

Better ways of getting into the space business: microeconomic reform in Australian space affairs

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Abstract

This personal view of trends in global space enterprise suggests that, unless they adapt and re-structure, large-scale national and regional space agencies built on traditional lines may struggle to survive, at least in the developed world. With the growing maturity of speculative private sector space initiatives, the role of traditional space agencies as project managers and mediators between providers and the market may become redundant, while in the absence of a cogent national security argument, public interest in space is no longer to be relied upon to deliver large national space budgets. Australia's newest space mission, the FedSat scientific microsatellite, was announced at the same time as the former national space program was terminated. This process and its consequences are examined as an instance of microeconomic reform, which seeks to improve productivity and competitiveness by producing a regulatory and infrastructure environment that gives business more flexibility. Historical circumstances unique to Australia may have contributed to this change of direction, but many contributing elements also apply elsewhere. The features of the new approach are identification of public sector space needs; selecting the most suitable team from both public and private sectors to manage the project; and the acceptance of a large proportion of the risk by the proponents. © 1999 Elsevier Science Ltd. All rights reserved.

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1. An idiosyncratic review of global trends in space policy

Through much of the past decade during which space advocates in Australia called for establishing a national space agency and enlarging national space program funding, many space programs and agencies in the developed and former socialist worlds have been declining in size, prestige and funding base. For example, in real terms NASA has experienced a 20% decrease in appropriation in the past six years [1]. In Russia, the decline since the end of the Cold War and the break-up of the Soviet Union has almost been a state of free fall: in the four years after 1991, for example, space expenditure fell in real terms by over 80% [2].

This observation does not hold true for many developing countries, particularly those of the Pacific Rim, where a number of administrations – Chile, Taiwan, Thailand,

and Malaysia, for example, have recently commenced or have greatly expanded their government space programs [3]. But their circumstances are different: their tax bases have been engorged through very high growth in Gross Domestic Product during the past decade, at least until the hedge fund-led currency crisis starting in 1997. In other cases, for example on the sub-continent of India and on the Korean peninsula, space programs have been stimulated by “proximity problems” – sub-region scale conflict, or its threat; whereas in global terms the end of the Cold War has much diminished the strategic argument for large-scale space expenditure. In most of the countries in which space budgets have increased, the government of the day is substantially free to make decisions irrespective of the level of public support for the action. In any event, large scale technology-driven initiatives may well be popular with influential sections of the community, for example the aspiring middle class elites for whom these offer prestigious and lucrative work, travel and the opportunity to proclaim that space is no longer the playground of western and former socialist countries alone, but must now be shared with the increasingly self-confident emerging economies.

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Ironically, the centralised long-term planning approach to space exploration appears to have broken down in Russia, while this artefact of command economy planning survives in liberal democracies such as the USA, Japan and Western Europe, and in the emerging economies of the Asia-Pacific region. In these economies, space programs fulfil an anomalous role as a Keynesian pump primer for technological and economic growth, as advocated for example by the economist John Kenneth Galbraith.

Galbraith [4] argued that the modern industrial state is characterised by dependence on technology. Part or most of the development risk is absorbed by the state, through the judicious use of public funds. This is the “planning economy”. The “market economy” dominated by large corporations is more dynamic and responsive, but is inherently unstable in terms of wages and prices: to tune these and also to grow aggregate demand, the planning economy must be of sufficient size to have impact as a corrective and restraining influence on private capital. Galbraith approved of large public expenditures in socially benign areas, such as space, which have consequential benefits to the economy and private sector (in the way of increased skills and know-how, and contracts awarded). The private sector will tolerate and even encourage such government intervention, he argued, since this subsidised the innovation which stimulated growth of more lucrative markets – such as consumer goods – in which the public sector did not participate.

