Australian Academy of Science

SUBMISSION TO THE

HOUSE OF REPRESENTATIVES

INQUIRY INTO FUNDING AUSTRALIAN RESEARCH

FROM THE AUSTRALIAN ACADEMY OF SCIENCE / JULY 2018

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Executive Summary

Science, technology, engineering and mathematics (STEM) are fundamental to Australia's continued economic prosperity in the generation and application of new knowledge and ideas, in the development and maintenance of skills and capabilities for a wide range of current and future industries, and in the critical engagement and diplomacy that comes from international science collaboration.

Australia has a strong foundation of basic and applied STEM research built over decades of public investment in school and tertiary education and in public and private investment in basic and applied research and development. Growing this base of public support and facilitating further private investment in research and development is necessary if we are to keep pace scientifically and economically with international collaborators and competitors over the coming decades.

The critical requirements for Australia in the context of research funding are:

1. **Long-term funding growth and program stability**. The Academy recommends the establishment of a **National Science Future Fund** modelled on the Medical Research Future Fund and international examples to provide long-term targeted support for national science and research priorities, and for significant engagement in international science programs, over and above existing funding mechanisms.
2. **A comprehensive, funded international STEM strategy with capacity to drive strategic country-level engagement with major science initiatives and with priority partners.**
3. **Gender equity and diversity in STEM**. The Academy recommends continued investment in programs aimed at reducing barriers to participation of women and individuals from diverse groups in STEM across academia and industry.
4. **Increased collaboration between academia and industry**. The Academy recommends a suite of measures to improve collaboration between academia and industry, including:
    - **establishing** a **central point of access to the knowledge, expertise, services and facilities available from Australian universities and research institutes for industry and commercial organisations**, based on the successful Scottish model, Interface.
    - **a collaboration premium for the non-refundable offset component of the R&D Tax Incentive**, as recommended by the 2016 Ferris, Finkel, Fraser Review of the R&D Tax Incentive.
    - **strengthening Research Technology Organisations, expanding intersectoral mobility, growing the Co-operative Research Centre program, and increasing collaborative funding arrangements**.
5. **Streamlined and efficient research funding processes**. The Academy recommends consolidation of processes across existing research funding streams to minimise duplication and to reduced administrative burdens. The administrative loads from grant application processes should be reduced to what is necessary to identify high quality research proposals.

Funding for research

The terms of reference for the present inquiry refer to the "diversity, fragmentation and efficiency" of research investment by the Australian Government.

The Academy supports streamlined, stable and efficient research funding programs, and suggests consideration of consolidation of processes across existing research funding streams to minimise duplication and reduce administrative burdens.

However, research funding schemes must be fit for purpose, and the apparent "fragmentation" of the Australian research funding environment may simply reflect the different requirements, aims and purposes, drivers and constraints, funding sources, and time scales of each funding scheme.

Research funding principles

Any changes to Australia's research funding environment should ensure that research funding continues to be:

- allocated fairly and through rigorous and transparent peer-review of scientific merit
- fit for purpose, meeting all costs of research, including infrastructure and salary on-costs
- accessible to researchers without undue administrative burden
- sufficiently stable to allow for development of research streams without truncating promising lines of inquiry
- sufficiently flexible to allow exploration of innovative research pathways
- sufficiently stable to allow career development, from PhD and early career researchers through a research career.

Australia's research funding system must ensure support for basic research (also known as fundamental, pure or "blue-sky" research), as the foundation for development of skills and capacity, and as the knowledge base from which solutions and industries of the future arise.

It must also support applied and "priority driven" research focused on developing solutions to real-world challenges or establishing proof-of-concept for potential commercial applications.

The present research funding system in Australia, which supports basic research largely through competitive grant schemes within the ARC and the NHMRC, and through block grants to universities and research institutions that allows discretionary allocation of funding supplemented by competitive grants awarded on scientific merit, meets this purpose.

