments] need to take a more prominent role in policy formulation and industry support. [37]

Comparison with other countries

6.46 It is often noted that Australia is becoming unusual among its peers in not having a space programme:

> …we are the only OECD country without a space programme of any sort.[38]

6.47 There are also very many developing countries that are much further advanced than Australia in space activities, making Australia's lack of contribution incongruous considering its relative wealth.[39] As one witness noted:

> South Africa, I am sorry to say, is well ahead…They see the challenges ahead for them—population stress, food stress, water stress—and have decided that space infrastructure is a very important way of securing the information they need as a nation. For that they have passed a space affairs

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35 Mr Peter Nikoloff, Auspace, *Proof Committee Hansard*, 29 July 2008, p. 64.

36 South Australian Government, *Submission 79*, p. 12.

37 Senate Standing Committee on Transport, *Communications and Infrastructure, Developing Satellite Launching Facilities in Australia and the Role of Government*, April 1992, p. 73.

38 Mr Tony Wheeler, ASIBA, *Proof Committee Hansard*, 29 July 2008, p. 39. Similar observations were made by, for example, Dr Andy Thomas, *Draft Committee Hansard*, 23 May 2008, p. 11; Mars Society, *Submission 22*; Dr James Moody, *Submission 32*; Australian Spatial Information Business Association, *Submission 37*, p. 5; Mark Ramsey, *Submission 43*, p. 7; Australian Space Research Institute, *Submission 46*, p. 4; Luke Webb, *Submission 47*, p. 2; Epsilon Foundation, *Submission 56*, p. 1; and Australian Space Industry Chamber of Commerce, *Submission 64*, p. 10; Senator Grant Chapman, *Space: A Priority for Australia*, December 2005, pp 25-6; and Jeff Kingwall 'Punching below its weight: Still the future of space in Australia?', *Space Policy*, no 21, 2005, p. 162.

39 The space programmes of several Asian economies, mostly smaller than Australia, are discussed in Dr Bruce Middleton, *Submission 87a*.

act, or something along those lines. This is a bill that went to the National Assembly last August.[40]

6.48 An indication of government expenditure on space in other countries is given by Table 6.2.

Table 6.2: Government space budgets, 2007, US$ billion

United States (of which NASA $16.3 billion)	62.6
European Space Agency	4.0
Japan	2.2
China	1.5
Russia	1.3
France*	1.0
India	0.9
Italy*	0.7
Germany	0.4
Canada*	0.4
United Kingdom	0.1

*Civilian agency only. Source: Space Foundation, *The Space Report 2008*, pp 24-6.

The United Kingdom model

6.49 The United Kingdom's space agency, the British National Space Centre (BNSC), has been suggested as a model. It 'essentially coordinates the activities of a range of ministries that still retain their budgets and their responsibilities'.[41] The BNSC reports to the Minister of State for Science and Innovation. It describes its role in the following terms:

> …BNSC is at the heart of UK efforts to explore and exploit space. Formed from 10 Government Departments and research councils, we: co-ordinate UK civil space activity; support academic research; nurture the UK space industry; and work to increase understanding of space science and its practical benefits.
>
> We have three long-term objectives: to enhance the UK's standing in astronomy, planetary and environmental sciences; to stimulate increased productivity by promoting the use of space in government, science and

40 Mr Stephen Ward, Symbios Communications, *Proof Committee Hansard*, 1 August 2008, p. 41.

41 Dr Michael Green, DIISR, *Committee Hansard*, 16 May 2008, p. 5.

commerce; and to develop innovative space systems, to deliver sustainable improvement in the quality of life.[42]

6.50 This was attractive to some witnesses:

> Perhaps the UK approach, which is more like a national committee which has the key representatives at the table, may be an appropriate model. [43]

> …the British National Space Centre presents an excellent model for what could be achieved here. It is a partnership among government departments, research bodies and the Met Office, or the Bureau of Meteorology as it is known here... The director-general…I think is the single employee of the British National Space Centre…the rest of them are on secondment from various places…There are 50 of them, or something like that. They spend UK£207 million a year. It is about to go up hugely because the UK sees its needs in climate and environment as really escalating in this century...I could see the Bureau of Meteorology here and the CSIRO, Defence, and you could probably name a few others to take in the astronomy people such as Tidbinbilla and all those people, getting together in the same way and organising their money in the same way. Before you know it, you have a critical mass, which you did not think was possible.[44]

6.51 It is also consistent with the views of the United Kingdom Parliamentary Science and Technology Committee, which concluded:

> Space is a highly significant area of science policy and it is necessary for the Government to take a strategic approach to space activities…The forthcoming civil space strategy should inspire and motivate the UK space sector and emphasise the UK Government's commitment to space.[45]

6.52 The former head of the ASO had some reservations about the BNSC model:

> In 2007 BNSC received £50.67 from its portfolio department and subscribed £21.37m to the ESA general budget, suggesting that it had available £29.3m for administration and program activities. Its total expenditure of £217.88 indicates that other agencies – principally the Science and Technology Facilities Council, the Natural Environment Research Council and the Meteorology Office – provided a total of £167.21m towards the programs BNSC supported. BNSC's contribution would appear to be around 1/7th of the total space program expenditure by the UK in that year. Based on my experience at the ASO, this would not be high enough in the Australian context to secure investment by other agencies.[46]

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42 www.bnsc.gov.uk.

43 Dr Susan Barrell, Bureau of Meteorology, *Committee Hansard*, 16 May 2008, p. 18.

44 Mr Stephen Ward, Symbios Communications, *Proof Committee Hansard*, 1 August 2008, p. 36.

45 United Kingdom Parliamentary Science and Technology Committee, July 2007.

46 Dr Bruce Middleton, *Submission 87*, p.2.

A space agency as a contact point

6.53 Entering 'Australia space' into the Google search engine gives the website of the National Space Society of Australia, followed by that of the Australian Space Research Institute (and then the *Lost in Space* Australian Fan Club!). There is no sign of the relevant parts of the Department of Innovation, Industry, Science and Research.

