National Committee for Space and Radio Science

Space Science Research Capacity and Priorities Survey

Data analysis report

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Introduction

To inform development of the next strategic plan for space science, the National Committee for Space and Radio Science undertook a survey of current and future space science research capacity and priorities. The survey comprised 5 short answer questions plus one open-ended question and was conducted using an invitation-only Academy of Science website over 22 May - 12 June 2020. A copy of the survey instrument appears in the Appendix.

The survey specifically and solely targeted heads of space science research groups in universities, government divisions, and SMEs, 50 of whom were invited to respond via personal emails. Thirty detailed responses were received, 5 from government divisions or departments, 5 from SMEs, and the remaining 20 from university groups. All areas of space science research are more or less evenly represented except for space life sciences, which was featured in only 7 groups.

Responses to open-ended questions in particular provided valuable insight on current capabilities and future priorities for space science research. Individual responses are confidential but main points and trends are summarized below. Since this survey the university sector has experienced Covid-related capacity reductions.

Personnel

Altogether over 600 employees, around 120 higher degree research (HDR) students and over 60 honours students are represented by the respondents. About 25% of these employees and 70% of the HDR students are attached to university groups.

Respondents were optimistic about staffing trends, with 70% expecting employee numbers to increase a bit or a lot over the next 2-3 years (especially in industry), and 17% expecting no change (mostly in universities). These results are depicted in Fig. 1. Expectations were similar for HDR student numbers.

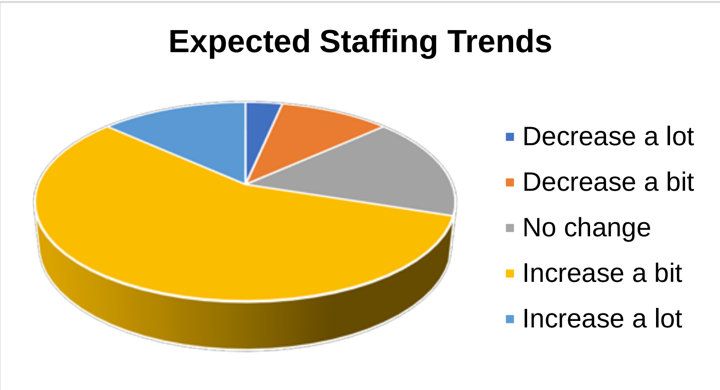

Fig. 1. Anticipated staffing trends over next 2-3 years

All but one respondent confirmed the presence of a gender equity policy in their institution, although 20% claimed no resources were provided for its implementation.

Resources

Heads of groups were asked to identify their principal sources of research funding, in order of importance. The response varied by sector, as seen in Fig. 2. For university groups the main sources were ARC grants, recurrent (institutional) funds, and other government support, in that order. Not surprisingly, government departments relied overwhelmingly on recurrent funding, while government funds were important sources for industry.

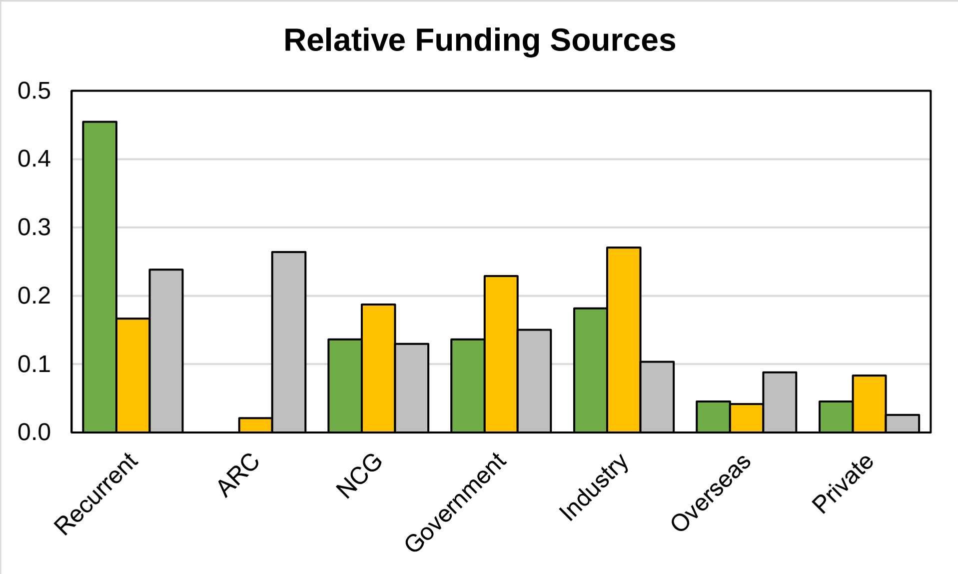

Fig. 2. Relative importance of funding sources for government departments (green), industries (orange), and universities (grey).

