EVALUATION OF KNOWLEDGE AND INNOVATION REFORMS: Reviewing Australia's Block Research Funding Schemes

A submission from the Queensland Office of Higher Education

September 2003

Introduction

This submission is prepared in response to an invitation from the Chair, External Reference Group, Professor Chris Fell, to provide a written submission on aspects of the operation of Australia's Block Research Funding Schemes. The submission does not attempt to address in any comprehensive manner the full extent of the review's terms of reference. It is the view of the Queensland Office of Higher Education that the broader issues embraced by the review are best left for individual universities, as the chief recipients of block grants, to respond to. Rather, and in particular, this submission seeks to address –

- Aspects of the effectiveness with which the allocation and re-allocation processes of the Research Training Scheme (RTS) operate;
- The impact of these processes on regional universities; and
- Whether the application of the 5% capping mechanism should continue beyond 2004.

The issues raised below should be interpreted as being broadly consistent with an approach to research funding in universities that reflects its importance to the future economic well-being of Australia. As the Queensland Minister for Innovation and the Information Economy, the Honourable Paul Lucas, has indicated in a separate submission to Minister Nelson, on this Review and the Review of Closer Collaborations between Universities and Major Publicly Funded Research Agencies, Australia's research funding schemes should have the following features -

- a longer-term commitment to boost the level of funding for university-based research over the next ten year period;
- preservation and enhancement of institution-based infrastructure funding;
- a commitment to boost research training load in Queensland institutions;
- a continuing funding program specifically aimed at developing the research capacities (fundamental and strategic) of regional institutions, and their links with local business and industry;
- improved incentives via taxation policy for industry support for research;
- improved incentives for collaboration between universities;
- a framework for discussion and negotiation of joint Commonwealth and State approaches to research and research infrastructure funding and priority setting; and
- a balanced approach which maintains the strength of Australia's fundamental research base for the longer-term benefit of Australia.

The Queensland Government commitment

With respect to research training, the Queensland Government has three primary objectives, namely –

1. Increase the levels of education achieved by Queenslanders in recognition that the higher their education levels, the more likely the State will achieve and sustain its Smart State ambitions which are predicated on leading-edge skills, knowledge and creativity;

2. Ensure that as many Queenslanders as possible have adequate information communication technology (ICT) skills; and

3. Arrest the decline in the number of students pursuing careers in science and technology, particularly disciplines that have a strong mathematical component such as chemistry, physics, and engineering and new fields like bioinformatics.

The Queensland Government has invested heavily in a number of initiatives in order to progress these objectives**,** including through the following initiatives –

Smart State Fellowships: Instigated to provide incentives to attract and retain world-class researchers to Queensland and to stimulate and grow critical mass in excellence in priority research areas for the State. Applications are invited from outstanding early career researchers who have already demonstrated considerable talent and capabilities and have gained some recognition for their work, to join a team that is led by an eminent Queensland based researcher. The Queensland Government will provide grants of up to $150,000 paid over three years, exclusive of GST. The Government's contribution will be matched collectively by two co-sponsors, one research and one industry or business, bringing the Smart State Fellowships to a total value of $300,000 over three years. Up to four Smart State Fellowships will be awarded each year for four years, commencing in 2003.

Queensland Smithsonian Fellowship Program: joint program of the Queensland Government and the Smithsonian Institute, to foster scientific exchanges between Queensland and the Institute.

Queensland and Northern Territory Multimedia Centre: Funding for 160 scholarships in visualisation and games development.

Australian Microelectronics Centre: Funding provided to the Centre which operates a postgraduate microchip system design program to grow a pool of qualified and talented chip designers for the ICT Industry.

Bachelor of Biotechnology Innovation Degree: Funding provided to Queensland University of Technology to help establish the degree.

Smart State Research Program: PhD students are provided with up to $4000 per year (increased to a maximum of $5000 per year in 2003/04) for up to three years to support research that is relevant to policy development and decision making in State Government agencies.

As a reflection of the State's objectives in research training and its commitment to the achievement of optimal outcomes for the national research training programs, the remainder of this submission addresses two specific issues which represent shortcomings in the operations of the current suite of programs. These are – the allocation and re-allocation of RTS places and the absence of specific programs for new and emerging researchers and research institutions.

Allocation and Re-allocation of RTS Places

The process of allocation of RTS places and the performance-based process through which separations recorded in one year are re-allocated to universities in the next has proven problematic in their early experience of the scheme. This process is serving to diminish the effectiveness with which the RTS resource base can be utilised fully in any given year.

The Problem

As is widely understood, the re-allocation of RTS places from one year to the next is driven by the relative performance of each university as measured by the RTS formula. The formula acts as a rationing instrument for a scarce and finite resource. Through this re-allocation process, the highest performing universities are receiving increasing numbers of places at the expense of 'relatively' lower performing universities. In some cases the quantum of re-allocated places to an individual university can be quite large and is only muted by the application of a 5% capping mechanism that constrains the extent to which places and funding can be re-directed between universities in any one year. Notwithstanding the capping mechanism, it is the case that at least some of those universities that are receiving significant growth in their share of the RTS are unable to attract students to fill those additional places, at least within the available timeframe. This results, for some universities, in a proportion of the RTS funds being unspent in any year and having to be returned to the Commonwealth while at other universities, there is an excess of research students above the supply of places delivered through the RTS. As the scheme stands, its effectiveness is compromised because –

1. It is likely, and chronically so, that some proportion of all allocated RTS funds will not be expended in any given year;
2. Enrolled research students in some universities are being denied access to RTS places because of this flawed re-allocation process; and
3. It is only the capping mechanism which is serving as an impediment to this problem being even more significant in scale.

In any scheme such as the RTS, which has as its basis the requirement to distribute a finite and valuable resource, ie funding for research training places, under-utilisation of that resource should be avoided. This is not to say that performance should be questioned as the basis of any re-allocation process. It should not. Rather, it is the way in which high performance is rewarded in the re-allocation process which seems to be resulting in less than optimal outcomes for universities and less than optimal utilisation of the available resource base of the scheme. Simply, the source of the problem is the aggressiveness with which the re-allocation process is rewarding the best performing universities. It is delivering re-allocated places at a rate far greater than even they have a capacity to absorb.

Of equal significance is the negative impact that this process is having on those universities that, in relative terms (not necessarily in absolute terms), are performing less well. These universities are often located in regional areas where the challenges associated with building research programs are quite distinct from those institutions in metropolitan locations. Yet in Queensland, without exception, these universities could fill more RTS places than they are allocated under the scheme because they have many more enrolled research higher degree students than they have RTS-funded places. These universities are forced into the position of having to fund these students from other sources in order to continue to expand their research activities.

Suggested Solutions

The Reference Group might consider any number of options in addressing the need to achieve a more effective distribution of RTS resources. However, in making these suggestions, this office is not suggesting that performance should not be the key principle on which allocations are determined. It could –

- Seek to adjust the weightings in the RTS formula in an effort to take greater cognisance of a university's capacity to absorb new RTS places before determining re-allocations (It is clear that the weighting for research income in the current formula is the major determinant of the re-distribution process);
- Add a new element into the assessment process to examine what share of a university's total research higher degree load is, in fact, funded by the RTS. (A lower proportion would be indicative of a latent capacity to absorb more RTS places than it currently has); and/or
- Tighten the application of the capping mechanism from the current 5% in order to reduce losses from individual universities in any given year, particularly in cases where there is research higher degree load in excess of RTS quotas.