According to Galbraith, to serve its purpose as a reservoir for the regulation of aggregate demand in the economy, large is better as far as the public or planning sector is concerned. Also, public spending must focus on technology intensive fields like weapons and space, where artificial demand can be created and expenditure can be rapidly expanded or contracted as circumstance demands. These areas are also characterised by technology risk levels not normal in commercial enterprises. In some respects space exploration offered an alternative to weapons expenditure in terms of providing the wherewithal for government intervention in marketplace fluctuations – but its virtue was dependent upon it being sufficiently large:

Anything that is roughly equivalent in scale and technical complexity will serve ... this would be equally satisfactory provided always that the costs are sufficiently great. The industrial system has not become identified with the weapons competition by preference or because it is inherently bloody. Rather, this has been the area where the largest amount of money to support planning was available with the fewest questions asked. And since armies and cannon have always been in the public sector, government underwriting in this area has the fewest overtones of socialism. But the space race

shows that underwriting outside the area of weaponry is equally acceptable. [4, p. 337, p. 338].

Galbraith was not speaking purely in abstract terms. Under John Kennedy, who employed Galbraith as an Ambassador to India, the US national space program expanded greatly, reaching just over 1% of GDP at the peak of the Apollo period [5]. To some critics, NASA is viewed as a job creation scheme in the sky, or at least, in the constituencies of some legislators. Economists retained by NASA argued, possibly predictably, that investment in space programs not only stimulated demand at the high-technology end of the economy (increasing aggregate supply), but also reduced inflation due to the effect of increasing productivity arising from the ensuing technologies [6].

Of course, interventionist economists brought up on the New Deal and advocating government led job-creating initiatives (like the Hoover Dam and Australia’s Snowy Mountains hydroelectricity scheme) are now thin on the ground in the governments of the developed world. However, it is not at all clear that national space agencies have adapted to this fundamental change in economic policy: many appear to expect that the state, as commander of the economy, will continue to purchase from them large scale and long-term space goods and services even if these are required only indirectly by the state.

Contemporary US commentators are now challenging this comfortable view. Whereas once the organisation was virtually sacrosanct, some now openly question NASA’s ability to adapt and deliver, and call for a greater degree of competition in the supply of space products [7–9]. The remote-sensing program EOS is a topical example. NASA proposed the Earth Observing System in 1988 and will spend around \$US 10 billion on it by 2005: the first spacecraft is yet to fly. EOS was essentially designed to service the data requirements proposed by a few tens of scientists invited by NASA [10, 11]. Leaving aside assessment of the technical merits and timeliness of the system, from a governance and public administration perspective this arrangement would strike the “rationalist” economic school as being inherently risky. In essence, large amounts of public funds have been given to a public agency for purposes best described as vague. The agency determines how the money is to be expended, defining the performance parameters with the help of an invited group, many of whom receive grants, equipment, travel and other support from the spending agency. This represents a high degree of moral hazard: in addition, there are no formal means of determining if the public receive value for money, or indeed if there is any independently verifiable demand for the program’s outcomes.

The current generation of public sector managers, economists and policy makers in developed nations has generally abandoned the interventionist philosophy in

favour of letting the market seek its own level. Many administrations have also adopted aspects of what could broadly be called the “managerial revolution”, including de-layering; the retreat to “core competencies”; adoption of decentralised or federated organisations [12]; and the temporary nature of jobs and projects [13]. In general, this class of public servants and legislators embraces the idea of relatively smaller public sectors. In reaching this goal, devices such as benchmarking, market testing, and the purchaser/provider model have been employed. In this context, *benchmarking* means that government enterprises compare their efficiency with kindred organisations in the public or private sector – for example by inviting bids for performing certain services previously performed in-house. *Market testing* means that the need for services is quantified before their provision is embarked; and *purchaser/provider model* means that funds are given to the end user of a potential or actual service, rather than to the provider.

These concepts and tools have been introduced in many federal and state government administrations in Australia, New Zealand and Britain [14]. In New Zealand, for example, scientific research “outcomes” are purchased by public research corporations following competitive bidding by universities, government laboratories and the private sector. Under this paradigm, the US government could, for example, have given \$10 billion to the National Science Foundation, for the purpose of obtaining research and advice about Global Change. The NSF could then have determined what goods and services represented best value for the money. While it is possible that some portion of the funds would still have been spent on space hardware, it is almost certain that the scientific return on investment would have been evident, or subject to assessment, much sooner than has been the case with EOS.