6.54 This may explain why the committee heard of two amateur enthusiasts in their twenties being approached by the media looking for the Australian view on space issues or by overseas organisations looking to arrange international collaborations:

> The National Space Society is frequently confused with being Australia's national space agency by the general community and tends to be confused by the media as well. I am the first one that is called when something happens…Just this morning with Sky News I was asked to comment on what the water on Mars would mean for Australia and the world.[47]
>
> Anecdotally we have had a number of requests from people who come and speak to BLUEsat, thinking that perhaps we are some sort of conduit to the Australian space industry…[48]

6.55 With no disrespect to the young enthusiasts concerned, it would be better if the point of contact was a professional government agency.

6.56 The former CEO of the Cooperative Research Centre for Satellite Systems described how he by default was sometimes regraded overseas as representing Australian space science:

> I was introduced at a number of international fora …as head of the closest thing Australia had to a space agency… it was a tag with which I was quite uncomfortable because I had no executive authority to act or represent the whole or even part of government, unlike the majority of colleagues around the table…I continued to be invited to represent Australia even to chair or co-chair important meetings such as the Asia-Pacific Regional Space Agencies Forum in Canberra in 2004 and in Japan in 2005.[49]

6.57 Similarly, private industry organisations are sometimes regarded as a proxy space office:

> I received an email from the Korean Space Agency saying that they did not know who to speak to in Australia. They got my name from NASA and were contacting me to see if I could give them some specific information... we are repeatedly contacted by international companies who are looking for

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47 Ms Anntonette Joseph, National Space Society of Australia, *Proof Committee Hansard*, 1 August 2008, p. 13.

48 Mr Anthony Wicht, BLUEsat, *Proof Committee Hansard*, 1 August 2008, p. 7.

49 Professor Andrew Parfitt, *Proof Committee Hansard*, 29 July 2008, p. 99.

> someone to talk to in Australia about the nation's needs, the opportunities, and so on.[50]

6.58 This concern that there was no prominent point of contact in Australia for overseas agencies or private companies who wish to discuss space matters was expressed by many witnesses:

> …'Who do we come and see?' has been the question to many of us in the industry.[51]
>
> …there should be a centralised coordinating body…which has the capacity to act as an international point of contact.[52]
>
> When I came here first of all, I said, 'So who do I talk to that is coordinating your requirements and the industry?' and there was no-one.[53]
>
> One of the standard complaints is that the international space agencies or companies or just the research groups do not know who to contact in the Australian government if they want to do something.[54]

Other perspectives on a new Australian space agency

6.59 Although some submissions advocated the establishment of an 'Australian NASA', many others recognised that Australia already has much occurring in the space arena and better coordination, as well as political will to enhance the sector, is what is required.

6.60 The committee found the views of Dr Bruce Middleton, former Executive Director of the Australian Space Office between 1987 and 1993 to be particularly instructive. Dr Middleton considers that Australia is making a serious mistake in not investing significant public funds in space, in addition to the funds invested by individual government agencies in pursuit of their own missions:

> I believe that by not investing we are missing out on opportunities and making ourselves more dependent on others. I believe our current policy on space short-changes the educational, scientific, technological, innovation, industrial, environmental, public good and national security objectives of national policy. I believe we will pay a heavier price in the future if we continue not to invest.[55]

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50 Mr Kirby Ikin, Australian Space Industry Chamber of Commerce, *Proof Committee Hansard*, 1 August 2008, pp 25-6.

51 Mr Roger Franzen, Earthspace, *Committee Hansard*, 16 May 2008, p. 44.

52 Institute for Telecommunications Research, *Submission 48*, p. 2.

53 Mr Richard Kolacz, COM DEV, *Proof Committee Hansard*, 22 July 2008, p. 10.

54 Professor Iver Cairns, National Committee for Space Science, *Proof Committee Hansard*, 29 July 2008, p. 92.

55 Dr Bruce Middleton, *Proof Committee Hansard*, 23 September 2008, pp 2–3.

6.61 One thing that came out clearly from the inquiry is that although large amounts of funds can be expended on space related activities, they do not have to be. A range of estimates of appropriate funding levels were advanced. Dr Middleton suggested $50 million a year:

> I would think that if Australia was not committing A$50 million a year it was not serious and would be seen for that. I would not see $50 million in a national program as being a honeypot. I would see it as a very careful effort to target that to national objectives, with those objectives being carefully weighed and with a very hard-nosed decision being asked: are we going to address national prestige? If the answer is yes, we might train an astronaut, because that goes a long way to getting people excited about space. If it is no, forget about things like that, forget about things like the remote manipulator arms and focus your money in other areas. Those decisions have to be made. [56]

6.62 The Australian Space Research Institute argued that an agency would:

> …give cohesion to the various disparate space elements that are still in Australia and help bring back some of the expatriate space assets that have had to go overseas to look for work in the last decade or so.[57]

6.63 The lack of an agency may mean that Australia misses out on larger interdisciplinary projects:

> Missing are large coordinated programmes of research and development that span many organisations both in Australia and obviously internationally. We cannot do things like this alone. As director of a research institute, that is really where I see the lost opportunity.[58]

6.64 Dr Andy Thomas argued:

> I do personally believe that a single coordinating body is needed in Australia…I do have a sense that there are a lot of competitive organisations in the Australian arena in all of those various dispersed activities that you referred to. I am sure the people in those organisations have the best of intentions of their organisations, but I think you do need an operation that has a vision that looks at the national scale of what has to be done on a national basis and pull all of those things together to support that national programme.[59]

6.65 The Australian space industry is supportive of a central coordinating body:

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56 Dr Bruce Middleton, *Proof Committee Hansard,* 23 September 2008, p. 9.

57 Mr Gary Luckman, *Committee Hansard*, 16 May 2008, p. 35.

58 Professor Alexander Grant, Institute for Telecommunications Research, *Committee Hansard*, 23 May 2008, p. 4. Similarly Dr Peter Woodgate was approached by a Chinese agency interested in a joint satellite venture but unable to find an agency in government to approach.