It is absolutely clear that in no way does the current allocation of RTS places to Queensland universities reflect the higher education sector's capacity to support programs of study for research higher degree students. By any measure current resources delivered through the RTS are inadequate. But if the scheme is to continue at its current level, the very least that should be achieved through the review is to address the mal-apportionment of RTS places and funding, to which this submission refers, to ensure that the RTS funds are optimally expended in any given year.

In the event that growth in the funding available for the Research Training Scheme is possible, there is no doubt that it is desirable, it would be timely to consider the impact that the current arrangements are having on those universities seeking to expand their research performance and culture. A useful starting point for establishing a mechanism for growing the RTS pool would be to measure its size in proportion to the pool of undergraduates places and allow it to grow, with appropriate attention to the high/low cost mix, at the same rate.

The Case for Emerging Researchers and Research Institutions

There is, quite rightly, a pre-dominant emphasis in the allocation of national public research funds on peer-assessed performance as the criterion that determines the distribution of funds to individuals, to research programs and to universities. There can be no question that this approach is serving to reward the excellence and achievement of the very best researchers in Australia, wherever they are working. However, such is the pre-dominance of this single rationale for research allocations, there is the potential to ignore the need to nurture and cultivate the research outputs and potential of our younger, emerging researchers and those universities that aspire to build more mature and diverse research programs. In many cases these aspirations align closely with local and regional communities but do not embrace, necessarily, well-established research training opportunities or, as yet, large investments in research infrastructure. It is difficult to identify a Commonwealth-funded research program that addresses "potential" as a priority or that introduces this issue as a basis on which to make funding decisions. This "potential" exists in all

universities. Some utilise the flexibility of block grants to address this group of researchers as a priority. They should be congratulated for doing so. For others, the diminishing level of support from these sources makes this option problematic and gives them reason to invest block grant monies where it is assessed that immediate higher performance and outputs are more likely. Arguably, many universities in this latter category are serving regional areas of Australia where, coincidentally, industry support and infrastructure is more limited.

It is the view of this Office, that the "Knowledge and Innovation" schemes, broadly, do not serve the interests of universities in regional Australia with the same level of utility as they do their metropolitan counterparts and that this policy position is to the detriment particularly of the development of young researchers with high potential in aspiring universities with young research missions.

There is a case for assessing the merit of introducing a scheme which responds to this category of research activity, which applies a different set of criteria to funding decisions and which, in particular, seeks to focus on the potential of regional universities. This Office does not propose that this suggestion provide a basis for carving a proportion of funds off existing programs. Rather, it suggests that in the event new funding provisions are considered in response to this review, that a program be established to respond specifically to this identified need.

Conclusion

This Office encourages the Commonwealth to take a comprehensive approach when considering the outcomes from all current reviews, to ensure that future policy development is based on a balanced and consistent assessment from these processes. With the significant number of Commonwealth reviews currently operating in parallel, there is a real potential for outcomes to compete for scarce Government resources and, potentially, at the expense of existing programs. For this reason, the Queensland Government submission to the National Research Infrastructure Taskforce is also attached for your information and consideration. In no sense should any of the suggestions made in this submission be interpreted as giving tacit support for a strategy of improving funding of one research funding scheme at the expense of another. Equally, any increases in research funding programs should not be at the expense of universities' recurrent operating grants.

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QUEENSLAND GOVERNMENT SUBMISSION

TO

THE NATIONAL RESEARCH INFRASTRUCTURE TASKFORCE

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INTRODUCTION

The following submission is provided to the National Research Infrastructure Taskforce in response to its Invitation for Submission of 14 August 2003. This Submission is based on the five key issues identified in Section Five of the Invitation for Submission, and also on information available within Queensland Government agencies (particularly the Departments of Innovation and Information Economy, Primary Industries, State Development, Natural Resources and Mines, Education Queensland, Queensland Health, and Queensland Treasury). Where relevant, links to Departmental and other websites are provided, together with electronic versions of relevant Government policy.

The Queensland Government welcomes the Commonwealth Government's initiative to develop a national research infrastructure strategy that will inform policy and funding decisions and the nature of research infrastructure over the next five to ten years. Queensland strongly supports the development of a planning and implementation framework for future research infrastructure investment that enables a coordinated approach between the Commonwealth and State and Territory funding programs. Such a framework should also provide for the establishment of critical mass in major infrastructure and focus on reducing duplication of facilities.

OVERVIEW

The Queensland Government through its recently released Smart State Strategy (*Queensland the Smart State- Investing in Science: Research, Education and Innovation*) is committed to positioning Queensland at the forefront of knowledge intensive industries, and recognises that world class research infrastructure is a pre-requisite to attract, retain and develop highly skilled knowledge workers.

The Queensland Government has a long history of investment in research infrastructure in traditional industries through the Department of Primary Industries, the Department of Natural Resources and Mines, the Environmental Protection Agency and the Queensland Museum, as well as through Queensland Health's public hospital system. More recently, the Queensland Government's Smart State agenda has recognised the importance of strategic investment in new emerging industries and enabling technologies, such as ICT, biotechnology, nanotechnology, gene technology, and biomedical research. Much of the investment in research and associated infrastructure has been through collaborations with state and nationally based organisations such as universities, independent research institutes, CRCs, CSIRO, Australian Institute of Marine Science (AIMS) and the Commonwealth Government.

In 2001 the Queensland Government established the Smart State Research Facility Fund (SSRFF), a dedicated fund to facilitate Government investment in major science and technology infrastructure and equipment, recognising that individual universities and research organisations cannot by themselves fund significant infrastructure without support. This $150M competitively based Fund also aims to encourage collaboration between research organisations and industry in building critical mass and avoiding duplication of expensive facilities and equipment.

Further, to ensure that investment decisions for research are being made on a strategic basis, the Government has developed a set of research priorities. The Queensland R&D Priorities aims to guide State Government spending on R&D (including selection of projects under the Smart State Research Facilities Fund), drive development of critical mass and collaboration, leverage co-investment and maximise the efficiency of investments. The priorities address six broad areas of R&D:

- **Enabling Technologies** - building Queensland's capacity in key technologies such as ICT, biotechnology, nanotechnology and smart materials;
- **Environmentally Sustainable Queensland** – gaining a better understanding of climate change and developing sustainable management practices for our coastlines and the Great Barrier Reef, in response to the impact of human activity;
- **Foods for the Future** - using biotechnology, health sciences and food science to produce functional foods and nutraceuticals for improved human health and well-being;
- **Safeguarding Queensland** - strengthening our capacity to detect and respond to terrorist threats, cyber-fraud and invasive pests and diseases;
- **Sustainable Health** – developing new health products and services with the aid of a greater understanding of social, environmental, psychological and physical factors contributing to good health; and
- **Tropical Futures** – utilising our scientific capacity and technology to address challenges in tropical regions of the world.

