Queensland University of Technology

Submission in response to the Queensland Government science strategy discussion paper

Research funding and capability in Queensland's university sector

August 2019

Queensland University of Technology (QUT) is grateful the Department of Environment and Science for the opportunity to respond to the discussion paper *Research funding and capability in Queensland's university sector*. Our submission draws together the collective expertise and research interests across QUT's diverse fields of research and teaching. We would be pleased to provide further information on any of the points raised should this be required.

A coherent and deliberative science strategy for Queensland will enable the sector to drive research collaboration at scale, establishing and leveraging dynamic research networks for sustained impact in identified areas of research need, across public policy, industry and the economy, and social and cultural activity. Our responses to the specific questions are geared around this higher-order goal.

1. The Queensland university research sector is a large industry and employer in its own right that is substantially supported by revenue sourced external to Queensland. How could a Queensland science strategy help the sector to attract even more external revenue?

Play to our strengths

The science strategy should support the sector to generate additional external revenue from national sources, overseas investors, international research collaborators and industry partners through establishing and negotiating access to people and facilities that are either only available in Queensland or where Queensland enjoys an existing prominence. This includes partnership with key research personnel and centres, as well as the use of highly specialised and in-demand infrastructure, such as world-class research or scientific equipment, joint-laboratories, and collaborative research centres.

Defining Focus

Identifying practical, real-world grand challenge initiatives will assist the sector to focus Queensland's research effort on delivering tangible specified economic, societal and environmental benefits. Queensland could define its challenges based on internal consultation with Government Departments, Queensland universities and industry and research partners, as well as by reference to external frameworks such as the United Nations Sustainable Development Goals and the objectives of other multijurisdictional bodies such as the Asia Pacific Economic Cooperation (APEC). Using external frameworks would empower Queensland to leverage existing networks both internally (between local, city and regional communities) and externally (with national and international partners in business, government, industry and research).

The Smart State initiative in Queensland saw successful investment in scientific research, which continues to reap benefits. Any approach should continue to promote Queensland as a national leader in bilateral scientific exchange partnerships to tackle global challenges in agriculture, society and culture, bioeconomy, education, health, the environment and social justice, and attract talent from economies with similar science priorities.

Support Systems and Useful User data

QUT backs state-developed support programs that facilitate university, government and end-user engagement as a platform to attract additional funding from external sources. The implementation of cross-institutional research data management strategies showcasing the sector's research capability and research infrastructure, such as in the mode of an interactive web portal, would benefit this cause.

Consolidating and Enhancing Reputation

The relatively youthful Queensland Higher Education sector is still building international reputation, a factor that affects efforts in attracting external talent, partnership and funding. Performance on international rankings such as Academic Ranking of World Universities, Times Higher Education World University Rankings and QS World University Rankings positively impacts the ability of institutions to recruit students and academic, professional and research talent. Most ranking systems are calculated using a combination of citation and publication data and reputation. A state-wide drive to increase Queensland's ability to recruit talent, increasing citation performance, leading to improved rankings and strengthening the virtuous circle.

Several practical measures can be implemented to this end in partnership between the state government and the universities. Attraction of both national and international academic and scientific conferences to Queensland not only promotes visibility and enhances our reputation, it also enables Queensland's up and coming scholars to demonstrate their wares before a high-powered audience of influencers and decision-makers in their fields – an audience they would have a hard time getting in front of any other way. Similarly, the Government's longstanding commitment to attending the annual BIO events, both the medically-oriented Convention and the agriculture/commodities-oriented Congress is paying off in spades in both domains: consideration should be given to whether it would be worth establishing a Team Queensland campaign at other carefully selected international industry-research conferences. We only advocate this approach for domains where a unified and justified Queensland ambition for domain superiority can be established, but we should be alert to the possibility of replicating the success of the BIO presence.

HDR Student Strategy

QUT suggests implementing a strategy on improving industry-funded HDR scholarships, projects and internships. Currently, there is no direct data or discussion on the relationship to HDR students in the metrics they cite on research revenue and industry engagement. Targeted strategy could lead to broader external revenue streams for larger research programs. This is a key area of growth in that industry, allowing partners to start with small investment and grow their funding and collaboration with Queensland universities.

