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 space; 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.