59 Dr Andy Thomas, *Committee Hansard*, 23 May 2008, pp 17-8.

> …noting a persistent call from industry and other groups for stronger and more visible coordination of effort, recommend that the Australian Government establishes a national coordination body responsible for, and to show leadership in, all facets of Australia's space engagement, including relationships with international space agencies.[60]

6.66 A number of other groups also felt the absence of a single space agency was damaging to Australia:

> …Australia has become ever more dependent on space based services, often invisibly. Much like water in a tap, we do not understand where the services come from; we just expect them to be there…there appears to be no whole-of-government coordination that addresses our dependencies and hence our vulnerabilities that arise from those dependencies...[a space agency] should initially reside probably within the Department of the Prime Minister and Cabinet so that it holds a whole-of-government perspective and does not need to consider individual departmental priorities, and therefore it can look at all of the nation's dependencies at a strategic level.[61]
>
> The primary impediments [to strengthening space science and industry in Australia] are first, that Australia has no single coordinating body for space science.[62]
>
> There is an urgent need to establish a single coordinating framework for Australian space related research and applications.[63]
>
> Having an agency gives you a centralised, unified voice that can look after the governance and provide leadership, vision and so on and so forth. Our space agency reports directly to our minister of industry…[64]
>
> If we had an Australian space agency—a national body that could encourage that, could fund it, could coordinate and ultimately could buy the technologies that we produce—I think that would lead to long-term benefit for the country.[65]
>
> …so many countries—in fact, almost all countries in the Western world—look to Australia and wonder why Australia is not running any sort of serious space programme. The reason for that is that we are part of a civilisation that expects to find more and more work in space and those countries are bit surprised that we do not accept that as part of the culture and take it up.[66]

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60 Appendix 4.

61 Mr Roger Franzen, Earthspace, *Committee Hansard*, 16 May 2008, p. 42.

62 University of Sydney, *Submission 18*.

63 University of Newcastle, *Submission 53*, p. 2.

64 Mr Jocelyn Dore, Canadian Space Agency, *Proof Committee Hansard*, 22 July 2008, p. 11.

65 Professor Russell Boyce, Australian Hypersonics Network, *Proof Committee Hansard*, 29 July 2008, p. 20.

66 Professor Raymond Stalker, *Proof Committee Hansard*, 29 July 2008, p. 20.

> There currently appears to be a lack of cohesion across state and federal jurisdictions in dealing with space sciences, with no specific agencies identified as having carriage of space-related issues…herein lies the opportunity to seriously consider the formation of a national council, group or forum, comprising key federal and state stakeholders, focusing specifically on space science related issues.[67]
>
> You need a group of good people to make the decision as to which way we are going, to work out a long-term policy and hopefully to provide funding for five- or 10-year plans to achieve that.[68]
>
> Ultimately I think the government has to set the policy and you need an agency to implement it.[69]
>
> It is not possible to extract maximum return from public investment in space through a decentralised structure; there will inevitably be gaps and overlaps, not to say duplication. Therefore, effective coordination is essential.[70]
>
> We have been losing credibility [internationally] regarding…global issues—like climate change, perhaps, and security aspects which are global. We have been losing that credibility over some period of time… I think that Australia is viewed as a country which has had individuals doing a lot but which has not had an organised programme at all…[71]
>
> the establishment of a single, national, coordinating agency that covers all space related policies, programs and directions is absolutely vital.[72]
>
> It is dangerous for a major country not to have an organised way of assessing space opportunities. This capability is the minimum. It isn't enough to know that there is a lot of expertise scattered here and there in universities, industry, et cetera. It requires a more systematic approach. But this need not be expensive, especially if Australia can demonstrate enough expertise to make it once again an interesting international partner.[73]

6.67 The Bureau of Meteorology commented:

> …Australia would benefit from a more coordinated national policy framework on space matters, developed and administered through a whole-of-government mechanism; that, through such national policy

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67 Western Australian Department of Industry and Resources, *Submission 85*, p. 22.

68 Professor Richard Morgan, *Proof Committee Hansard*, 29 July 2008, p. 23.

69 Dr John Boyd, *Proof Committee Hansard*, 29 July 2008, p. 77.

70 Dr Bruce Middleton, former head of Australian Space Office, *Submission 87*, p. 3.

71 Professor Iver Cairns, *Proof Committee Hansard*, 29 July 2008, p. 91.

72 Ms Anntonette Joseph, National Space Society of Australia, *Proof Committee Hansard*, 1 August 2008, p. 13.

73 Professor Roy Gibson, who served as inaugural director of both the European Space Agency and the British National Space Centre, asked for these comments to be passed onto the committee by Mr Stephen Ward, *Proof Committee Hansard*, 1 August 2008, p. 43.

> arrangements, the value of current and continued international collaboration on space is recognised and coordinated; and that targeted national investments in space science and technology in relation to both ground and space segments should build on and complement the international effort, with a special focus on Australia's national objectives—for example, in relation to climate monitoring, water resources, environment, and disaster mitigation… in terms of a coordinated engagement with other countries, there is no single framework for that to happen. [74]

6.68 The Department of Defence sounded supportive:

> Defence could see value in greater national level policy coordination of Australia's space dependency. We believe that the current arrangements are not able to fully address this complex area of policy. We think that some form of coordinated whole-of-government policy discussion might assist a more consistent and clearer approach, especially as space policy becomes more complex. As for a national coordinating body, Defence's position would be guided by the scope and authorities of such a body. However, as a key stakeholder, Defence would be happy to work closely with such a body should government choose to create one.[75]

6.69 The CSIRO sounded unenthusiastic about having their space-related activities hived off into a new agency:

> it is actually a real benefit because we can bring together the Earth Observation folk with the hydrologists or with the spatial analysts or whatever and you can actually do that in a very flexible way…one of the real benefits that we have at the moment is that space is embedded within other parts of the…CSIRO. I think that, for government to consider that, you would probably want to take into account whether we could maintain all of those particular linkages.[76]

6.70 An agency could also help give Australian entities more credibility overseas. For example, the BLUEsat student satellite-builders thought:

> An Australian space agency would also add to our credibility when we go overseas for most of the launches which we have targeted as useful. If there was an Australian space agency which was able to say, yes, BLUEsat, or a similar student project, is a legitimate project that gives us more credibility and would make the space launch and certification process much more straightforward.[77]

6.71 A representative from Canada's largest manufacturer of space technology noted that in Australia:

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74 Dr Susan Barrell, *Committee Hansard*, 16 May 2008, pp 14 and 18.