2. Does the relatively low level of excellence in HASS disciplines signify a problem? Could boosting performance in HASS disciplines provide strong benefits for Queensland—and what would those benefits be? For example, would increasing the quality of Queensland's HASS research help to attract a greater share of international students in HASS fields of education?

Investment in HASS disciplines, including Business, Law, Education and the Creative Industries, can provide strong benefits for Queensland tourism, employment, corporate performance and the strength of our public sector, as well as the cultural vibrancy of urban, rural and remote communities. But success in these disciplines is also critical to addressing large-scale, transdisciplinary research problems that emerge from other domains of activity such as agriculture, health, manufacturing, resource extraction and defence.

Care needs to be taken when assessing the performance of HASS discipline: the perception of a 'low level of excellence' is due, in part, to the choice of Elsevier SciVal as the data source for research output analysis. SciVal covers the STEMM disciplines in a much greater details than it

covers the HASS disciplines, and research outputs that do not conform to the STEMM based journal tradition are not covered well by SciVal.

A look at other data sources reveals that in fact HASS disciplines in Queensland's universities are performing better than those other metrics would indicate. For instance, Communication and Media research at QUT is ranked #1 in the country and #16 in the world, while Art & Design is ranked #5 nationally and #45 in the world. Indeed, within the QS World University Rankings by Subject 2019, four of the highest ranked subjects at QUT are HASS disciplines. The improved ranking of these disciplines has without a doubt had a positive impact on attracting international students to QUT, and hence to Queensland, and we are confident that all the other Queensland universities have similar stories to tell of their HASS achievements. A long-term strategy at QUT to continue this positive development is expected to further boost international recruitment in these fields, so important to the jobs that will be done by humans in the automated future workplace.

It is also the case that, outside the Creative Industries and their cognate disciplines, HASS research has been traditionally more prioritised by comprehensive universities, of which Queensland only boasts one (compared with several in each of NSW and Victoria). In addition, the industries relying directly on HASS research, such as the Creative Industries, have been stronger and more influential in Victoria and NSW. Any assessment of the relative strengths of Queensland HASS needs to be considered in light of those gradients.

With those caveats in mind, it is worth noting that national HASS performance is held back by its small and dwindling support from the major funding agencies. There are numerous contributing factors, from the misalignment of HASS outcomes to the mainstream indicators of success mentioned above, to direct political interference, to perverse elements of the funding system that equate grant size with quality (disadvantaging disciplines that cost less to run), but the net effect is that HASS research takes an ever-shrinking piece of the pie. Lack of integration in big data or basic science projects also limits growth potential. Given the impact of HASS on consumers and citizens, crossing boundaries between the sciences and the humanities would support translation and dissemination and awareness. Increasing funding for HASS itself and to support the additional transaction costs of transdisciplinary collaboration more generally would have a direct impact on the ability to build critical research mass and help address the confounding human factors in complex research problems.

3. What are the main reasons that Queensland and other jurisdictions don't appear to be closing the gap to Victoria in Medical and Health Sciences? What strategies could Queensland employ to improve its scientific impact in this important field?

(Please note there is considerable overlap between this question and Question 8 below – please cross-reference our responses.)

The Victorian Government has a long and impressive history of supporting the world-class medical research undertaken by Victorian universities and medical research institutes. This systemic push drives research intensity in health and medical disciplines and enables greater collaboration in key disease areas across their medical research sector. The below statements, taken from the Association of Australian Medical Research Institutes press release From Lab to Market – Victoria's Medical Research Institutes Welcome State Budget (28/05/2019) illustrate this point:

- Victorian Government has reaffirmed its commitment to Victoria's medical research sector, with a $116.5 million funding injection as part of 2019-20 State Budget.
- Victoria's medical research institutes directly employ over 5,300 staff and students, bring more than $600 million in annual revenue to the state and create over $1 billion in annual economic impact.

- The Victorian Chapter of the Association of Australian Medical Research Institutes (VicAAMRI) welcomes the Government's investment into six of its fourteen member institutes – the Walter and Eliza Hall Institute for Medical Research, the Peter MacCallum Cancer Centre, St Vincent's Institute of Medical Research, the Bionics Institute, the Centre for Eye Research Australia and the Murdoch Children's Research Institute.