The Queensland R&D priorities have been developed to align with the National Research Priorities and CSIRO's Flagship Projects, reflecting substantial agreement between the State and Commonwealth on desirable research objectives. An analysis of the alignment of the Queensland and National research priorities is attached.

Details on Queensland Smart State investment in research infrastructure are outlined in the *Queensland the Smart State - Investing in Science: Research, Education and Innovation* publication, which can be found together with the *Queensland R&D Priorities* on the Department of Innovation and Information Economy Website: www.iie.qld.gov.au

In this Submission, the Queensland Government's key comments relate to:

- Establishment and maintenance of critical research infrastructure, which requires increased investment from the Federal Government, on a more consistent and comprehensive basis. For instance, the Major National Research Facilities program is ad hoc in its delivery and does not provide support beyond five years, which compromises long term planning of major infrastructure in Australia.

- Improving coordination between the Commonwealth and State and Territory Governments to maximise mutually beneficial outcomes from infrastructure investment.

- Broadening of the Commonwealth's approach to infrastructure investment to address:
  - emerging and supporting infrastructure requirements of modern research (e.g. broadband and access to databases);
  - Australia's lack of commercialisation and development infrastructure, which is required to expedite commercialisation of the nation's R&D base; and
  - whole-of-life costs of infrastructures.

- The need for a strategic approach to domestic and international collaboration. Increased coordination is required to meet the needs of all stakeholders, to maximise benefits and

returns from investment, to avoid duplication of infrastructure, and to encourage complementarity rather than competition.

Detailed comments on these issues and others are included below.

ISSUE 1: Australia's Future Research Infrastructure Needs

Gaps in Research Infrastructure

There are a number of major collaborative research infrastructure initiatives currently in progress, including the Institute for ICT Innovation and Energy Centre of Excellence. These are additional to recent successful examples of cooperative partnerships such as the Institute for Molecular Biosciences, the Queensland Institute for Medical Research, and the Queensland Centre for Advanced Technology. However, Australian Bureau of Statistics comparative data indicates that there has been consistent underspending by the Commonwealth more broadly in Queensland at only $33 a year on a per capita basis compared to spending in other States (e.g. Victoria gets more than twice as much Commonwealth R&D spending as Queensland, South Australia gets nearly four times as much, Tasmania gets nearly six times as much and the ACT gets over 30 times as much) despite a number of areas in Queensland having high levels of R&D activity and Queensland Government investment. Many of these areas fall into the categories outlined under the National Research Priorities. This trend is having a detrimental effect on the State's research capacity, particularly in restricting opportunities for investment in key supporting infrastructure.

Environmentally Sustainable Australia

Australia's economy, long term environmental sustainability, quality of life and identity are underpinned by its unique biodiversity. Managing and maintaining biodiversity is crucial for the survival of ecosystems and all species. Queensland has higher species diversity than any other State in Australia and is considered to be one of the top 17 mega biodiverse regions in the world – which together contain more than 70% of the world's biota. The Queensland Government is currently developing its Biodiscovery Policy which will deliver world's best practice in streamlined access to biodiversity and the equitable sharing of benefits sourced from that biodiversity.

Research infrastructure gaps have been identified in a number of sciences focussing on environmental sustainability in Australia, including natural resource management, biodiversity, agriculture and fisheries. These include:

- The nation's deep earth resources. The Queensland Government and CSIRO are investing in an Energy Centre of Excellence which will focus on research into sustainable coal. Significant Commonwealth investment will also be required to establish a demonstration plant to prove the economic, technical, social and environmental feasibility of coal based power generation that utilise zero emission technologies.

- Land and water sciences. Research infrastructure and advanced technologies to enhance the measurement, monitoring and process understanding of landscape functions (including land, water, vegetation and climate). Innovative technologies and tools and monitoring networks are essential for measuring and monitoring catchment

health, groundwater, surface water, the impacts of climate variability and change, and the drivers of resource degradation. Examples include the following:

- *Ready, economical access to mass spectrometer facilities* are needed for analysing landscape function and using isotopes to investigate movement of water, nutrients and carbon.
- *Visualisation facilities* are a key tool for effective visualisation of landscape process with stakeholders, although software is still developing. The capability requires a high bandwidth network in order to move large data sets.
- *Flexible state-of-the-art remote sensing technologies and infrastructure* are required for marine and terrestrial applications (eg assessing the health of the Great Barrier Reef as against land and vegetation resource assessment).
- *Telemetry and portable infrastructures* for water quality monitoring have been suggested as a useful way for capturing episodic events at different locations as and when appropriate, thereby overcoming some of the potential limitations of fixed-location infrastructure.
- *Supercomputing capability* is perhaps the major issue. Australia needs the capacity to store and transport large file sets related to natural resource data. The Australian Partnership for Advanced Computing may provide a suitable arrangement for sharing the technology.

- Amenity horticulture, fisheries, aquaculture, tropical hardwood timber, and predictive and precisions systems for agriculture. Laboratories and equipment focusing on these areas in Queensland are below adequate standards in comparison with southern states and international research organisations. This area requires attention if Queensland is to contribute to the transformation of Australia's existing industries for the knowledge economy.

- Biodiscovery. Around 50% of today's medicines are derived from natural products, yet most of the world's terrestrial and marine species biodiversity remains unsurveyed. There are a range of organisations involved in biodiscovery collection, screening, lead identification and development, however Australia's biodiversity collections are fragmented with expertise dispersed across a range of R&D organisations. A national facility focussed on screening, assaying and analysing Australia's rich flora and fauna, with the capacity to draw together Australia's vast array of collections and research and development expertise, would ensure Australia capitalises on the potential of its mega biodiversity.

In regional Queensland, there are a number of research areas where the key ingredients of R&D excellence and critical mass already exist, and which would benefit from investment in infrastructure, both physical and human. In northern Queensland these fields include marine science, rainforest science, biodiversity and sugar research. Queensland has invested in these disciplines through the SSRFF and individual departmental programs generally run through the Departments of Primary Industries and Natural Resources and Mines, and the Environmental Protection Agency. There are, however, opportunities to consolidate Queensland's research leads in these areas through collaborative investments in science infrastructure with the Commonwealth Government and associated agencies (namely CSIRO, AIMS and GBRMPA) and other States and Territories such as Western Australia and Northern Territory. This point is further explored in Issue 4.

Promoting and Maintaining Good Health

The Queensland Government, through its capital works funding for hospitals and through the SSRFF, has invested substantially in hard infrastructure for basic medical, biomedical and clinical research. The Commonwealth Government, however, currently has no specific program for funding medical R&D infrastructure. Without a long-term, integrated strategy for the nation's health research infrastructure, the capacity for basic medical and clinical R&D in hospitals will continue to be overlooked.

Recently, the State Government committed $10M and $0.8M from the SSRFF in support of the Mater Medical Research Institute and the Wesley Research Institute respectively, to build and fit-out Clinical Trials Centres at each Institute. This will enable the Institutes to conduct Phase I and Phase II clinical trials and establish procedures in the early phase testing of new drugs, devices and health treatments. While these projects contribute to the growth of health and medical research in Queensland, adequate infrastructure for clinical trials is generally lacking. The development of further clinical trials centres would:

- attract drug company involvement in Queensland medical research at the Phase I stage testing stage (this usually means the involvement of higher level players than would be expected for late phase trials); and
- allow early phase testing of local products, thus enhancing returns on IP.