75 Ms Rebecca Skinner, Department of Defence, *Proof Committee Hansard*, 29 July 2008, p. 3.

76 Dr James Moody, CSIRO, *Proof Committee Hansard*, 29 July 2008, p. 34.

77 Mr Anthony Wicht, *Proof Committee Hansard*, 1 August 2008, p. 4.

> I have found a range of very good capabilities and technologies associated with the space, ground and data-processing segments. However, in my opinion, what was lacking was an ability to bring these elements together.[78]

6.72 An agency could help to bring together people working in aspects of space science:

> Up until about two years ago, there was essentially no communication at all between different members of the space science community—as in even space physicists like me from the University of Sydney might have had absolutely no idea what our colleagues at the University of Newcastle, a scant 200 kilometres away, were doing, let alone what our colleagues in astrobiology were doing. We want to become a much more cohesive community which manages itself and identifies scientific goals which are important and crucial in our opinion but which also have national benefit.[79]

6.73 Dr Middleton suggests that there are two elements for coordination: some machinery where people with sufficient authority to commit their agencies meet together; and a program with enough money to 'put mortar between the bricks'. [80]

6.74 One suggested model for a co-ordinating agency was a unit within the Department of Prime Minister and Cabinet:

> the National Security Science & Technology Unit that was set up in PM&C a few years ago to provide a single point of contact for counterterrorism technology development. This organisation is peopled by secondments from the interested organisations and agencies so that there is representation there and no-one feels that their sovereignty is being threatened or that their toes are being stepped on.[81]

6.75 It will always be a challenge in getting departments to agree to a coordinating agency which may be seen as encroaching on their turf. The former deputy director of the Australian Space Office recalled:

> I would never expect them to hand over any responsibility to some central agency…I suppose you would always lose their support if they thought that money was coming out of their budget to go into the Space Office, which I think might have been part of the problem all along.[82]

6.76 Drawing on his experience with the Australian Space Office, its former director suggested:

> I would think that if Australia was not committing A$50 million a year it was not serious and would be seen for that. …I would say it needs to be a

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78 Mr Richard Kolacz, COM DEV, *Proof Committee Hansard*, 22 July 2008, p. 2.

79 Professor Iver Cairns, *Proof Committee Hansard*, 29 July 2008, p. 85.

80 Dr Bruce Middleton, former head of Australian Space Office, *Submission 87*, p. 3.

81 Dr Miriam Baltuck, CSIRO, *Proof Committee Hansard*, 29 July 2008, p. 35.

82 Dr John Boyd, *Proof Committee Hansard*, 29 July 2008, p. 81.

> statutory agency. It needs to have enough staff but not too many, and it needs to have expert staff. It needs to have a board of eminent people who command respect in government and in the industry—and in the research community…[83]
>
> …high-level secondees from stakeholder departments and agencies (including the Department of Defence)…[84]

6.77 The success of a space agency may also reflect its status as reflected in the seniority of the minister assigned responsibility for it. Examples of very senior ministers include India, where at one stage the Minister for Space was Indira Gandhi, and the United States, where the National Space Council is chaired by the Vice President.[85] The former director of the Australian Space Office suggested:

> Clearly a minister needs to be responsible…It needs to be a senior minister. A junior minister is a kiss of death. The bureaucracy is very sharp: 'Junior minister? Don't pay it as much attention; he doesn't have the horsepower in cabinet.' And you are on the slippery slope.[86]

6.78 An alternative view is that what is more important is that the minister have a commitment to, better still an enthusiasm for, a space policy.

6.79 There were some views that a new agency should start off with modest goals:

> I think we should start it small and get its foundations laid and then let it evolve in an appropriate way.[87]
>
> …a space agency in Australia could start off at a very simple level by simply acting in a coordinating role, pulling together various industries and academia throughout Australia…[88]

Conclusions

6.80 The committee notes that for each successive review into the Australian space sector, broadly similar findings are made each time, including for the committee's current inquiry. Principally, these findings are that the Australian space industry is fragmented, there is a lack of clarity in organisation, confusion as to who does what and who is able to fund what.[89]

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83 Dr Bruce Middleton, *Proof Committee Hansard*, 23 September 2008, pp 9 and 11.

84 Dr Bruce Middleton, *Submission 87*, p. 3.

85 Senate Standing Committee on Transport, *Communications and Infrastructure, Developing Satellite Launching Facilities in Australia and the Role of Government,* April 1992, pp 101-2.

86 Dr Bruce Middleton, *Proof Committee Hansard*, 23 September 2008, pp 9 and 11.

87 Mr Shaun Wilson, Engineers Australia, *Proof Committee Hansard*, 29 July 2008, p. 98.

88 Mr Anthony Wicht, BLUEsat, *Proof Committee Hansard*, 1 August 2008, p. 4.

89 For example, *An Integrated National Space Program*, Report by the Expert Panel, 15 June 1992, p. xii.

6.81 However, it notes the problems that arose when these findings were implemented in the mid-1980s. It would be highly undesirable if a new agency were again to dissolve after a decade with promises unfulfilled. Accordingly, the committee wants a new agency to evolve gradually.

6.82 The committee notes that firms within the Australian space industry seem keen for an agency to succeed. They already donate time to industry and enthusiast organisations and share information. They may be willing to contribute to a space agency.