When asked about the adequacy of their research funding, all government groups, 75% of university groups, and 60% of industry groups stated that their funding was inadequate. All university research groups whose main source of funding is ARC grants find this inadequate. Nobody reported having more than adequate funding.

However, the pattern for anticipated funding over the next 2-3 years is more optimistic. Most industry and some university groups expect significant increases in their research funds, while government departments expect no change or small increases. These trends suggest general belief in growth of the space sector.

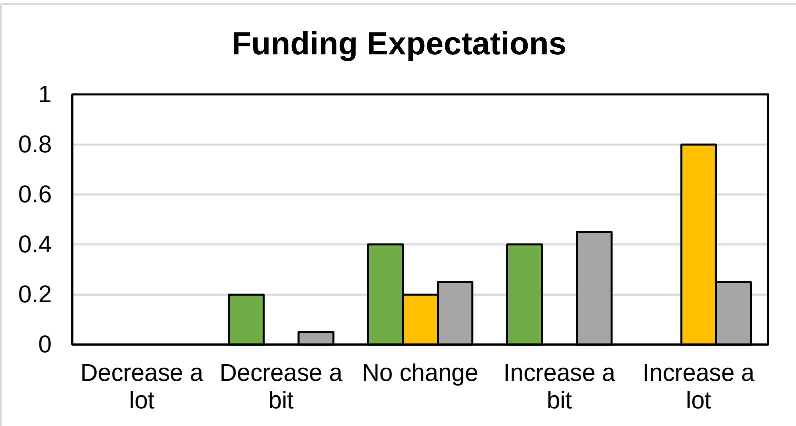

Fig. 3. Anticipated funding trends over next 2-3 years for government (green), industry (orange) and university (grey) groups.

Regarding research infrastructure, 80% of government and industry groups reported this is adequate at least, while 35% of university groups find this inadequate.

Collaborations

All respondents reported that their research is strongly influenced by international collaborations, and all but two university groups stated that industry-university collaborations are important.

These results suggest that Australian space science researchers are well connected with international researchers and groups, and that most seek to form collaborative linkages with industry.

Barriers to research

Heads of groups were invited to identify the main barriers to growing their group's research activities through an open-format question. A variety of responses was received but in essence there were three areas of concern: funding (80% of all responses), workforce (30%), and strategic policy supporting space science development (30%). Twenty-five percent of university group heads also expressed critical difficulties around their personal workload.

Responses about funding highlighted barriers due to the very competitive and limited funding streams which only cover short-term projects and contracts: for example 'short term nature of funding', 'no funding stream for space science missions', and 'no funding avenue for larger groups who develop substantial capacity'. All government department heads reported difficulties due to funding restraints. Workforce constraints were also expressed across all sectors and focused on 'lack of skilled people' and 'difficulty attracting students'. Responses related to strategic policy included 'lack of support for building basic space capabilities', 'lack of [institutional or government] strategic focus', 'competition between state governments', and 'lack of government support for local industry'. University groups cited problems with 'convincing large industries to invest' and 'industry linkages difficult'.

The above barriers all point to a common problem: lack of a national strategy or program for development of a sustainable space-related R&D system through provision of support, beyond limited short-term measures, to encourage growth of and collaboration between government, university and industry groups.

Improving collaboration

The survey invited respondents to identify measures to improve industry collaborations, and new areas for collaboration. Responses basically focused on two critical areas: more effective mechanisms for establishing linkages between researchers and industry; and access to funding sources to support cross-sector collaborations.

Responses regarding the first topic highlighted aspects such as the need for institutional business development expertise, difficulty in understanding industry strengths and needs, mobility or alignment of staff between academia and industry, and better mechanisms for shared PhD students. There were calls for 'an information sharing platform to bridge R&D barriers', and 'annual Space2.0-type workshops' to bring government, academia and industry together to identify areas of mutual interest. One rather candid comment, 'eliminating ineffectual enthusiasts and research mafia, with no proven ability, who hinder productive interactions between academia & industry', highlighted the stresses felt by some researchers in obtaining effective business development support.