The Commonwealth Government recently established two national food industry Centres of Excellence focussed on Functional/Nutraceutical Foods and Food Safety and Integrity. Both these centres are based in southern states. It would be advantageous for the Commonwealth to develop mechanisms to ensure truly national approaches are adopted to maximise opportunities from Queensland and Northern Australia's strengths in tropical agriculture and horticulture, genomics and biomedical research.

Frontier Technologies for Building and Transforming Australian Industries

The Queensland Government has clearly identified ICT, biotechnology, nanotechnology and advanced materials as research priorities, and together with universities, industry and the Commonwealth, has invested substantially in infrastructure (e.g. $10M Queensland Parallel Supercomputing Facility, $105M Queensland Biosciences Precinct, $50M Australian Institute for Bioengineering, $13M Institute for Glycomics, and $60M Berghofer Comprehensive Cancer Centre). Given the pace of technological development in these fields, on-going investments will be required to provide scientists and researchers with world-class skills and equipment to compete internationally.

Adequate communications infrastructure for regional institutions which provide access to national and international research programs needs further investment. The State has made a number of bids for Commonwealth funding to support regional universities' access to 155 Mbps connections, but without success. This remains a critical issue in regional universities' efforts to access national and international research networks, and to develop research activities relevant to their unique locations in Queensland (this issue is further explored below under *Enabling and Supporting Technologies*).

The use of ICT in the health industry is another focus of the Smart State which has been identified as a priority area requiring investment in infrastructure to build on research strengths in this field. As part of the Smart State Strategy, the State Government has earmarked $13.75 million in funding to create an Institute for ICT Innovation in Brisbane. One of the foci of the Institute will be e-Health, with research programs in the areas of telehealth and the delivery of health care in remote locations. The E-Health Research Centre is being developed in collaboration with CSIRO. Infrastructure will include a gigabit broadband link to the Institute, which will allow linking into the GrangeNet and CENTI networks nationally and support general Internet access via AARnet. An Access Grid will also be set up within the Institute to link to the national and international Access Grid network. This includes connection to Queensland based universities via the Queensland Parallel Supercomputing Foundation's Access Grids at Griffith University, University of Queensland, Central Queensland University, Queensland University of Technology and the soon to be launched site at the University of Southern Queensland.

Further investment is required to develop globally competitive, integrated infrastructure that delivers economic and environmental benefits for industry and the community. The Queensland Government has committed $7.5M from its Smart State Research Facilities Fund towards a new Centre of Excellence in Engineered Fibre Composites at the University of Southern Queensland (USQ), Toowoomba. Fibre composites are new engineered materials which are stronger, lighter and more durable and flexible than traditional materials like concrete, steel and timber. Fibre composites have the potential to revolutionise the construction industry with wide ranging applications in infrastructure like telephone and electricity poles, railway sleepers and marine structures such as jetties and wharves.

Safeguarding Australia

In Northern Australia, the protection of the population, agriculture and the environment from invasive pests and diseases through incursion management and improved technologies for detection, diagnosis and containment of biohazards, is an important concern. The Queensland Government has recognised the significance of this issue by including it as a priority goal under the Queensland R&D Priorities. The Queensland Government is also supporting the new $17.5M Cooperative Research Centre for Australian Biosecurity that aims to develop new capabilities to monitor, assess, predict and respond to emerging infectious disease threats which impact on national and regional biosecurity. The CRC's research program focuses on developing new technology and knowledge platforms for disease detection and surveillance. Research outcomes will include devices to detect pathogens on-site and new platform technologies to enhance the speed, sensitivity and specificity of laboratory and on-site tests.

Biological containment facilities including PC3 and PC4 for Northern Australian linked to a national array of facilities (i.e. the Animal Health Facilities at Geelong and CSIRO's new containment facilities in Perth) are required to address the threat of pests and other biohazard incursions, particularly in the wake of the SARS epidemic or the potential spread of foot and mouth disease. It would also be advantageous for the Commonwealth to take a national approach to developing biotechnology capabilities across the research sector to control infectious diseases and respond to bioterrorism which builds upon the new CRC for biosecurity.

The Queensland Government is also committed to ensuring the safety and security of local communities, businesses and infrastructure in the face of potential threats such as cyber crime. Queensland has the second largest e-security research cluster in Australia and the second largest population of e-security companies in the world. As part of the Institute for ICT Innovation being developed by the State Government, research activities will be focused on e-Security, including the full range of trust, privacy and security issues arising from the application of ICT in government, business and the community. The State Government is currently exploring collaborative arrangements with national and state-based organisations for developing the e-Security focus of the Institute.

Enabling and Supporting Technologies

The application of enabling technologies is becoming critical to the sustainability and global competitiveness of Australia's important traditional industries such as agriculture and mining, and for the growth of emerging industries such as e-health, e-security and bioinformatics. Up-take of enabling technologies, however, is not as rapid as it could be. This is due partly to funding constraints and partly to lack of skills (across the board) in use and adaptation of new technologies. Bioinformatics in particular, as an essential enabling platform in the biotechnology industry, requires stronger and broader infrastructure support services for research such as computer processing and storage facilities. Whilst a shortage of skilled bioinformaticians in Australia has been identified as the most critical issue for the industry by the National Bioinformatics Expert Taskforce, this problem is further compounded by a lack of access to world class infrastructure.

As the most decentralised mainland state, Queensland requires equitable access to supporting technologies such as ICT infrastructure (and associated skills training and business support services) that offers significant potential to reduce the disadvantages arising from distance and physical isolation. Queensland's SmartNet and Reef Network initiatives (refer case studies on pages 101 and 102 of the *Queensland the Smart State – Investing in Science: Research, Education and Innovation* document also enclosed) are providing remote and regional areas with broadband telecommunications services, enabling researchers, particularly those in the State's regional universities, to connect to each other, as well as other national and international research institutions, and to rapidly transmit large amounts of data. The connectivity provided by the Queensland Parallel Supercomputing Facility's Access grids are also enhancing collaboration and vital access to datasets and computing infrastructure, thereby closing geographical divides.

Funding from the Commonwealth in the area of telecommunications infrastructure, however, is manifestly inadequate. In a recent survey of knowledge based and information technology firms in Brisbane, access to affordable broadband telecommunications (of a capacity greater than being delivered by ADSL) was rated as a major impediment to the development of these industries. Access to broadband of up to 100 mbps is required for participation in high end applications for R&D and data transfer. The Queensland Government is concerned about consistent underspending in this area and the impact a decline in competitiveness will have on the development of emerging knowledge based industries. For these reasons, the development and provision of cost effective broadband infrastructure to technology companies and research institutes in Australia should be a major element of a National Research Infrastructure Strategy.