National Science Future Fund (NSFF)

The Medical Research Future Fund (MRFF) has already demonstrated its capacity to support mission-driven research and to foster a world-class research environment. **The Australian Academy of Science recommends the creation of a National Science Future Fund (NSFF),** potentially modelled on the MRFF to support or supplement high-value basic research that cannot be adequately supported through other mechanisms, and to support large-scale priority-driven research (for example, funding future National Missions).[1] Such a fund would ensure that Australia's scientific research and innovation capacity can develop rapidly, with substantial spill-over benefits for the Australian economy, our workforce, our export income and our global reputation for cutting-edge science research and innovation.

[1] https://industry.gov.au/Innovation-and-Science-Australia/Australia-2030/Pages/default.aspx

The proposed NSFF would enable the scientific community to continue to make major scientific research breakthroughs, of national and global significance. An NSFF could be deployed broadly to support high-value research that cannot be easily funded by existing mechanisms, or to support targeted research and innovation in areas of national priority.

The foundational principles of the NSFF could be the same as those for the MRFF: building stronger partnerships between researchers, government, industry and the community; positioning Australia as a global leader in cutting edge, global science research; making better use of important data and infrastructure resources; promoting collaboration between science-researchers and industry to accelerate the translation and commercialisation of this research.

To be fully effective, the NSFF must be a new addition to science funding in Australia, complementary to continued funding for platforms such as the Australian Research Council; it must be more than a simple repackaging and rebadging of existing science funding.

Research infrastructure

An important component of the research environment is the support of major research infrastructure.

The Australian government supports research infrastructure through the National Collaborative Research Infrastructure Scheme (NCRIS) scheme, which was recently expanded according to the National Research Infrastructure Roadmap. Research infrastructure is also supported by the ARC Linkage Infrastructure, Equipment and Facilities (LIEF) scheme, which operates on a smaller scale than NCRIS. Ongoing, university-level support for research is a function of the Research Support Program of the Research Block Grants.

Because infrastructure facilities represent a large, long-term investment, it is imperative support for these facilities remains stable and predictable, so they can be maintained and operated over their lifetime. The physical facilities must be maintained, and there must also be continuity of expertise and staffing to ensure continued operation.

As an example, the recent Australian Government decision to expand the operations of the Marine National Facility, the *RV Investigator*, was welcome in this regard. The *RV Investigator* was previously funded to operate for only 180 days a year out of an operational capacity of 300 days. The decision to expand operations allows the *Investigator* to meet its full potential, maximising its utility as a research vessel.

Collaboration support for major international projects

Science is international, and Australia derives major scientific, international, diplomatic and economic benefit from engaging at scale in bi-lateral and multi-lateral international science programs.

In 2010, the Australian Academy of Science released a report showing that that funding for strategic international collaboration provided a rate of return of between six and seven to one. When longer-term commercial outcomes and the attraction of international funding were taken into account, this leverage factor increased to 21.[2]

[2] Internationalisation of Australian Science, 2010. Australian Academy of Science. https://www.science.org.au/files/userfiles/support/reports-and-plans/2015/internationalisation-of-australian-science.pdf

Astronomy and space science projects require whole-of-sky and whole-of-earth coverage. Oceanography and climatology study global interconnected systems. Antarctic research requires mutual international support. Energy, food and resource chains require multi-nation study and analysis. Global sustainability requires international consideration of disaster risk, urban health and city design.

Australians are extensively involved in international scientific projects, technical reports and other initiatives, in particular those targeting developing countries.

Australia's participation in global research initiatives – such as the Square Kilometre Array, the International Global Observation Strategy, the research program of the Scientific Committee for Antarctic Research – provides great benefits, both in terms of return of research investment and, more generally, increased scientific credibility and international reputation. It provides access to international infrastructure and data, greatly expanding the operational horizon for Australian researchers.