Adoption of market-testing in the case of human spaceflight would result in a complete re-orientation of space programs, with a resultant focus on the potential consumer rather than on governments. As pointed out by Rogers [1]:

... after 40 years of spending \$100s of billions (in today’s dollars) on human space flight activities, there is still not a single customer for human space flight goods and services other than the government.

Rogers pointed out that public opinion polling indicates that about 40% of adult Americans would go into space were they able. Space tourism is simply one of many space market sectors in which the prospective private sector demand far exceeds the static or declining demand from governments.

Harris [15] argued that governments around the world are moving away from major public works programs, and are avoiding industry policies based upon

market intervention. He proclaimed the end of the large, government funded central space program, and welcomed the “post-modernist” approach of mixed public/private funding on a project specific basis.

2. Can “faster, cheaper, better” save the agencies?

Although the new paradigm of “faster, cheaper, better” was first enunciated from within NASA by its Administrator Daniel Goldin, some space analysts doubt that the long-established space agencies can adapt to radically new ways of carrying out low-cost and fast-response space missions. The European Science Foundation, for example, in proposing a new class of cheap scientific missions utilising small satellites, doubts the ability of ESA to operate successfully in this fashion [16]. Small organisations and teams, such as those producing the 41 satellite amateur radio AMSAT series, and Surrey Satellite Technology Limited, have been remarkably successful in drastically lowering the cost and development time of small space missions, without obvious loss of performance compared to traditionally organised space projects within specialised agencies [17]. This new style of space project management often involves creating, from a pool of suitable personnel, a well-integrated but small project team which can see a short-term space project through from start to finish within 3–4 years. The nature of large space agencies – particularly their inertia, their lines of control, and their lack of budgetary flexibility – makes it rather difficult to adopt some of these innovative practices. Where similar results have been achieved in large organisations, such as the famous “Skunk Works” of Lockheed Aircraft, or with the Clementine space mission at the Naval Research Laboratory of the Department of Defense, this has been characterised by project management with substantive autonomy from the main body [18].

In summary: the end of the Cold War has removed a major driving force for superpower space contention, which fed the largest space programs of the past four decades. Changes in public policy in respect of industry stimulus and market intervention, and an increasing aversion to deficit budgeting, are restraining or reducing space program expenditure worldwide. The old-style, centralised space agencies – at least, the larger ones – may be unsuitable or reluctant hosts for radical new low-cost methods and space missions.

I now turn to forces and trends in space policy in Australia, which to some degree reflect those noted above.

3. Living in the land downunder

From promising beginnings in the earliest years of the Space Age, Australia has been widely perceived by the

domestic and international space community as having lost its way in space. Instead, I will argue that it has sensibly bided its time and has emerged with a new paradigm that may interest others.

In the 1960s and 1970s Australia briefly possessed at Woomera a world-standard space port. The significance of Woomera as a launch site has perhaps been inflated with the passage of time: only two satellites were ever successfully launched from the site, and the reality was that Australia was in a very unequal relationship in which land was traded for military assistance from Britain and the United States. As is clear from the most comprehensive history of the “Anglo-Australian project”, as it was formally known, the principal purpose of the Woomera prohibited area between 1946 and 1980 was as a test site for British and, later, US missiles and bombs, including nuclear devices [19].

Woomera closed at the end of the Joint Project essentially because the Australian domestic market was non-existent, since the government had neither budget nor requirement for satellites other than those whose services were supplied by other governments. Ignoring this simple but inconvenient fact, a subsequent plethora of reviews, investigations, studies, exhortations and reports on Australian public space policy have argued that vastly increased government expenditure was the Aladdin’s Lamp which alone could conjure Australian space greatness [20–24].