ISSUE 2: The Commonwealth's Research Infrastructure Funding System

The Queensland Government acknowledges the significant investment by the Commonwealth in research infrastructure under the Backing Australia's Ability Strategy, including a range of infrastructure specific programs, the MNRF program, Systemic Infrastructure Funding, ARC Centres of Excellence, and the CRC Program as well as existing block funding programs to support university and public funded research organisations (eg CSIRO, AIMS).

There are, however, some key issues with the current funding schemes that require important consideration in the Taskforce's review.

Inconsistency of Funding Schemes

- Some of the current funding schemes appear to lack a strategic approach to funding R&D infrastructure. The MNRF program addresses a crucial need for large shared infrastructure facilities in the range of $10M to $30M, but its delivery is somewhat ad hoc as there is uncertainty of ongoing support beyond five years. There is also no guarantee of new funding to address emerging needs. The MNRF needs to be a consistent, well funded program if Australia's long-term major research infrastructure is to be established and maintained. There is also a need for another tier of funding below that of the MNRF, to meet the need for infrastructure in the $2M to $10M range to support the acquisition of specialised equipment and instrumentation (e.g. high resolution nuclear magnetic resonance machines and mass spectrometers) which are beyond the means of individual organisations to fund. This scheme should also incorporate collaborative arrangements between research organisations.

- As mentioned above under *Promoting and Maintaining Good Health* (page 4) the Commonwealth Government currently has no specific program for funding medical R&D infrastructure. Apart from ad hoc funding allocations, independent medical research institutes receive no infrastructure funding from the Commonwealth, whereas, universities receive 50 cents of infrastructure funding for every dollar of peer-reviewed competitive research grant obtained. This anomaly needs to be addressed.

- The current system is slanted very much towards asset acquisition not whole-of-life costs. Over the life of a building, the initial acquisition cost is only a small part. Ongoing operation and development are seldom factored into the overall costs but over time this is where major costs are incurred (e.g. maintenance, refurbishment).

- In funding bids, it is important to consider all potential collaborative stakeholders, both within government and the private sector. This maximises the cost benefit from money invested. The funding system can encourage collaboration by fostering the development of key centres of excellence.

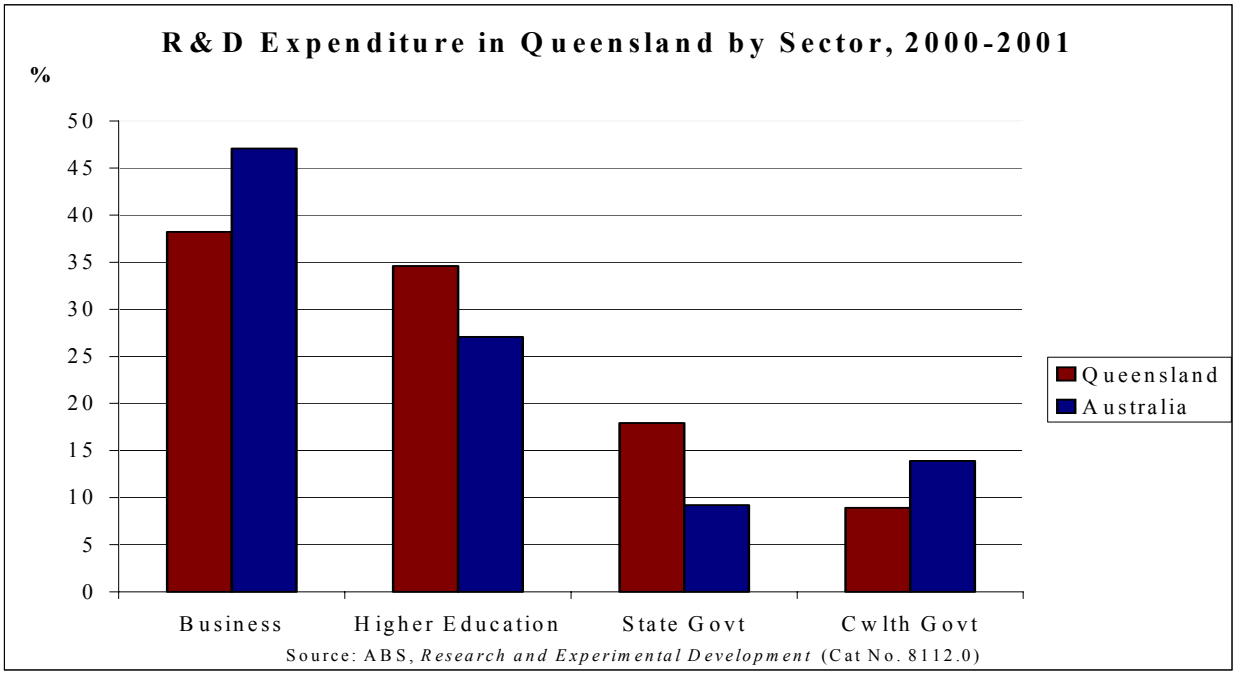
Commonwealth under spending on R&D in Queensland

In Queensland, a number of significant research infrastructure initiatives have been developed that provide a strong national focus and contribute to building national capacity in research and commercialisation. Despite this, the Commonwealth continues to underspend on R&D in Queensland compared to the other States and Territories based on per capita figures.

In 2000-01, the Commonwealth Government spent only $119.6 million of its total R&D expenditure of $1,424.8 million in Queensland – this represents 8.4% of Commonwealth R&D spending and is less than half of Queensland's population share (18.7% as at 30 June 2001). In per capita terms, the Commonwealth spent less than $33 per person in Queensland, which was less than half the national average ($73.39) and the lowest of all the States and Territories. By comparison in 2000-01 the Queensland Government spent $240.3M on R&D, or around $66.21 per head of population, more that any other State in per capita terms.

Figure 1 shows the State Government and Queensland universities are spending proportionately more on research than their counterparts in other States, while the private sector and the Commonwealth are investing less in Queensland than in other parts of Australia.

Figure1: R&D Expenditure in Queensland by Sector, 2000-2001



Queensland's high level of expenditure on infrastructure should not be considered a reason to redirect Federal funding to other jurisdictions. Rather, allocation of funds should be based on research strengths and opportunities, and to address key gaps in facilities.

A similar pattern prevails for R&D expenditure in the higher education sector. In higher education, Victoria receives 3% more R&D than Queensland in per capita terms; South Australia receives 16% more; and the ACT receives nearly 8 times as much. (Figures derived from ARC and NH&MRC reporting statistics for grants commencing in 2003).

Importantly, this spending shortfall is most keenly felt in regional Queensland, particularly by our regional universities. Queensland is the only mainland state where more than half the population lives outside the capital city precinct. The implications of Queensland's regional character needs to be considered in Commonwealth R&D policy.

The Queensland Government strongly urges the Commonwealth to address this underspending in Queensland and bring expenditure levels on a par with the rest of Australia by funding infrastructure through programs that are genuinely contestable.

Alignment of State and Commonwealth Programs and Principles

Development and use of major research infrastructure must be responsive to the priorities set by funding bodies. Queensland has taken a large step in aligning State and Commonwealth research focus through the development of the Queensland R&D Priorities. These Priorities have been prepared to complement the national priorities and to guide spending on R&D. They reflect the Queensland Government's strong commitment to building the State's knowledge industries through strategic coordination.