Recommendation 1

6.83 The committee recommends as a first step that the Government give the existing unit within the Department of Innovation, Industry, Science and Research more resources to enable the establishment of an Australian government Space Information Website. This would provide information on government programmes and contacts, and links to Australian companies working in the space industry as well as Australian universities offering courses in space science and space engineering.

Recommendation 2

6.84 The committee notes that Australia is the only OECD country without a national space agency and, as a consequence is missing out on opportunities to engage in this important area of innovation and technology. The committee also notes the comments by the Chief Scientist and the conclusion of the Cutler Report in relation to the importance of the space industry for innovation within Australia. The committee recommends that immediate steps are taken to coordinate our space activities and reduce our over reliance on other countries in the area of space technology.

Recommendation 3

6.85 The committee notes the wealth of expert, well informed evidence received by the committee. Despite some deviations, the overwhelming majority of witnesses strongly supported the formation of a government unit to coordinate Australian space activities, including those in the private sector. The committee supports this conclusion and notes that there must be a proper balance between industry and government involvement.

Recommendation 4

6.86 The committee notes the various models of space agency within the OECD and emerging economies and supports Australia having a space agency. The committee recommends initially establishing a Space Industry Advisory Council comprising industry representatives, government agencies, defence, and academics. The committee recommends that the advisory Council be chaired by the Minister for Innovation Industry Science and Research or his representative.

Recommendation 5

6.87 As a precursor to the establishment of the space agency the Advisory Council would:

- **Conduct an audit of Australia's current space activities within six months of the establishment of the Council;**
- **Analyse the strengths, weaknesses opportunities and threats to Australia's emerging space industry;**
- **Focus on the key "workhorse" space applications of Earth observation, satellite communications and navigation as the most practical and beneficial initial priorities;**
- **Systematically evaluate the medium/long-term priorities for a space agency including the national benefit of defence related activities, Earth observation, environmental, land management, exploration, national disaster prevention and management, treaty monitoring, e-commerce and telemedicine;**
- **Examine the benefits to Australia of improved international collaboration including membership of the international space groups;**
- **Develop a draft strategic plan for the establishment of a space agency and the most appropriate form of that agency, including public/private funding, budget and staffing priorities; and**
- **Identify critical performance areas such as research, technological development, development of the skill base, effective partnerships, delivery of new services, and financial management.**

Linkages with other space agencies

6.88 Back in 1985 the Madigan Report had suggested that:

> Australia should also initiate discussions with other West Pacific countries on the establishment of an appropriate agency to create the synergy which the European Space Agency has brought so beneficially to its subscribing nations.[90]

6.89 An Australian space agency would facilitate linkages to other space agencies. The European Space Agency has four times offered Australia an associate membership. Some leading space scientists advocate taking up the offer, pointing out it would allow Australian companies and universities to win contracts with the ESA and gain better access to satellite data.[91] However, the committee was told that a lack of an Australian space agency makes it harder to take up membership. When the ESA approached Australia in 2006:

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90 Australian Academy of Technological Sciences, *A Space Policy for Australia*, June 1985, p. 1.

91 Associate Professor Lachlan Thompson and Professor Pavel Trivailo, *Submission 33*, p. 3.

> the request was sent all around Canberra. There was no-one really in a position to say yes or no and there was no individual agency that had the funds to commit to it. So Australia was not in a position to say yes even though there was some enthusiasm to do so.[92]

6.90 An interesting case is Canada, arguably the most similar country to Australia.[93] It has its own space agency, funded to around $300 million per year.[94] The Canadian Space Agency is an associate of the European Space Agency. They gave this example of how the relationship works:

> we were the first non-European country to join the Galileo program. As a result of that we have several companies in the GNSS domain who have secured contracts. Since Galileo will be here for many years to come, that spells out great opportunities for Canadian industry.[95]

6.91 The committee heard that there can be strong returns to industry from associate membership with the European Space Agency:

> Canada has enjoyed great success in the space domain, largely due to our international cooperation and participation programmes…Our contribution to ESA alone has resulted in over $420 million in contracts.[96]
>
> Under the ESA rules they would expect about 80 per cent of what they contribute to come back in contracts to Canada…[97]

Recommendation 6

6.92 **The committee recommends that any Australian Space Agency reassess the case for Australia becoming more closely linked to an international space agency**.

Senator Annette Hurley

Chair

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92 Mr Tony Wheeler, who had been working on a project with CSIRO at the time, *Proof Committee Hansard*, 29 July 2008, p. 42.

93 As Mr Richard Kolacz of COM DEV noted, 'both have a large landmass and relatively small populations and also similar requirements and views relating to maritime security, safety, surveillance, environmental monitoring and resource management'; *Proof Committee Hansard*, 22 July 2008, p. 2.