In the early 1980s, the Australian government, both directly and through various scientific channels, began receiving offers to participate in large scale international space missions, including the ill-fated *FUSE-LYMAN* ultraviolet space observatory; the *RADIOASTRON* Very Large Baseline Interferometry space radio telescope; and the *SOHO* solar astronomy mission. A cynical observer may comment that these offers arose in direct proportion to the financial difficulties experienced by the originators; nevertheless, they required some considered response by the Australian government. It was partly in order to give some coherent policy framework to these responses which prompted the Labor Minister of Science, the Hon. Barry O. Jones, to commission the Australian Academy of Technological Sciences to report on space program options open to Australia. This report [20]; hereafter “Madigan” created the frame, canvas and artwork, over which subsequent Australian space program reviews added a few brushstrokes.

The Madigan inquiry took place during a vigorous phase of space exploration on the international scene. The prevailing paradigm for this activity was the public-funded, “national space program”, under the control of a space agency and often with a formulaic approach to international participation or task sharing. It was not surprising that this was the model for Australia which Madigan recommended, with a new statutory space agency and an annual budget of about \$AUS25 million.

This was the minimum amount, in the view of Madigan, which would permit Australian scientists to take part in international or national space missions, and for Australian industry to obtain “space qualification” for their products.

The ambient conditions at the time of the Madigan report offered the best opportunity for the establishment of an Australian space agency and space program. The effort was championed by an energetic, pro-active and popular Minister, supported by what was then one of Canberra’s most vigorous and visionary administrative departments – the Department of Science, which also housed space product users such as the Bureau of Meteorology; the Australian Landsat Station; and the Ionospheric Prediction Service. However, in what has since become a familiar pattern, the government of the day rejected the meat of the Madigan report, citing “economic difficulties” but claiming to accept the report “in principle”. The result was the establishment in 1985 of a small unit within the Department of Industry – the Australian Space Office. The Office supervised a program, approved by a statutory board, ranging in financial scale from \$AUS 2.5 million to about \$AUS 9 million per year over the next 11 years.

The failure of the Labor government to support the fundamental recommendations of the Madigan report was seen in Canberra administrative circles as being the result of poor interpersonal communication between Minister Jones and Cabinet. However, the government’s unwillingness to commit public funds to support space industry development also reflected a growing antipathy within a significant part of the bureaucracy to sectoral industry support. In opposition to enthusiasts of government intervention in the Departments of Science and of Industry, the “economic ministries” of Treasury, Finance, and Prime Minister and Cabinet argued that, except in restricted areas such as public goods and services, space industry does not warrant sectoral support. They claimed that the small potential size of the market addressable by Australian industry did not justify special government support; and that more use should be made of general support measures, such as government R&D agencies and funding mechanisms. The “economic Ministries” associated sectoral industry support with protectionism, which they regarded as abhorrent and, under new international regimes such as GATT, possibly unlawful.

Big ticket infrastructure and technology programs have become increasingly rare in Australian public life, as governments and increasing numbers of senior public servants have become persuaded that governments should facilitate and follow markets rather than building and leading them. What matters for the sake of this brief history is not whether Maynard Keynes or Milton Friedman was more correct; the important point was that the policy environment in Australia became progressively

more hostile to proposals for spending programs which had the objective of strengthening one industry or another.

From the early 1990s, the emphasis of Commonwealth economic policy was the *creation of conditions that allow industry to develop*. In the major policy statement “*Building a Competitive Australia*”, Prime Minister Hawke, Treasurer (later Prime Minister) Keating, and Industry Minister Button explicitly rejected a public-spending led attempt to recover from recession [25]. Instead they argued that the key roles for government lay in choosing macro-economic policies – such as removal of tariff barriers and de-regulation of finance markets; in encouraging enterprises to become more competitive through increased efficiency (a process they termed “micro-economic reform”); and in promoting research and development. In the latter area, Prime Minister Hawke announced an initiative to build what he called “The Clever Country”: this became the Cooperative Research Centres Program, credited by some commentators as having won the subsequent election for the Labor party. The program is one of the few government initiatives retained throughout the 1990s by successive Labor and Coalition governments.