Queensland has made a tremendous start by investing in medical research institutes such as the QUT Institute of Health and Biomedical Innovation, UQ Institute for Molecular Bioscience and Queensland Brain Institute, and Translational Research Institute. However, continuous and ongoing support is required to maintain and grow profile in this highly competitive area. A long-term Queensland science strategy focusing on scale, scope, critical mass and research infrastructure could help to close the gap with Victoria in Medical and Health Sciences. This strategy should:

- Incentivise researcher collaboration across Queensland;
- Target specific areas to pursue aggressively where we know we have strength, such as biomanufacturing, medical devices and genomics;
- Focus on intimately engaged collaborative research effort with industry and clinicians, including industry investment attraction;
- Encourage robust organisational collaboration, which accounts for much of funding flow to Victoria: Queensland should forge research partnerships at state-level between its Institutes, Universities and Hospitals;
- Attract substantial secondary funding: Queensland lacks philanthropic and not-for-profit backing of NSW and Victoria, and should solicit the critical seed funding to establish projects to be competitive in NHMRC;
- Lobby federally for improved Medical Research Future Fund support, both through local LNP federal MPS and Senators and in concert with other state Health Ministers from the other states, in light of the vastly disproportionate MRFF investment in Victoria;
- Establish a collaborative NHMRC development scheme, where resources, insights and experience are shared;
- Fund near-miss NHMRC applications;
- Enable collaborative research ecosystems in priority fields, similar to the way Neurosciences Victoria was established with the intent of creating a world-leading collaborative ecosystem in neuroscience, producing significant dividends in the award of NHMRC Centres for Research Excellence, ARC Centres of Excellence, and Cooperative Research Centres (http://neurosciencesvic.com.au).

4. Queensland's research capability is of a high standard and is comparable with other Australian jurisdictions. However, it is possible to identify some areas which have room for improvement. What are the opportunities for research capability improvement that will have the greatest benefit in terms of funding attracted to Queensland?

A number of opportunities for research capability improvement are available to the state that will deliver significant benefit in terms of funding attracted to Queensland.

Team Queensland

The Department could initiate a series of regular roundtable workshops of interested and engaged researchers, research administrators, ADRs and policy advisers who are keen on working together

to boost collective performance, sharing best practice and seeking out opportunities for collaboration between Queensland's universities.

Research Missions

As recommended in the Department of Industry, Innovation and Science *Australia 2030: Prosperity through Innovation* report, a strong innovation ecosystem can be built by launching ambitious research missions. Two of the potential missions identified in the Australia 2030 report (Preserving the Great Barrier Reef beyond 2030 and Hydrogen City) are of direct relevance to Queensland and relate to areas where Queensland has world leading capabilities.

Funding for Queensland's research missions could follow the successful model utilised for the MRFF, which has significantly increased the scale and quality of research in the Medical and Health area. For example, Queensland could champion and co-invest with the Commonwealth in a Great Barrier Reef Future Fund (GBRFF) that would complement the Reef Restoration and Adaptation Program, especially beyond the currently committed 10-year funding window.

HASS

Queensland government's recent attention for the tourism industries, the screen industries and other creative industries as drivers of economic growth in Queensland is to be commended. World-class HASS research at Queensland's universities is supporting and pioneering these high-growth industries, receiving more traction and support from partners interstate than locally. More support for HASS research at the state level could further strengthen this performance in related industries, leading to a stronger, more diverse and more resilient Queensland economy.

Regional Sector Funding

The impact of environmental factors (such as climate change and variability, extreme weather and lack of water resources) on regional development is already enormous, and will only grow in significance. The Queensland Government could drive an increase in agricultural and environmental research capability through increased regional sector funding, support for joint projects with rural research and development corporations and regional industries, incentives for increased collaboration between universities, and a more inclusive approach to facilitating institutional collaboration.

There is also room for improvement and growth in various other areas of research linked to Queensland's distinctive geographical features such as reef research, agricultural research, and solar and hydrogen research.

Attraction, Development and Retention of Talent

Attraction and retention of talented research staff matched with world-class infrastructure is the primary conduit to bringing in more external research funding to Queensland. Research capability could be improved throughout the researcher lifecycle through increased interactions between Queensland researchers and academics, and research and clinical institutions both internally and externally. In particular, Queensland should position itself not just as a springboard for research careers elsewhere, but as a home for world-class research that feeds back in to the local research ecosystem.