The SSRFF could serve as a model for a Commonwealth and State partnership in research infrastructure funding. Underpinning this program are established funding principles which include scientific and academic excellence; clear and demonstrable benefit; competitive advantage; critical mass; collaboration; commercialisation; public benefit; value-adding; and ethical principles (the complete set of principles are attached for your information). It would be advantageous for the Commonwealth to work with the states to establish a set of national principles for funding research infrastructure that addresses the needs of all jurisdictions.

Balance of Investment Between Acquisition and Operation

Through R&D stakeholder consultation in Queensland, it has been suggested that consideration should be given to a national funding scheme that focuses on employment and training of technical expertise for acquired infrastructure. Advantages of such a scheme would include:

- better access to infrastructure instrumentation and facilities to researchers across Australia;
- more efficiency in the running of facilities that are well staffed;
- better access by regional centres to sophisticated instrumentation that is often located in the larger cities. Technical expertise, employed by a research centre but located in a major regional centre can facilitate more remote access; and
- protection of investments in infrastructure.

ISSUE 3: The Acquisition, Development and Operation of Research Infrastructure

Generally, there needs to be a strategic approach to development of R&D infrastructure. Primarily, funding should build on existing infrastructure and research strengths and excellence, and investment should be guided by the principles of excellence and contestability. Given the limited nature of funding at all levels of Government, it is crucial that investment in R&D infrastructure be managed efficiently and effectively, and that strategic investments in R&D are considered and evaluated within an encompassing framework rather than on a piecemeal basis. It is particularly important that the refurbishment and replacement of existing infrastructure be coordinated with the establishment of new infrastructure to ensure:

- complementary and synergistic outcomes are maximised;
- critical mass development and collocation opportunities with non government organisations including industry and the private sector are captured where appropriate; and
- the duplication of expensive R&D equipment and facilities is avoided.

It would be advantageous for the Commonwealth to establish a comprehensive register of infrastructure and research expertise to enable information sharing amongst jurisdictions with the aim of enhancing coordination of future planning and development of infrastructure. This register could be supported through Commonwealth facilitated planning forums which include the Commonwealth, and State and Territory government science leaders (i.e. Chief Scientists) and executive officers, which could be responsible for addressing key issues outlined above.

As mentioned under Issue 2 – *Inconsistency of Funding Schemes*, the current Commonwealth funding system is biased towards acquisition, not whole-of-life costs. Over the life of the building, the initial acquisition cost is only a small part. Ongoing operation and development are seldom addressed robustly in the overall cost business planning process, however this is where major costs are incurred (e.g. maintenance, refurbishment). Integration of research priorities and programs will assist in addressing the current focus on acquisition alone. Funding of collaborative Centres of Excellence will also help in capturing whole-of-life costs, facilitate modern facility management, and build flexibility to meet changing research requirements.

ISSUE 4: Processes for Domestic Research Infrastructure Collaboration and Access

There are obvious benefits in strengthening collaborative efforts. In essence, State Governments will achieve a greater impact from their own investments in R&D infrastructure if they can leverage other key players (such as the Commonwealth, universities and industry) in making joint investments. In practice, this will involve alignment of research priorities and programs with Commonwealth agencies, state governments, independent research organisations, and universities. It will also involve developing a basis to attract large industry to invest in R&D centres (e.g. the Astra-Zeneca facility at Griffith University in Queensland)

Strengthening collaborative efforts involve:

- taking a strategic approach to domestic collaboration. Increased coordination is required to meet the needs of all stakeholders, to maximise benefits and returns from investment, and also to avoid duplication of infrastructure and spending on unnecessary infrastructure;

- formal cooperative agreements which present opportunities for co-location of infrastructure and facilities in common research priority areas, thus strengthening critical mass. The Queensland, Northern Territory and Western Australian Cooperative Framework Agreement on tropical science, knowledge and innovation, for example, will help identify new opportunities for joint investment in tropical science and identify opportunities for increased Commonwealth and industry engagement in this area;

- establishment of national centres of excellence, which are supported by appropriate infrastructure and allocated investment based on their alignment with R&D priorities, evidence of critical mass and national focus. Generally, large ad hoc funding requests should not be considered within the same context as smaller targeted R&D projects. The collaboration should be a prerequisite for funding approval;

- including industry in collaborative arrangements for investing in and operating research infrastructure. There is now a strong interest from private sector in investing in infrastructure projects where a long-term revenue stream is available. Private sector funding has the potential to deliver economies in construction, a more innovative approach to funding, and the provision of more cost effective and appropriate technology. Increasing incentives for greater industry involvement in infrastructure funding needs to be addressed at the Commonwealth level, as well as by the State Governments. Consideration also needs to be given to private and public partnerships (PPP) as a funding model for acquisition of enabling research infrastructure. The Queensland Government is currently assessing use of PPP to deliver major science and research facilities where needed. It has released a PPP policy (which can be found at www.sd.qld.gov.au) that recognises optimising value for money in the provision of infrastructure is necessary in identifying and managing a project's whole of life costs and risks;

- development of strong linkages through technology parks and research precincts, particularly in regions where there is an existing strong industry presence (i.e. agricultural industries in major country centres such as Toowoomba); and

- investment in supporting ICT infrastructure such as broadband and supercomputing facilities to encourage linkages between universities. Developments such as Australian Partnership for Advanced Computing and the Queensland Parallel Supercomputing Facility are essential to enabling collaboration at significant levels.

Barriers to Collaboration

Investment issues such as intellectual property, requirements for demonstrated return on investment, timing of political cycles in relation to return on investment, and the high risk of R&D ventures, do however pose barriers to increasing collaboration. The Queensland Government has developed a set of IP Principles (refer to www.iie.qld.gov.au for a version of the principles) to provide agencies with guidance on how to appropriately manage and commercialise their IP assets. These principles are consistent with the Western Australian Government's IP model, and the Queensland Government encourages the Commonwealth to apply similar principles to funding processes in order to maintain consistency across all government jurisdictions.

ISSUE 5: Processes for International Collaboration and Access

The globalisation of R&D has been generally motivated by firms' search for lower costs, reduced regulatory barriers and access to markets and technology. In many OECD countries, R&D activities are less internationalised than production, but this is changing as more and more multinationals set up offshore R&D laboratories supported by major pieces of research infrastructure.

Firms engage in alliances with other countries in order to achieve one or more of the following:

- Access to markets;
- Accelerated return on investment;
- Cost sharing of investments such as R&D;
- Spreading risk;
- Access to resources such as complementary technologies;
- Efficiencies through economies of scale and scope;
- Open up otherwise unattainable investment options; and/or
- Co-opt competition.

Australia has recognised the importance of foreign investment in building R&D and innovation in Australia. The current national focus is on attracting investment in the biotechnology, information communications technology, nanotechnology, renewable energy, and mining and light metals sectors. While federal government initiatives such as the *Innovation Access Program* and the development of bilateral and multilateral agreements on cooperation in science and technology assist in promoting international collaboration in science and technology, many Australian state governments are not implementing any specific initiative or strategy in relation to international collaboration specifically. For most states, international collaborations are an element of other priority initiatives.