Australian participation in these research projects should be supported, and opportunities to participate should be identified, as noted in the *2016 National Research Infrastructure Roadmap*.

While Australia has over 30 science and technology agreements with other countries, there are only two bilateral funds supporting strategic scientific collaboration of mutual benefit to both countries: **the Australia-China Science and Research Fund and the Australia-India Strategic Research Fund.** These funds **should be examined as models for further strategic international investment aimed at ensuring strategic participation in global knowledge exchange.** Bilateral agreements such as these, and multi-lateral understandings such as the International Brain Initiative[3] have the potential to improve Australia's international strategic position and scientific standing.

[3] http://www.kavlifoundation.org/international-brain-initiative

Research training

An effective research sector depends very strongly on a high-quality research training system. Tertiary education of researchers is the express purpose of the Research Training Program of the Research Block Grants. Early- and mid-career researchers must be supported through targeted funding instruments that select for emerging researchers with innovative research proposals.

Administration of grant funding processes

Equity and diversity

One of the most pressing issues in science, academia and research is equity and diversity. There is a significant discrepancy in engagement and participation between women and men in STEM disciplines.

Women comprise up to 50% of PhD students and post-graduate positions in many scientific fields, but hold fewer than 20% of the most senior academic positions. Overall, only 16% of university and vocational education and training (VET) STEM graduates are female (Office of the Chief Scientist, 2016).

Leadership and strong commitment to change is required to achieve gender equity and diversity within Australia's research environment. Research grant authorities hold significant power and influence over the research sector, including the inclusivity and diversity of the research workforce. Imbalances and biases in grant selection processes can propagate throughout the system. For this reason, funding schemes are critical for addressing matters of equity and diversity.

Gender and individual diversity should be reflected on all grant committees.

Grant schemes should be sufficiently flexible to allow work/life balance, and it is imperative that grant assessments include consideration of performance relative to opportunity. Where this is already practiced, refinements to this approach based on implementation are also important to ensure that it delivers the intended outcome.

The report of *Women in the Science Research Workforce: Identifying and Sustaining the Diversity Advantage*,[4] led by Professor Sharon Bell and Professor Lyn Yates, provides information, tools and resources to address gendered patterns of success in science.

Duplication in grant programs

The Academy supports a transparent examination of grant funding schemes to identify process duplication and opportunities to streamline grant processes, and to ensure best practice in identifying research for funding is applied across the sector. As part of this process it may be advisable to identify funding streams with similar goals and consolidate them into simpler, broader funding schemes, reducing confusion in the sector and minimising the administrative burden that comes from applying for similar but distinct funding rounds. However, such consolidation should not compromise funding of basic research, including that in the Humanities.

To this end, **we recommend careful, rigorous and transparent analysis of grant funding schemes to identify opportunities to improve efficiency in grant funding.** This should be accompanied by extensive consultation with the sector to ensure that the needs of the research community are understood and accounted for. It must also be noted that major changes to the research funding

[4] http://www.womeninscienceresearch.org.au/index.html

environment will be disruptive, and for this reason a review process must have a clear view of its intended scope and must be undertaken with a view to measuring its impacts against clearly articulated objectives.

Efficiency in application processes

The Academy strongly supports efficiency in grant application processes. While seeking grant funding is a necessary component of scientific research, for most researchers and administrators the application process represents a significant drain on research time and resources.

Wherever possible, **the administrative load from application processes should be reduced to what is necessary to identify high quality research proposals.** The present combination of heavy administrative load and low success rates contributes to researchers leaving the system, either to research groups and institutions overseas or out of the sector entirely. This loss of trained research capability represents a marked inefficiency in the research sector.

This might be addressed with more frequent grant rounds, so that researchers who fail to secure funding do not need to wait twelve months for the next one. A long break between grants encourages people to leave the sector, particularly when overall success rates are low. Improvement in success rates will obviously require an increase in funding for grant agencies. The Academy is also concerned about a perceived over-reliance on investigator track record when judging competitive grant applications. While evidence of a productive track record is clearly important, so is the merit of the proposed research itself, and it can introduce bias against younger researchers. It is important that these two aspects are balanced and judging track record relative to opportunity is critical to fairness.