It is not often acknowledged that HDR students contribute up to 30% of university publications. Queensland could seize a latent national advantage by developing a strategy to:

- recruit more HDR scholarships in key research capability areas as a means to drive improved research metrics and further research collaborations, particularly for international students who go on to be alumni collaborators; and
- use this "incubation" time to invest in the research capabilities of our future research leaders.

5. There appears to be a strong, two-way causal relationship between outcomes in the university teaching market and outcomes for university research. How can a Queensland science strategy best help to build the 'virtuous cycle' between teaching and research in both the domestic and international markets?

Supporting Learning and Teaching

The discussion paper argues that "jurisdiction strategies to boost university research need to pay at least as much attention to the competitiveness of university teaching as to the competitiveness of university research." Given the growing importance of the domestic and international university education market, as Australia's third-largest export (at AU$32.2 billion and with an increase of 22% in 2018), the Queensland State Government could consider making an investment in higher education research, with a view to exploring the specific conditions of higher education markets pertinent to Queensland that the few higher education research outfits elsewhere in Australia will not examine. The market for international students is very competitive, with Queensland vying for market share with high ranking universities from Southern Australia, the US, Europe, Asia and online providers. To increase competitiveness, research into the international student experience is needed. Higher education is also crucial to the social mobility of domestic students. It improves graduates' income (on average by 20% for men and 15% for women), which results in economic benefits through higher tax contributions. Graduates enhance the cultural and economic connectivity of their host community and nation and contribute to society and industry through creativity, criticality, inventiveness, problem-solving, entrepreneurship, and leadership.

Given its financial and societal impact, higher education research is significantly underfunded at present. Since the demise of the OLT, it receives little government support, as it is rarely funded by ARC and not included in NHMRC categories. In addition to focusing on our unique issues, investment by the state government could therefore position Queensland well ahead of its competitors as the preeminent place to invest in higher education, be it as a student, industry partner or philanthropist. To achieve this, Queensland could invest in research that affords a deeper understanding of learners and learning in the 21st century and provides the catalyst for new and innovative approaches to higher education. This would help us more fully understand the implications of rapidly evolving technologies for learners and learning. Through research we can gain deeper insights into how to best equip graduates for a dynamically changing world of work and gain a greater understanding of international mobility, including the benefits to domestic students of international study experiences and the experiences, as well as the challenges and benefits of studying in Australia for international students. To gain market share of international student enrolments, ensure retention and student success, and optimise graduate employability, we need to innovate at the cutting edge of learning and teaching in higher education and develop a rigorous, research-driven approach and a robust evidence base for the strategies we adopt. We should also conduct robust longitudinal studies to verify the effects on employability and social mobility. To gain our best advantage in the higher education market, we need to invest in a strategic agenda for higher education research.

Investment in higher education research is currently gaining recognition as an important priority area. At present the southern states host all the current research centres: the University of Melbourne's Centre for the Study of Higher Education (CSHE) and LH Martin Institute; Deakin University's Centre for Research in Assessment and Digital Learning (CRADLE); and the federally-funded National Centre for Student Equity in Higher Education (NCSEHE) based at Curtin University.

Higher education research includes research on learning and teaching, technology, pedagogy, policy, management and governance, leadership and culture in higher education. Higher education research related to learning and teaching specifically includes learning and teaching practice,

course and curriculum design, learning environments and technologies, student success and support, the nature of knowledge and knowing, quality systems and management, professional and academic development, and management and leadership. This can be usefully extended to include student experience (including online and international experiences), graduate employability, social mobility and contribution to society. There is vast potential to improve Queensland's performance in student outcomes with the fruits of enhanced research into these areas, with a flow-through effect into all other areas of science and research.

In principle, higher education research also includes research on research: that is, research into topics in the conduct, funding, dissemination, transfer and assessment of research. Most significantly, perhaps, it also includes research into research policy itself. Apart from some work on the research training aspects of doctoral candidature, however, surprisingly little research on research is conducted systematically in the centres listed above, or even their foreign counterparts, although there is a fair quantum of activity taking place around the country in more or less isolated pockets. At QUT we have recognised the number of people working here with significant expertise in various aspects of research, from policy to operational aspects, and we are working on drawing together this effort into a coherent program of work. There is an opportunity for Queensland – led by QUT in concert with our fellow Queensland universities – to fill a national (and global) void by establishing a leading academic research centre focused on improving every element of the research enterprise, end to end, including: improving efficiency, maximising benefit, improving transparency and reproducibility, removing perverse incentives and reducing waste, improving architecture for the pipeline from fundamental to applied research, ensuring viability, reducing red-tape while improving compliance, and optimising policy design. Nobody does this work systematically in Australia, and barely anyone does it globally: Queensland is well positioned to undertake this work, and the Government could play a productive role in facilitating this effort, to mutual benefit. The outcomes of this work have the potential to enhance the effectiveness of work across all other areas of science and research in Queensland, further boosting performance as discussed at Question 4 above.