Many group heads identified a need for an R&D seed funding scheme: e.g. ‘long term sustainable program to develop government-academia-industry collaborations and projects’, ‘government co-investment in research-industry activities’, ‘Australian Space Agency partnering ARC-linkage type grants’, and ‘collaboration scheme not requiring industry cash contribution’.

Some areas for policy improvement were also identified: need for ‘standardised IP agreements’, need for ‘government policy to buy local’, and ‘the government needs to view substantial research groups & centres in same way as industries: developing IP to sustain their own development roadmap rather than adjuncts to industry’.

New areas for collaboration include in-orbit astronomy, off-Earth mining and related operations including in-orbit manufacturing, and advanced data analytics and AI.

Australia’s main advantages

Respondents were very clear about Australia’s main advantages in the context of international space science: geography and geopolitics (70%); and scientific and technical expertise (53%). Typical responses include ‘strong university research and political stability’, ‘strong academic research base’, ‘skilled workforce’, and related views such as ‘collaborative and innovative spirit’.

Other advantages identified by more than one head are ‘strong demand for Earth Observation services’, and ‘strong primary industries with ability to develop secondary space industries’.

Research and infrastructure priorities

Respondents were asked to identify key developments including infrastructure which would provide Australia with international leadership in space science and significantly benefit society.

While responses spanned several topics, one very clear theme emerged. The overriding ‘discovery or development’ theme was sovereign capability to develop, manufacture, launch, operate, use and distribute data from a satellite mission or constellation. This was also the most common ‘infrastructure’ priority.

Eleven respondents (37%) specifically identified sovereign capability to develop an Earth observation constellation with associated data assimilation infrastructure: e.g. ‘national EO program including space infrastructure, science teams, utilisation teams, calibration and validation, ideally led by the ASA’; ‘user-driven sovereign EO satellite suite and data processing with support for research and industry groups to develop high TRL sensors and hardware’.

Nine respondents similarly identified a sovereign space situational awareness/space traffic management/space weather capability as an area in which Australia could lead internationally. For example: ‘leadership in STM’; ‘SSA/STM supremacy (cops of space)’; ‘funded, coordinated Team Australia (e.g. Defence funded CoE) combining all relevant areas of science and legals underpinning SSA/STM. Should include dedicated Australian missions coupled with ground based radar and AI’.

Some respondents suggested that such a mission or missions could accomplish more than one task: ‘integrated studies of solar-terrestrial system coupled with EO, GPS, improving space weather predication and environmental monitoring, e.g. Murray-Darling basin, Barrier Reef'. However, a third of all respondents identified the capability as the goal rather than specific missions; e.g. 'vibrant service-focused nationally collaborative microsatellite development & launch centre'; 'national space industry hub', and 'at least one substantial science focused mission under ASA flag, e.g. NASA explorer-class, or cubesats'.

Other important developments mentioned by respondents include optical and quantum communications; space medical and life support technologies; investment in developing human resources; and space agency funding for science.

Summary and recommendations

A survey of heads of government, industry and university heads of space science research groups undertaken in June 2020 has revealed the following points.

1. Research staffing levels are generally expected to increase but there is already difficulty in finding suitably skilled personnel. Given that one of Australia's key advantages is its scientifically and technically skilled workforce this is a worrying trend.

   Recommendation 1. Develop a national strategy for recruiting and training students, researchers and technologists into space R&D areas.

2. While individual SMEs are optimistic about future funding, all sectors report considerable funding stress, which is the single major impediment to growing research capacity. A critical problem is that funding sources, e.g. through the National Competitive Grants scheme, are limited to relatively short duration projects and do not allow development of sustainable capacity.

   Recommendation 2. Articulate a funding mechanism facilitating the development of substantial cross-sector space R&D projects as part of a national space strategy or program.

3. Australian space science researchers are well linked with international collaborators and seek to develop linkages across the Australian government-university-industry system. However, they are hindered by lack of a coordinated framework for establishing and growing such opportunities.

   Recommendation 3. Develop coordinated mechanisms to facilitate establishment of linkages between researchers and industry, such as information sharing platforms or conferences, and a seed funding scheme including government or ASA co-investment supporting cross-sector collaborations and projects.