94 Mr Jocelyn Dore, Canadian Space Agency, *Proof Committee Hansard*, 22 July 2008, p. 6.

95 Mr Jocelyn Dore, Canadian Space Agency, *Proof Committee Hansard*, 22 July 2008, p. 4.

96 Mr Jocelyn Dore, Canadian Space Agency, *Proof Committee Hansard*, 22 July 2008, p. 3.

97 Dr Bruce Middleton, *Proof Committee Hansard*, 23 September 2008, p. 4.

APPENDIX 1

Submissions Received

Submission Number	Submitter
1	Paul Cally, Professor of Solar Physics, Monash University
2	Mr Gregory Seil
3	Mr Ralph Buttigieg
4	Mr Ange Kenos JP
5	Mr Jacques Chester
6	Mr Matthew Allen
7	Department of Innovation, Industry, Science & Research (DIISR)
8	Mr Wesley Bruce
9	Mr Desmond J. Lugg MD
10	Emeritus Professor Ray Stalker, The University of Queensland
11	Professor Roger Clay
12	GPSat Systems Australia Pty Ltd.
13	Australian National University (ANU)
14	Sydney Section of American Institute of Aeronautics and Astronautics (AAIA)
15	SMS Management & Technology
16	Professor Stuart Phinn, University of Queensland
17	Mr Don Fry AO
18	University of Sydney, DVC Research
19	School of Geosciences, Monash University
20	Professor John Dickey & Dr Simon Ellingsen, University of Tasmania
21	Geoscience Australia
22	Mars Society Australia (MSA)
23	Spatial Sciences Institute
24	La Trobe University
25	Professor Colin Norman, Physics & Astronomy, John Hopkins University
26	Israel Aerospace Industries Ltd (IAI)
27	National Space Society of Australia (NSSA)
28	Professor Patrick G Quilty, University of Tasmania
29	Mr Jack Dwyer
30	Geological Society of Australia's Specialist Group in Planetary Geoscience
31	Ms Anntonette Joseph
32	Dr James Bradfield Moody
33	Associate Professor Lachlan Thompson & Professor David Trivailo, RMIT University (VIC)
34	BAE Systems
35	University of NSW (UNSW)
36	Australian Hypersonics Network
37	Australian Spatial Information Business Association (ASIBA)
38	Australian Academy of Science

39 University of Queensland
40 Australian Antarctic Division of the Department of the Environment, Water, Heritage and the Arts
41 National Committee for Space Sciences (NCSS)
42 Ms Anne Kovachevich
43 Mr Mark Ramsey
44 Victorian Space Science Education Centre (VSSEC)
45 Ms Jeanette Rothapfel
46 Australian Space Research Institute (ASRI)
47 Mr Luke Webb
48 Institute for Telecommunications Research, University of SA
49 Centre for Hypersonics, University of Queensland
50 Dr Sean Tuttle
51 BLUEsat
52 Professor Don, Sinnott, PhD, FIEEE, FIEAust, CPEng, Professorial Research Fellow in Radar Systems, University of Adelaide
53 University of Newcastle, Centre for Space Physics
54 Grollo Aerospace & RMIT University
55 Confidental
56 The Epsilon Foundation
57 Earthspace
58 Mr Brett Biddington
59 Ms Jo-Anne M. Gilbert
60 Symbios Communications
61 CRC for Spatial Information (CRCSI)
62 Australian Spatial Information
63 Optus
64 Australian Space Industry Chamber of Commerce (ASICC)
65 Bureau of Meteorology (BoM)
66 Professor Mervyn J Lynch
67 Engineers Australia
68 COM DEV
69 Space Policy
70 Department of Defence
71 Mr Roy Sach
72 Landgate
73 Mr Brent McInnes
74 Confidential
75 Auspace Pty Ltd
76 Mr Ian French
77 CSIRO
78 Intelsat
79 South Australian Government
80 Thales Australia
81 Dr Brian J O'Brien
82 Dr John Boyd
83 Mr Paul Baird

84 Reaching Critical Will, Women's International League for Peace & Freedom, UN Office
85 Department of Industry & Resources, WA Government
86 Australian Alumni of the International Space University
87 Dr Bruce Middleton
88 The National Space Intiative of Australia, Spicy Brains Group

Additional Information Received

- Received on 30 May 2008, From Dr Michael Green, Department of Innovation, Industry, Science & Research. Answers to Questions taken on Notice 16 May 2008;
- Received on 20 June 2008, from Dr Peter King, CSIRO. Clarification on comments made during hearing of 16 May 2008;
- Received on 12 August 2008, from Department of Innovation, Industry, Science & Research. Answers to Questions taken on Notice on 1 August 2008;
- Received on 29 August 2008, from Department of Defence. Answers to Questions taken on Notice on 29 July 2008;
- Received on 30 September 2008, from Australian Research Council. Answers to Questions taken on Notice on 29 July 2008;
- Received on 15 October 2008, from Dr James Moody, CSIRO. Answers to Questions taken on Notice on 29 July 2008;
- Received on 7 November 2008, from Australian Communications and Media Authority. Response to matters raised by submissions received from Intelsat and the Bureau of Meteorology.

TABLED DOCUMENTS

- 23 May 2008, ADELAIDE SA:
    - Professor Dyson, La Trobe University, Melbourne '*Space Weather*' Paper;
    - Professor Thompson, La Trobe University, Melbourne, '*Capitalising on Australia Space Technology and Innovation*' PowerPoint presentation printout.
- 22 July 2008, ADELAIDE SA:
    - Com Dev, '*A Framework for Collaborative Space Activity – Australia/Canada*' paper;
    - Com Dev, '*International Collaboration Opportunities Canada – Australia*' PowerPoint presentation;
    - Mr Jocelyn (Josh) Dore, '*The Canadian Space Program: Space Systems and Applications Serving Citizens*' PowerPoint presentation printout;
    - Com Dev, '*Down to Earth, Everyday Uses for European Space Technology: ESA*' Paper;
    - Com Dev, '*Land Use & Monitoring: ESA*' Paper;
    - Com Dev, '*Cars & Trucks:ESA*' Paper.

- 29 July 2008, CANBERRA ACT:
    - Mr Brett Biddington, '*Skin in the Game: Realising Australia's National Interests in Space to 2005*' Paper;
    - Engineers Australia, '*Risk Management of space information services*' submission paper;
    - Australian Research Council, '*ARC funding for space science since commencement year 2002 until 2008*' table.
- 1 August 2008, SYDNEY NSW:
    - Symbios, '*South African National Space Agency Bill*' Paper.