Support the Teaching-Research Link

Queensland science strategy should support the link between teaching and research, providing increased pathways for research integration, including targeted efforts to help industry embrace opportunities for engagement with universities in both teaching and research modes. There is undoubtedly a two-way causal relationship between outcomes in universities' efforts around teaching markets and outcomes for research.

While there is little evidence that university research standing directly influences prospective students' decision making (research standing is far exceeded by student experience, teaching quality, and employability), students do benefit when universities place high value on the infusion of research into teaching. Consequently, a Tertiary Education Quality and Standards Agency (TEQSA) guidance note on the Australian University Category Standards emphasises the expectation that higher education providers demonstrate sustained scholarship, with academic staff who are active in research and scholarship that informs their teaching.

The reciprocal is often also true: it is no accident that the most productive researchers are often also the most dynamic and engaged teachers. The seemingly naïve questions of students fresh to a subject challenge assumptions and received wisdom, and in their interrogation of fundamentals can often encourage genuine innovation and new thinking.

Supporting Undergraduate Engagement

The Queensland science strategy should support undergraduate engagement by:

- Showcasing career pathways across the lifespan;
- Enabling involvement in research projects;

- Increasing the number of state scholarships or cadetships for students; and
- Increasing funding for HDR scholarships and top-up scholarships.

Partnership
Queensland science strategy should encourage partnerships through the use of targeted linkage schemes and the provision of collaborative funding schemes.

Developing International Markets and Increasing Reputation

There is an identified strong relationship between undergraduate enrolments (domestic and international) and the size of the research workforce at the state level (Figures 4.1 and 4.2 of the discussion paper, pp. 14 & 15, respectively), although such a link is more complex and weaker at the institution level. For example, the scale of the research workforce and overall research productivity of Go8 universities is much higher than other universities on a per-student basis; the ratio will also vary considerably on a discipline basis.

Though cross-subsidisation of research staff numbers has been part of the Australian higher education landscape, it is not a guarantor of research excellence as measured by national or international benchmarks. An institution's record of accomplishment for research, productivity of existing researchers, years since establishment and prestige (reflected in world rankings) are arguably much more significant variables when discussing research outcomes and excellence.

The Commonwealth's cap on domestic funding for undergraduate places limits opportunities for growth in domestic undergraduate enrolments. Therefore, under the current policy setting, growth of teaching income would have to focus on the development of international markets. The quality and return from Queensland's international student cohort could reduce if there is pressure to grow the teaching part of the "virtuous circle" at a faster rate than research. Research growth is needed to attract a growing pool of quality international fee-paying applicants willing to pay a suitable premium to live and study away from their home country. There has already been significant growth in international student enrolments in Australia over the past decade. Fee-paying overseas student enrolments as a proportion of total enrolments have increased significantly, with the Go8 share growing most rapidly during this period. However, such growth has generated concern about the sustainability of this market and potential risk of over-exposure. Growing evidence of fee discounts, media attention on poor quality of students in some universities, and an inability to generate significant yield (revenue per equivalent full-time student load) by lower ranked institutions may signal saturation and challenges for continuing growth. To avoid antagonising these initial symptoms of stress in the system, the Queensland Government should join the university sector in advocacy to the Commonwealth for the removal of the hard cap on enrolment, with a resumption for each institution at the rate of natural growth projected from the moment of the freeze (December 2017), thereafter indexing the CSP volume to the growth in the undergraduate target demographic of 17-24 year-olds (with the CSP value to be indexed to CPI over the entire period).

To add value, a state-level strategy should also focus upon amplifying the success that can be achieved when institutions act together to benefit from regional advantages and coordination. Research amplification strategies such as raising the overall profile of the region through coordinated activity and promotion, and increased citations through focus on international co-authorships might become the key features of such a strategy.