Research is often a collaborative activity **and track record assessment should focus on teams.** By placing incentives on a team-based focus, high-flyers are encouraged to collaborate more effectively and bring people along with them, reducing the so-called “leaky pipeline” and, in the long term, promoting more innovation by improving diversity.

Funding decisions

Grant funding decisions must be transparent and based on clearly identified criteria. This principle applies to grant funding through the Research Block Grants and Competitive Grant Schemes, but should also apply to “special” grant funds such as the Medical Research Future Fund. At all levels, it is important to demonstrate probity and accountability in decisions affecting research funding disbursements.

Grant process analysis and reform

Periodic review of grant processes is an important aspect of research funding governance. The present inquiry may identify deficiencies in current grant processes, and while these deficiencies should be addressed, **we recommend careful, rigorous and transparent analysis of the individual grant processes to mitigate the disruptive impacts of changes to grant processes, and to minimise unintended consequences of changes.**

Acknowledgment of research-related activities

Researchers, whatever their role, are often called upon to perform many different activities that go well beyond what might be considered “bench work”.

Many academic researchers have a dedicated teaching role, and many spend significant time working to translate their research findings through commercial, engagement or public policy

mechanisms. Researchers are encouraged to communicate their work in public forums, maintaining a social media profile, writing press articles, and engaging with the general public.

Research impact is increasingly important in research performance metrics, and requires demonstration of community, government and/or industry engagement. Research training and mentoring are important activities for more established researchers, and are of great significance to early-career researchers, especially women. It is important that all of these activities are recognised when judging track record.

Logistics support for research

Many scientific disciplines require field research in extreme or remote locations, and therefore may require greater support. **Logistics support mechanisms should be closely aligned with grant funding mechanisms**, to minimise logistical barriers to grant-funded research in distant or remote areas.

Likewise, because of inadequate funding for general research overheads in schemes such as the ARC and NHMRC, universities and research institutes are forced to find additional funds to ensure the success of grants awarded. For universities, this is often sourced from funds obtained from teaching activities and it is well-known that this has led to an over-reliance on fee-paying, usually international, students. This is not a sustainable system. **The Academy recommends that a consideration of the full costs of undertaking research is included in this review.**

Academic – Industry Collaboration

The Academy strongly supports closer and more effective collaboration between industry and the academic and research community. Such collaboration is a general theme in our Decadal Plans on several science disciplines.[5] This interface should be a high priority for government, as improvements in this area will lift both academic and business performance, to the benefit of the Australian economy.

Drawing on these Plans and other research, the Academy has a number of recommendations for improving the interface between the academic and the industry sectors. The recommendations focus on:

- Brokering partnerships between industry and academia
- Strengthening Industry growth centres
- Inter-sectoral mobility and visibility
- Competitive Research Centres
- Collaborative funding instruments.

Partnership brokerage

SME's looking to innovate and grow often require scientific expertise to identify solutions for their businesses. However, connecting with the right experts and developing the relevant partnership conditions can be challenging for all parties involved. Australia would benefit economically from the establishment of a body designed to broker and nurture the relationship between industry and academia, such as the successful Scottish model, Interface. Such a body would act as a central point of access to the knowledge, expertise, services and facilities available from Australian universities and research institutes for industry and commercial organisations. Connecting businesses to academic expertise is a structured and impartial way has been proved to lead to increased R&D activity and the creation of new products, services and processes. Early stage funding and very modest funding to provide proof of concept is an essential part of any such endeavour. The adequacy of current funding schemes available to support innovation in this manner should be investigated.