In other countries where the “industry stimulus” argument for space expenditure has failed, space programs are nevertheless encouraged because of public good arguments. In particular, national defence is an apparently persuasive capturer of public-sector space dollars: global expenditure in this area is about as large as that on civil space objectives, both being about \$US 18 billion [5]. However, as pointed out by Ball [26], the biggest element missing from Australian national space planning has been a workable nexus between its civil and defence applications. One historian has characterised Australian society as demonstrating a greater preoccupation with its security than most other countries; in military terms, this has manifested itself in serial dependency on “great and powerful friends” [27]. A key consequence of the Australian–US security relationship has been the presence in Australia of several of the world’s largest and most important ground facilities for space-based signals intelligence and theatre surveillance [28, 29]. From one point of view, these facilities have spoilt the Australian defence forces with kindness, removing incentive to invest in the development of independent Australian military space capability. The prevailing strategic thinking assumed that the US alliance would deliver space-based defence services required by Australia: where this was not possible, the services would be purchased from the global market place. The former Labor Minister for Defence Science, the Hon. Gordon Bilney, expressed this view in an essay in which he decried those arguing that space investment was a totem of Australian regeneration and essential to the avoidance of national failure [30].

By the time the next major review of Australian space policy occurred [23], it was clear that the program was offering few products that the government wished to buy. Further, by that time economic rationalism had become orthodox even in parts of the Industry portfolio. While one part of the Department was proposing an enhanced national space program, another part – the Bureau of Industry Economics – trenchantly argued that there were no economic grounds to do so, except in public good areas [31]. However, with defence-related public goods already virtually excluded, the national space program compounded its own market failure by neglecting space science and terrestrial scientific applications, fields in which investment by other Australian institutions had yielded first-class results [21, 23, 32].

Asking rhetorically why it appeared more difficult in 1993 than 30 years before to persuade Australian governments to support a national space effort, the then head of CSIRO’s Office of Space Science and Applications surmised that apart from the rise of “rational” public economic thinking, also to blame were anti-science attitudes and a consequent fall in support for “big science”; and the fact that traditional space programs had become passé in a “post-modernist” world:

The watchwords of the 1990s are accessibility, mobility, rapidity, quick turnarounds, personal communications, local and national management, national priorities and information. Apply these words to any future Australian space programme and a much clearer picture emerges. Now the challenge is to sell the post-modern vision [15].

As Harris implied, with space industry advocates stuck in a policy time warp, which marginalised them from decision making, a new approach was needed in Australian space affairs.

By 1995, the Labor government decided to terminate the National Space Program and close the Australian Space Office. Although the space lobby gained a one-year reprieve of this decision, the incoming Coalition government endorsed their predecessor’s decision and in August 1996 Minister for Science the Hon. Peter McGauran MP asked CSIRO to carry forward Australian space projects on a completely new basis. This would utilise existing funding mechanisms and a cooperative process that encouraged commitment of resources from public service agencies and the private sector. He invited CSIRO to lead the establishment of a Cooperative Research Centre (CRC) in which industry, research organisations and universities would jointly develop and operate small satellites, initially for scientific purposes but eventually for commercial use. The first such mission, FedSat, would be initiated by the Commonwealth government as a celebration of the hundredth anniversary of the Commonwealth [33, 34].

From the government's point of view, this radical departure had several benefits.

First, it permitted the government (or the relevant Minister) to "buy" only as much of a space program as was required, or as much as the drier and more sceptical members of cabinet would swallow. In this case, the space "good or service" being purchased was a vehicle for expressing, during the Centenary of Federation, Australia's scientific achievement. Review points were established so the government could choose to expand or extend the program, or to terminate it if it did not perform. Placing the new project within an existing generic industry support program meant that no new policy proposal was needed, and avoided the argument against sector-specific industry programs. Third, by outsourcing the project management, access was gained to a greater range of hands-on space expertise than could normally be identified from within the bureaucracy. The skills issue had been a key criticism made by reviews of the Australian national space program [20, 23]. Finally, and possibly best of all from an ideological point of view, under the Cooperative Research Program scheme the participants provide most of the resources while the direct government funded component acts as an incentive. For about \$18 million, the government obtained the benefit of a research and development program with a budget (including non-cash items such as contributed facilities and staff) of around \$58 million. As well as a high profile space project, this sum also covered a seven-year long research program in space science, engineering and higher education.