In line with facilitating national collaboration (refer to Section 4), a strategic approach, together with government policies for investment in national R&D infrastructure, have been shown to be essential in attracting international flows of R&D investment. For example, one of the key drivers of international industrial collaboration in science and technology R&D is the development of centres of excellence in certain sectors (i.e. pharmaceuticals). Without clear policies on investment in domestic infrastructure that guide development of centres of excellence, Australia's attractiveness is inhibited.

A national approach is also needed to address barriers to collaboration. Differences in intellectual property guidelines across international markets, in particular, can lead to uncertainties and difficulties in research collaboration at a global level. The development of a truly global "innovation system" appears to be intensifying pressure for harmonisation in government policies in intellectual property, regulatory, tax, R&D and many other policies.

The dominance of large multinationals in pursuing international R&D collaborations and access to infrastructure is also a barrier for small firms who tend to lack information, overseas connections, technical expertise and financial resources. Governments therefore need to devise an approach to increase participation by SMEs in global technology development.

Queensland Government Collaboration Activities

The Queensland Government is playing an active role in developing and fostering greater collaboration and partnering between Queensland and international R&D institutes and agencies, universities and industry. It currently has 20 trade and friendship relationships around the world. These relationships range from Memorandums of Understanding to full Sister State Agreements.

Research in Queensland Government research facilities have also actively sought and undertaken international collaboration in R&D. The Department of Primary Industries, for example, has international research projects occurring through the Australian Centre for International Agricultural Research program with countries in the Asia Pacific region, including China, Vietnam, Indonesia, Philippines, Papua New Guinea and the Pacific Islands.

Queensland is also pursuing a number of opportunities for international collaboration on biotechnology R&D. For example, the recently signed Queensland and New Zealand Biotechnology Collaboration Agreement will provide a number of opportunities for aligning biotechnology research programs, and ensuring complementarity of facilities rather than competition. Mutual access to research facilities is also being explored. This Agreement will link with the Australian Biotechnology Alliance, thereby providing benefits nationally. It could also be a used a model for further international collaborative arrangements targeting complementation of infrastructure and access to facilities.

Queensland also actively participates in international collaboration mechanisms to promote the uptake and commercialisation of clean coal technologies. For example, the Queensland Government was part of the Commonwealth led delegation to the United States Carbon Sequestration Leadership Forum in July 2003. This Forum provides the mechanism for international cooperation in R&D for the separation, capture, transportation and storage of carbon as a means of reducing greenhouse gas emissions.

The establishment of Queensland R&D Priorities has provided a framework for promoting and establishing international networks in research areas that are mutually beneficial to a number of agencies. Integration of priorities nationally would assist in developing a strategic focus for pursuing collaborations domestically and overseas. The development of international agreements should be based on a strong government and industry focus on these priority areas.

It is also recommended that an international audit of R&D facilities be conducted to select key markets to seek collaboration in R&D activities and to pursue opportunities for access to facilities.

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ALIGNMENT OF QUEENSLAND R&D PRIORITIES WITH NATIONAL RESEARCH PRIORITIES

NATIONAL PRIORITIES	QUEENSLAND PRIORITIES
1. Environmentally Sustainable Australia • Water. *Ways of using less water in agriculture and other industries, providing increased protection of rivers and groundwater and the re-use of urban and industrial waste waters.* • Transforming existing industries. *New technologies for resource–based industries to deliver substantial increases in national wealth by reducing environmental impacts on land and sea.* • Overcoming soil loss, salinity and acidity. ***Identifying causes and solutions to land degradation using a multidisciplinary approach (examples include incorporating hydrology, geology, biology and climatology) to restore land surfaces*** • Reducing and capturing emissions in transport and energy generation. *Alternative transport technologies and clean combustion and efficient new power generation systems and capture and sequestration of carbon dioxide.* • Sustainable use of Australia's biodiversity. *Managing and protecting Australia's terrestrial and marine biodiversity to develop long–term use of ecosystem goods and services ranging from fisheries to ecotourism.*	**Responding to climate change** *Understand the nature of possible climate change, its impact on the environment, and identifying and developing (through R&D) appropriate management and mitigation strategies.* **Sustainable production and use of energy** *Reducing emissions from fossils fuels and identifying and developing more efficient and sustainable methods of production and use of existing energy sources as well as new and renewable energy sources.* **Living sustainably in the Tropics/Great Barrier Reef** *Use new and existing technologies to develop innovative products and processes in the fields of health, agriculture, marine science, mining and environmental management.* **Sustainable Queensland coastlines** *Management systems, policies, procedures and processes for sound decision making, underpinned by science, to ensure the sustainability of natural resources in response to the impact of human activities.*
• Developing deep earth resources. *Smart high–technology exploration methodologies, including imaging*	

NATIONAL PRIORITIES	QUEENSLAND PRIORITIES
and mapping the deep earth and ocean floors, and novel efficient ways of commodity extraction and processing (examples include minerals, oil and gas).	
2. Promoting and Maintaining Good Health • A healthy start to life. *Reducing the impact of genetic, social and environmental factors predisposing infants and children to ill health and reducing their life potential.* • Ageing well, ageing productively. *Developing new and better social and medical strategies to reduce mental and physical degeneration based on greater knowledge and understanding of the causes of disease and degeneration of mind and body.* • Preventive healthcare. *New evidence–based strategies to promote healthy attitudes, habits and lifestyles and to develop new health-promoting foods and nutraceuticals.*	**Sustainable Health** *Health & medical research to deliver new products and services (including potential for export), and a new understanding about the interaction of social, environmental, psychological and physical factors in sustaining good health.* **Healthy, safe and ethically produced food** *Use strengths in biotechnology (particularly animal and human genomics) and health sciences with leading edge food science and technology, including an expanded plant genomics capability, to focus on a specific set of human health and wellbeing outcomes.*

NATIONAL PRIORITIES	QUEENSLAND PRIORITIES
3. Frontier Technologies for Building and Transforming Australian Industries. • Breakthrough science. *Better understanding of the fundamental processes that will advance knowledge and develop technological innovations (examples include bio-informatics, nano-assembly, quantum computing and geo-informatics).* • Frontier technologies. *Enhanced capacity in frontier technologies to power world class industries of the future and build on Australia's strengths in research and innovation (examples include nanotechnology, biotechnology, ICT, photonics, genomics/phenomics, and complex systems).* • Advanced materials. *Advanced materials for applications in construction, communications, transport, agriculture and medicine (examples include ceramics, organics, biomaterials, smart material and fabrics, composites, polymers and light metals).* • Smart information use. *Improved data management for existing and new business applications and creative applications for digital technologies (examples include e-finance, multimedia, content generation and imaging).*	**Connected Queensland** *Innovative practices and technologies in transport and ICT to underpin services such as telemedicine, education and facilitate communication between domestic and international communities.* **High value-adding to light metals** *Reducing the production costs and developing new markets for light metal alloys, including aluminium, magnesium and titanium, in industries such as construction, transport and packaging, automotive and telecommunication/electronics.*

NATIONAL PRIORITIES	QUEENSLAND PRIORITIES
4. Safeguarding Australia • Critical infrastructure. *Protecting Australia's critical infrastructure including our financial, energy, computing and transport systems.* • Protecting Australia from invasive diseases and pests. *Counteract the impact of invasive species through the application of new technologies and by integrating approaches across agencies and jurisdictions.* • Protecting Australia from terrorism and crime. *By promoting a healthy and diverse R&D system that supports core competencies in modern and rapid identification techniques.* • Transformational defence technologies. ***Transform military operations for the defence of Australia by providing superior technologies, better information and improved ways of operation.***	**Safeguarding Queensland** *Enhance capabilities in anticipating and responding to potential threats to critical infrastructure and communities, and protecting our natural assets. E-security to protect against cyber-fraud and unlawful intrusion via hacking.*

Queensland Government

R&D FUNDING PRINCIPLES

In addition to the Queensland R&D Priorities listed above, the following principles have been prepared to be used as a guide for Queensland Government departments/agencies when assessing research funding applications or allocating resources to research projects. Additional criteria which apply to particular research programs may also be used.