APPENDIX 2

Public Hearing and Witnesses

CANBERRA, 16 MAY 2008

- BARRELL, Dr Susan, Assistant Director,
  Observations and Engineering Branch, Bureau of Meteorology
- BOYD, Mr Cameron Stewart, Academic Coordinator,
  Australian Space Research Institute Ltd
- BUTCHER, Professor Harvey Raymond, Director,
  Research School of Astronomy and Astrophysics, Australian National University
- FRANZEN, Mr Roger Leo, Principal,
  Earthspace
- GREEN, Dr Michael, General Manager,
  Manufacturing Innovation Branch, and Director, Space Licensing and Safety Office, Department of Innovation, Industry, Science and Research
- LEWIS, Dr Adam, Group Leader,
  Spatial Information Access and Remote Sensing, Geospatial and Earth Monitoring Division, Geoscience Australia
- LUCKMAN, Mr Gary, Chairman,
  Australian Space Research Institute Ltd
- PIGRAM, Dr Chris, Deputy Chief Executive Officer and Chief,
  Geospatial and Earth Monitoring Division, Geoscience Australia
- REA, Dr Anthony, Project Leader,
  Observations and Engineering Branch, Bureau of Meteorology
- SAMUEL, Mr Richard Henry, Small Sounding Rocket Program Manager,
  Australian Space Research Institute Ltd
- TERKILDSEN, Dr Michael, Physicist,
  Consultancy and Development, IPS Radio and Space Services, Bureau of Meteorology

ADELAIDE, 23 MAY 2008

- BRUMFITT, Ms Anne, Consultant-Lecturer,
  RMIT University
- CLAY, Professor Roger William,
  Private capacity
- DOUGLAS, Mr John Stuart,
  Private capacity
- DYSON, Professor Peter Lawrence, Emeritus Professor of Physics,
  La Trobe University
- GRANT, Professor, Alexander James, Director,
  Institute for Telecommunications Research, University of South Australia
- KASPARIAN, Mr Jeffrey John, Business Manager,
  Institute for Telecommunications Research, University of South Australia
- MABBS, Dr Stephen, Director Defence Solutions,
  SMS Management and Technology
- MILLER, Mr Matt, Director Defence and National Security,
  SMS Management and Technology
- SINNOTT, Professor Donald Hugh,
  Private capacity
- THOMAS, Dr Andrew Sydney,
  Private capacity
- THOMPSON, Professor Lachlan Arthur, Associate Professor,
  Aerospace Engineering, and Leader, Space Platforms Research, RMIT University
- WOODGATE, Dr Peter Wyndham, Chief Executive Officer,
  CRC for Spatial Information

ADELAIDE, 27 JULY 2008

- DORE, Mr Jocelyn (Josh) Joseph, Technology Development Officer,
  Canadian Space Agency
- KOLACZ, Mr Richard, Director of Mission Development,
  COM DEV International
- STAJCER, Mr Tony, Vice President,
  Corporate Research and Development, COM DEV International

CANBERRA, 29 JULY 2008

- BALTUCK, Dr Miriam, Director,
  Canberra Deep Space Communication Complex and National Aeronautics and Space Administration Operations, Commonwealth Scientific and Industrial Research Organisation
- BIDDINGTON, Mr Brett,
  Private capacity
- BOYCE, Professor Russell Robert, Chairman,
  Australian Hypersonics Network
- BOYD, Dr John,
  Private capacity
- BROWN, Air Vice Marshal Geoffrey, AM,
  Deputy Chief of Air Force
- CAIRNS, Prof. Iver Hugh, Chair,
  National Committee for Space Science
- COLEMAN, Mr Benedict, Assistant Secretary,
  Strategic Policy, Australian Defence Organisation
- CRAIG, Dr Duncan, Information Integration,
  Australian Defence Organisation
- DAVISON, Group Captain Dennis, Director,
  Defence Space Coordinating Office
- EINICKE, Dr Garry, Principal Research Scientist,
  Commonwealth Scientific and Industrial Research Organisation
- HOCKING, Mr David, Chief Executive Officer,
  Australian Spatial Information Business Association Ltd (ASIBA)
- HOOPER, Mr Graeme John, Managing Director,
  GPSat Systems Australia Pty Ltd
- KNOX, Ms Glenys, Director,
  Australian Research Council
- KRIX, Mr Phil, Senior Systems Engineer,
  Auspace Pty Ltd
- LEES, Mr Robert Duncan, Managing Director,
  SPOT Imaging Services (SIS)
- MARSDEN, Mr Len, Chief Operating Officer,
  Australian Research Council

- MOODY, Dr James Bradfield, General Manager,
  International Development, Commonwealth Scientific and Industrial Research Organisation
- MORGAN, Professor Richard Gareth, Director,
  Centre for Hypersonics, University of Queensland
- NIKOLOFF, Mr Peter, Director,
  Auspace Pty Ltd
- PARFITT, Professor Andrew James,
  Private capacity
- PENGELLY, Mr Nicholas, National Operations Manager,
  Auspace Pty Ltd
- PHASEY, Mr Craig, Business Development Manager,
  Auspace Pty Ltd
- SKINNER, Ms Rebecca, Head,
  Strategic Policy, Australian Defence Organisation
- STALKER, Professor Raymond, Emeritus Professor,
  Division of Mechanical Engineering, University of Queensland
- WATKINS, Mr Warwick, Chairman,
  Australian Spatial Consortium
- WELCH, Brigadier David, Director General Integrated Capability Development,
  Australian Defence Organisation
- WHEELER, Mr Antony (Tony) Charles, Past Chairman,
  Australian Spatial Information Business Association Ltd (ASIBA)
- WILSON, Mr Shaun Andrew, Chair,
  National Committee on Space Engineering, Engineers Australia

SYDNEY, 1 AUGUST 2008

- BALL, Mr David Linton, Treasurer/Executive Council Member,
  Australian Space Industry Chamber of Commerce
- DAVIS, Mr Michael Edward, Secretary,
  Australian Space Industry Chamber of Commerce
- GREEN, Dr Michael, General Manager,
  Manufacturing Innovation Branch, and Director, Space Licensing and Safety Office, Department of Innovation, Industry, Science and Research
- HALES, Mr Christopher, Visiting Fellow,
  BLUEsat
- IKIN, Mr Kirby Dean, Chairman,
  Australian Space Industry Chamber of Commerce
- JOSEPH, Ms Anntoinette, President
  National Space Society of Australia Limited
- LAWLER, Ms Donna Renee, Corporate Counsel,
  Optus Networks Pty Ltd
- PIKE, Dr Gordon Henry Stewart, Co-Vice Chairman,
  Australian Space Industry Chamber of Commerce
- SHERIDAN, Mr Paul Francis Scott, Head of Satellite,
  Optus Networks Pty Ltd
- WALSH, Mr Christopher, President,
  BLUEsat
- WARD, Mr Stephen, Director,
  Symbios Communications
- WICHT, Mr Anthony Charles, Visiting Fellow,
  BLUEsat

CANBERRA, 23 SEPTEMBER 2008

- MIDDLETON, Dr Bruce Stanley,
  Private capacity

APPENDIX 3

Decadal Plan for Australian Space Science

The Australian Academy of Science's National Committee for Space Science is developing a decadal plan for Australian space science. A full version of the current draft is available at http://www.physics.usyd.edu.au/~ncss/DraftPlan_Release.pdf.