4. The new approach summarised

The Cooperative Research Centre for Satellite Systems (CRCSS) was established on 1 January 1998 and is an unincorporated joint venture between six Australian universities, four private companies and two Commonwealth research laboratories [35]. A fundamental premise of the Centre is that reducing the cost of space missions is a pre-requisite of growth in public and private markets for space goods and services. The Centre focuses on education, research and commercial programs aimed at developing and proving technologies which support lower-cost space operations.

The CRCSS is one of about 65 special centres established to foster scientific research and to benefit Australian society and the economy. The first space project undertaken by the CRCSS is an experimental microsatellite, FedSat, which will carry out scientific, engineering and educational experiments for an estimated four years, commencing in 2001, the Centenary of the Commonwealth of Australia. The project is Australia's first scientific satellite since WRESAT in 1967. FedSat will carry payloads in space science (a fluxgate magnetometer to

measure magnetic field variations; and a GPS receiver for ionospheric sounding); in communications (a Ka band and UHF band receiver/transmitter for multi-media and rural communication experiments, and for the relay of in situ oceanographic data, respectively); and in satellite systems (an advanced on-board computer). The GPS receiver will also be used to improve navigation algorithms and for profiling the moisture and temperature properties of the atmosphere [36].

In its first six months, the Centre has attracted thirty-four Masters and PhD students who will be carrying out research projects in aspects of space science and technology, many related to the FedSat project [37].

5. Conclusion

Attempts to address "market failure" in space goods often founder because of distortion in the markets new space industries are supposed to enter. As long as entry costs remain in the range of hundreds of millions of dollars, corporations – especially small to medium enterprises – will be unable to enter the space marketplace without continuing national, public-funded space programs. However, the latter have a tendency to create a dependent, inefficient and self-perpetuating "partnerships" with a sub-set of space industry. Also, their distance from the innovative and marketing norms of commerce make governments poorly equipped to guide and stimulate the development of new space products and services.

The "rationalist" school of economic thinking generally supports a lower level of public expenditure; market testing of the requirement for government services; and a greater level of competition between prospective suppliers of these services. To some extent, this line of thinking also encourages an arm's length relationship between the purchaser and the provider of public goods and services. In many respects, all these attributes are at odds with the operations of "traditional" space agencies whose role is to manage large-scale space projects, the end-users of which are often individuals or organisations outside the government administration. To the "rationalist" school, these organisations, with their long-range plans and very long product cycles, resemble the centralised and inefficient bureaucracies of the command economies in the former Soviet bloc.

This arrangement is probably unstable in many parts of the developed world, where one may expect to see increasingly strenuous moves to require "accountability" from government-run space programs. Devices such as outsourcing and the purchaser/provider model may be introduced for this purpose.

The Australian government and legislature, believing that their need for space-based goods and services is limited or can be met through the strategic alliance with

the USA, has at least temporarily abandoned the concept of a National Space Program. Instead, it has implemented an arrangement in which space projects may be initiated on a project by project basis. Instead of having to establish an expensive infrastructure of specialist engineers, scientists and mission managers, as in a national space agency, the government has opted to out-source space project management to a competitively-selected consortium of universities, research agencies and private companies. The government has retained a small space policy section within the Industry portfolio, with responsibility for drafting legislation (such as the *Space Activities Bill*) designed to create a regulatory environment supportive of growth in space industries. The hope is that this approach will yield efficiencies that ultimately make customised space projects more affordable and therefore more attractive to private and public sector markets.

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