Strengthening Industry Growth Centres

Internationally, research technology organisations, however named, have been shown to play a key role in the translation of research to the industrial sector and its successful commercialisation by linking basic research generated in universities and research institutions with industrial development and commercial realisation. These organisations play a constructive role in developing industry capability, competitiveness and research translation capability, and must be supported.

In Australia, this role is served in part by the Industry Growth Centres. These centres are designed to set a strategic vision for their sectors through ten-year Sector Competitiveness Plans, focusing on key barriers to growth for their industry. These centres provide a valuable role in technology forecasting and identify opportunities and activities to boost sector productivity and drive cultural change.

[5] Further information on our Decadal Plans, including copies of those already published, can be found at our website:https://www.science.org.au/support/analysis/decadal-plans-science

However, **to be fully effective the Industry Growth Centres need to be funded on a long-term basis and equipped with the responsibility and resources to continue their work in technology forecasting, industry competitiveness, identifying areas for in-depth research and supporting collaborative frameworks across an evolving technology and priority base.**

Inter-sectoral mobility and visibility

Inter-sectoral mobility of personnel helps to increase business R&D capacity and university understanding of commercial imperatives, through two-way knowledge transfer. Grant funding bodies can support professional mobility by considering industry experience, placements and collaborations alongside numbers of peer-reviewed papers.

Academic mobility through laboratory-to-market spin-out companies is an increasing area of knowledge transfer overseas. Australian patent metrics are high, but commercialisation is lacking. Presently in Australia, insufficient support for spin-out companies means that Australian researchers are not commercialising their research or are going overseas to do so. **Better support for academic spin-outs would ensure Australia keeps both successful researchers and their profitable ideas in Australia.**

The introduction of CSIRO ON, a national science and technology accelerator program that provides assistance at different stages of the innovation cycle, is promising in this regard. This program should be supported and expanded to ensure more academics are able to avail themselves of the opportunity to test commercial opportunity and spin out their research into small and medium enterprises.

Cooperative research centres and Industrial Transformation Hubs

The Australian Cooperative Research Centre (CRC) program is world-leading, and its growth and support must be prioritised. Both universities and industry are seen to benefit from CRC programs, which link their research interests and allow for tacit transfer of R&D skills and commercial insight.

CRCs reduce transaction related barriers such as issues with IP ownership or burdens of university administration. Australian CRCs guide international best practice, with many countries adopting the program based on our successful model. The introduction of the CRC-P program to support short-term collaboration is in line with international trends.

Likewise, the ARC Industrial Transformation Research and Training Hub scheme provides important support for industry-academia interactions and the marrying of basic and applied research with directed outcomes. This scheme merits continued support.

Collaborative funding instruments

Increasing the variety of collaborative business R&D funding will remove barriers to innovation and incentivise further cooperation and collaboration. Subsidies and grants for business R&D produce spill-over benefits in the form of increased business R&D intensity and spending. Incentivising collaborative activity creates productive linkages and innovation outputs. This was a key message of the Ferris, Finkel, Fraser Review of the R&D Tax Incentive in 2016[6] and **the Academy supports the**

[6] https://industry.gov.au/innovation/InnovationPolicy/Research-and-development-tax-incentive/Pages/R-and-D-Tax-Incentive-Review-report-and-submissions.aspx

recommendation of that Review for a collaboration premium for the non-refundable offset component of the R&D Tax Incentive.

As noted above, Australia has a number of university-facing collaborative grants such as ARC Linkage Projects, Industrial Transformation Research Hubs and the Industrial Transformation Research Program. To target businesses, **introducing specific direct funding instruments based on the UK's Collaborative R&D program or Finland's Co-Creation and Co-Innovation grants will improve business capacity to take risks, engage in collaborative activity and absorb research output.**

An Austrian program – Partnerships in Research – acts as a precursor scheme to feed into its more established COMET program; this program could be used as a model to prepare businesses to enter the CRC program, with that program's strong and valuable outcomes.