The plan aims to demonstrate that important projects can be done at modest cost, a dollar per year for each Australian. The following summary was provided by the National Committee:

> a. A new Australian Coordination Committee for Space Science (ACCSS, pronounced "access").
>
> b. New science goals and coordinating themes determined by and agreed to by the space science community.
>
> c. A ground-based state-of-the-art network (Spaceship Australis) to make Australasia and Antarctica the world's best instrumented and modelled region for predicting the effects of Sun and space to Earth's surface,
>
> d. A new program (ICFO – International Collaborations and Future Opportunities) to fund Australian participation in future international space efforts, including human exploration and space medicine.
>
> e. A major education, training, and outreach capability that can coordinate and leverage existing and new projects, both national and international.
>
> f. Two innovative and exciting spacecraft missions with multiple world-class capabilities (Lightning and Sundiver).
>
> g. A new National Institute for Space Science.
>
> h. Support for medium-sized collaborations that range from digital radars to image analysis laboratories to propulsion.[1]

1 National Committee for Space Science, *Submission 41*, p. 3.

APPENDIX 4

Space conference resolution

The Australian Space Development Conference is a biennial meeting which brings together members of the Australian and international space community to review developments in Australian space activity and discuss issues of common concern.

The delegates to the 10th Australian Space Development Conference at Adelaide on 22 July 2008 adopted on the voices the following resolution with regard to the questions posed in the committee's interim report:

1. *Should Australia have a whole of government space policy?* Noting that the space environment, although considered to constitute the common heritage of humankind, is becoming increasingly contested and that Australia has a significant and increasing national dependence on space-based products and services, recommend the Australian Government to develop a whole of government space policy which embraces national security, economic, environmental, educational and broader social benefits;

2. *What should be Australia's role in pure space science?* Noting Australia's achievements in and contribution to space science and the Australian Government's commitment to investing in science of global excellence, encourage the Australian Government to invest in space science in a considered and strategic way which maximises the national and international collaborative benefit with existing investments in astronomy, engineering, and other relevant disciplines;

3. *In what areas of applied space science and industry does Australia have a comparative advantage?* Noting Australia's geo-strategic circumstance, identify comparative advantage in areas which include:

- radio and optical astrophysics,
- hypersonics,
- autonomous systems/mining
- space weather
- application of earth observation to weather and climate monitoring and natural disaster reduction
- the design and construction of precision instrumentation for astronomy and space flight;
- imagery analysis, interpretation and forecasting, especially through the use of advanced modelling and simulation and the use of advanced artificial intelligence techniques, and
- satellite communications, especially the design, development and use of advanced antennas, coding and other techniques to gain improvements in capacity, reliability and security of particular importance to remote users;

4. *Would greater involvement in space science be inspirational for students and others?* Noting a persistent view among science educators, reinforced by strong anecdotal evidence that space inspires interest in the broader physical sciences, engineering, mathematics, technology and innovation, encourage the Australian Government to test this assertion with quantitative research and to gather the experience of science educators around the world and to devise ways and means to make best use of the Australian diaspora;

5. *Is there an economic case for government assistance?* Noting that assured access to space-based utilities benefits all sectors of society to meet myriad requirements recommend that the Australian and state governments consider innovative national and international co-investment with industry such as public-private partnership arrangements to meet identified needs and promote development of space industry capability in Australia;

6. *Is there a security case for government assistance?* Noting the heavy and increasing reliance on space by the Australian Defence Force (ADF) and other national security authorities, encourage the Australian Government to continue to invest in space capabilities which enhance the operational capability of the ADF and strengthen Australia's national security overall, including by investing in a national space situational awareness;

7. *Should Australia be making more use of satellites?* Noting that Australia is a sophisticated user of space applications (communications, oceanographic and meteorological observation, positioning and timing and geo-spatial data), recommend that the Australian Government commit to strong participation in coordinated global earth observing systems and embraces the importance of understanding space systems in their totality in order to balance investment, technical and operational risks between nationally owned future systems and other systems to which Australia has access and to contribute to the design and operational utility of these systems;

8. *Should there be a space cluster?* Noting the importance to the national economy of Small and Medium Enterprises (SMEs) and the importance of SMEs to the national innovation system endorse the space cluster, including tertiary education partners, as a method of fostering and supporting the development, trialling and maturation of new technologies and products which a space industry may be expected to generate;

9. *Should Australia have (or join) a space agency?* Noting the Australian Government's current modest commitment to coordinated policy arrangements and noting a persistent call from industry and other groups for stronger and more visible coordination of effort, recommend that the Australian Government establishes a national coordination body responsible for, and to show leadership in, all facets of Australia's space engagement, including relationships with international space agencies;

10. *Should the Australian Government be giving more support to the SKA?* Noting and applauding the large investment already being made by the Australian Government in the Australian SKA Pathfinder project as well as the leadership role Australia is taking in the international SKA project and noting the considerable scientific, economic, educational, social and broader national benefit which the SKA project is expected to confer,

recommend that the Australian Government considers increasing its support for the SKA project, specifically through programmes and processes which encourage and enhance early Australian industry involvement;

11. Is Australian education adequate for a space future? Noting Australia's requirement to develop a highly literate and numerate society for current living standards to be sustainably maintained and improved, recommend a redoubling of effort to strengthen all sectors of the educational system, including curriculum components which deal with all facets of the space environment and supporting technologies.