1. Scientific and academic excellence

Scientific and academic excellence will need to be based on world-class academic achievement, not only to attract State Government funding but also to lever additional funding and investment from national and international funding sources. This may require use of peer review mechanisms to provide independent advice on the scientific quality and international competitiveness of particular proposals, taking into account:

(a) The quality of the research proposed and its contribution to addressing the objectives of the research.
(b) The originality and degree of innovation of the proposed research, taking into account the level of risk associated with the proposal.
(c) The track records of the investigators in the sphere of research.
(d) The adequacy of the chosen methodology and work plan for achieving the research objectives.

2. Clear and demonstrable benefit

R&D projects will need to demonstrate to public and private sector sponsors that projects have clear relevance to economic, social or environmental objectives, by:

(a) The degree of relevance to the Government's social, economic and environmental objectives/goals, including the R&D Priorities.
(b) The capacity for the research to enhance the development, implementation or evolution of the priority area.
(c) The potential of the research to result in economic, social or environmental benefits for Queensland from the expected results and outcomes of the research.

However, it is acknowledged that 'clear and demonstrable benefit' can be difficult to demonstrate in pure/basic research.

3. Competitive advantage

Research that demonstrates the following criteria should carry advantage over research that does not have such features:

(a) The extent to which the research will build on the State's traditional and/or unique endowments or circumstances, such as proximity to relevant knowledge sources, facilities or natural resources.
(b) The extent to which the research will develop Queensland's emerging, internationally competitive and value-adding industries.

4. Critical mass

Critical mass will be important in attracting world-class recognition, attracting high quality researchers and research projects, and boosting large-scale national and international investment. The potential of a research proposal to achieve critical mass may be assessed by:

(a) The degree to which the research enhances the concentration and coordination of research in the particular field of research.
(b) The extent to which the research would expand Queensland's knowledge base and research capability in the proposed priority area.
(c) The degree to which the research enhances the human, physical, intellectual and financial resources within the sphere of research.
(d) The degree to which the proposal utilises innovative means for linking and connecting research localities.

5. Collaboration

The Queensland R&D Priorities are multidisciplinary in nature and require a mix of science and technology and social science and humanities research. Co-operation among R&D institutions (State/Commonwealth, government/university, public/private) will be essential in attracting larger projects, building critical mass and furthering interdisciplinary approaches to complex problem solving. Strong and improved collaboration and communication between research users and research providers is vital so that R&D produces tangible results. The collaborative nature of research proposals may be assessed by:

(a) The planned links with Queensland research providers working in the proposed fields of research.
(b) The potential for enhancement of effective national and international interactions and linkages.
(c) The extent to which the research utilises a multidisciplinary approach to addressing the priority area.
(d) The adequacy of plans and strategies for facilitation of technology or knowledge transfer and dissemination of results to research users.

6. Commercialisation

Successful commercialisation of research will fulfil expectations of governments that seek to realise the economic benefits of R&D for the community (e.g. in job creation) and will also reduce reliance on public sector funding for R&D by generating external revenue sources for new research projects and facilities. Potential for commercialisation of research may be assessed by:

(a) The potential contribution to economic growth, the usefulness and range of applications and/or potential for exploitation of the research outcomes.
(b) The adequacy of plans relating to utilisation or commercialisation of research.
(c) The strategic impact of the proposed research and its potential to improve competitiveness and develop markets for the application of the research.
(d) Where research is deemed to have a commercial potential:
    - the extent to which this potential is likely to be realised in the short or longer term;
    - the extent to which it is likely to increase productivity in established industries or contribute to Queensland's emerging industries; and
    - the extent to which it is likely to meet global market opportunities as well as domestic needs.

7. Public benefit

The Queensland Government supports 'public benefit' research that may not generate a direct commercial return, but is nevertheless aimed at addressing the State's economic, social or environmental objectives. It is important for public benefit research funded by the State to demonstrate excellence and benefit in the same way as research having commercial potential:

(a) The contribution of the research to improving the quality of life and health and well-being of Queenslanders.
(b) The contribution of the research to improving employment prospects and the use and development of skills in Queensland.
(c) The contribution of the research to preserving and/or enhancing the environment.

8. Value-adding

For the State Government, facilitating the development of value-added R&D will be another important objective, reflecting the Government's concern to maximise the growth and application of successful research within Queensland:

(a) The creative and innovative nature of the proposed research and its capacity to lead to a significant advancement/improvement of products and/or processes in the designated priority area.

9. Ethical principles

All Queensland Government departments/agencies conducting research, and organisations that receive financial assistance from the Queensland Government to carry out research activities, or which have the State as a participating member, will be required to abide by the following fundamental principles:

(a) ***Integrity*** – having honesty and respect for the truth.
(b) ***Beneficence and non-maleficence*** – achieving the greatest possible good while doing the least possible harm to both humans and the environment.
(c) ***Respect for persons*** – treating patients, clients, research subjects and consumers as autonomous agents having freedom of choice, dignity and human rights.
(d) ***Justice*** – recognising wider community interests beyond the interests of the individual, organization or corporation; providing redress for the vulnerable; and promoting equitable access to resources.
(e) ***Respect for the law and system of government*** – complying with relevant laws and standards; fostering public participation and transparency in decision making; and demonstrating accountability for actions and use of resources

The following notions should also be considered in the allocation of financial resources for research:

Contestability

Introducing a greater degree of contestability than is currently applied to R&D resource allocation is likely to improve the outcomes generated from R&D investment, while ensuring that the State maintains core competencies and infrastructure in critical areas. Contestability exposes proposals to competitive review, increases the quality of applications submitted, enhances equity and helps ensure that individual stakeholders do not unduly influence government decisions or monopolise the results of publicly funded research. The challenge is to ensure that the cost of contestability does not outweigh the desired benefits or stifle collaboration.

Investment risk

R&D is a high-risk investment, and the public sector should not take on the risk unless it is better placed to do so than private sector providers of R&D. Where the private sector is better placed than the public sector to determine where the highest returns are most likely and/or is better placed to handle the risks involved, then supporting private sector on a competitive basis should be preferred to direct public provision. R&D support should be directed to those areas that are likely to provide the highest return to the community and where there is inadequate private sector support.