4. Australia's main advantages lie in its geography and geopolitics. The most important pathway for asserting international space leadership would be development of sovereign capability to manufacture, operate and analyse data from a science-based small satellite constellation, for example for Earth observation and/or space situational awareness purposes. This entails a coordinated approach to development of space infrastructure, science teams, calibration and validation, utilisation teams, and international data exchange, ideally led by the Australian Space Agency. Such growth is necessary if Australia is to develop competitive market products and strategic sovereign capability.

Recommendation 4. Articulate a program to develop space-based missions supporting national science and strategic goals, providing international leadership, and leading in time to sovereign space capability.

Note
These recommendations may be construed as arguing for a CRC, when in fact the SmartSat CRC was announced just in May 2019. However, the role of the CRC is more limited, to conducting research that makes industries more competitive. This does not build a sustainable program any more than, say, a CRC for submarines would create a sustainable shipbuilding capability. In the words of a research group leader: ‘the CRC’s focus is on industry problems, it will not meet space science needs or the opportunity of Australian SSA capability’.

Appendix

Research Capacity Survey

The National Committee for Space and Radio Science is managing development of the next decadal/strategic plan for Australian Space Science. This short survey aims to assess current and future research capacity in space science. One response is sought from the head of each research group.

The survey will close on 8 June 2020. All responses will remain anonymous. An email address is requested only to track responses. The survey contains 5 multiple choice questions and one question inviting longer responses, and should take 15 minutes to complete.

1. Type of institution [select one of the following]
   - University
   - Government department or operational agency
   - Government-funded research agency
   - Industry
   - Other (please outline)

2. Area(s) of space science research [select one or more]
   - Space situational awareness
   - Space weather
   - Solar system planetary sciences (not including geology)
   - The heliosphere (Sun, solar-terrestrial science, magnetospheres, aeronomy)
   - Remote sensing and Earth observation
   - Precise positioning, navigation and timing
   - Communications technologies
   - Space technology (satellites, launch or propulsion systems, sensors, etc)
     - Space medicine and life sciences
   - Education and training
   - Other (please outline) . . . .

3. Personnel

(a) Number of full time equivalent staff employed in your group who are active in space science research (do not include students).

(b) Number of higher degree research (PhD, Masters) students.

(c) Number of honours students.

(d) Over the next 2-3 years do you expect the number of staff in your group to:

Increase a lot / Increase a little / Stay the same / Decrease a little / Decrease a lot

(e) Over the next 2-3 years do you expect the number of students in your group to:

Increase a lot / Increase a little / Stay the same / Decrease a little / Decrease a lot

(f) Does your institution have a strategy to actively support gender equity and diversity in groups such as yours?

Yes / Yes but no resources provided / Not aware of any

4. Resources

(a) Principal sources of research funding [number in order of importance, where 1 is most important]

Recurrent (internal) funds (including salaries) / ARC / Other National Competitive Grant funding / Other external government funding / Industry / Overseas / Private (e.g. endowments, charitable trusts) / Other (please outline)

(b) Do you believe that overall funding for your research activities is:

Inadequate / Adequate / More than adequate

(c) Over the next 2-3 years do you expect your funds for research to:

Increase a lot / Increase a little / Stay the same / Decrease a little / Decrease a lot

(d) How well are your research infrastructure needs met (e.g. computing, technical support, laboratories)

Inadequate / Adequate / More than adequate

5. Collaborations

(a) To what extent do international collaborations inform your space science research?

A lot / A little / Not at all

(b) To what extent do collaborations with industry inform your research?

A lot / A little / Not at all

6. Future prospects [open-ended written responses]

(a) What are the main barriers to growing your group's research activities?

(b) What single action could most significantly improve your opportunities for collaboration with industry?

(c) Are there other discipline areas with whom opportunities for joint collaborative projects should be explored (e.g. in-orbit astronomy, in-orbit manufacturing)?

(d) What are Australia's one or two most important advantages in the context of international space science activities?

For the following questions assume no resource constraints.

(e) What one or two key developments or discoveries would provide Australia with international leadership in space science and significantly benefit society?

(f) What are the most important pieces of science infrastructure in which Australia should invest in order to realise (e) above.

(g) Please provide any other comments.