Given the ongoing improvements in research quality (shown in Figures 3.2 and 3.3 of the discussion paper, pp. 6 & 7, respectively) a Queensland science strategy should enhance the scale and breadth or research undertaken in Queensland. Therefore, additional investment is required to grow both the:

- Scale of research, by investing in areas of existing research strengths, such as robotics (as recently announced for the Advanced Robotics Manufacturing Centre), data science, or materials science; and
- Breadth of research, by investing in the development of new and emerging areas of research priority, such as space industries (as outlined in the Australian Civil Space Strategy 2019-2028).

A Queensland science strategy should support growth in targeted, but diverse, international markets. Such a strategy would also have a positive impact on recruitment of both students and talent and would lead to improved ranking and strengthen the virtuous circle (see response to Question 1).

6. What strategies could be adopted state-wide to increase the numbers of high quality applications to the ARC Discovery Projects program (and other Commonwealth programs)? Are there some best practices that could be shared?

The Discovery scheme is extremely competitive (less than 20% of applications are successful) and, given the proportion of applications that are funded after multiple attempts, there are a significant number of competitive proposals go unfunded. There are several initiatives that could increase the numbers of high-quality applications to the ARC Discovery Program.

Increase the Quantum

The ARC competitive funding pool has been eroded over the years through the diversion of resources or direct allocation to specific purposes (sometimes with designated recipients) to the extent that it is at risk of undermining the integrity, effectivensss and reputation of our national research enterprise. While some call for the establishment of a sister program to the MRFF for non-medical research, there is considerable risk that some of the infelicities of the operation of the MRFF would be replicated or even amplified in such a program. Instead, QUT seeks Queensland Government support in lobbying the Commonwealth to substantially increase the ARC's budget for peer reviewed competitive grant allocation within its existing programs, akin to the Howard Government's doubling of the ARC's budget that profoundly boosted Australia's research performance.

Utilise Existing Initiatives

All universities have existing peer review and support programs aimed at increasing the competitiveness of Discovery Project applications. Future initiatives should, where possible, aim to augment these. Queensland can also draw upon its strengths by utilising its interior expertise:

- Implementing a collaborative, cross-institution high-quality internal peer review process;
- Encouraging more Queensland researchers to nominate to the ARC's College of Experts; and
- Utilising our Centre of Excellence members more strategically.

Research Partnerships

Many Discovery Projects now involve multiple universities, including high-profile international institutions. The Queensland science strategy should explore help create opportunities and provide incentives for cross-university and international collaborative Discovery Project applications in areas of collective strength.

There are examples of successful schemes (particularly from Europe) that exist specifically to enable researchers to connect across universities and nations to build networks of excellence within priority areas. A similar scheme in this state could encourage Queensland's university

researchers to connect across the country or the Asia-Pacific, supporting the long-term growth of research capability that could lead to excellent Discovery Project performance.

Talent Development

Strategic talent development is crucial to driving future success. Given the virtuous cycle between teaching and research (shown in Figures 4.1 and 4.2, pp. 14 & 15, respectively), Queensland science strategy should not be only aimed at developing industry led research projects, but on developing capabilities in fundamental discovery-led research projects too. This investment should complement the ARC Discovery program and be targeted at early and mid-career researchers. In the form of fractional (for example, 0.6-0.8 FTE) projects or fellowships, this scheme would develop not only fundamental science capabilities, but also enhance teaching and research careers in Queensland.

Putting the outcomes of such a scheme into the context of the discussion paper's Figure 5.8 (p. 26), this would increase the number of researchers in the sector and application rates, and enhance researcher capabilities.

7. Queensland is relatively successful in winning Linkage Project grants, and there is a strong, broad-based participation across most Queensland universities. What are the key reasons for this success and are there any lessons that could be translated to other Commonwealth programs where Queensland's performance is not as strong?

Queensland's success in winning Linkage Project grants is the result of a sector- and state-wide focus on industry-engaged applied research. This is a priority for many of Queensland's universities, a result of their relative youth and need to differentiate by focusing on research directly linked to benefits for the industry and community partners. Queensland universities' strong relationships with commercial, government and not-for-profit partners are key to success in winning Linkage Project grants. However, this success must be assessed in tandem with weaker performance in ARC Discovery Project grants. Whether explained by early specialisation or failure and adaptation, Queensland universities have adapted to be successful in one scheme at the expense the other. While Go8 universities are able to leverage their endowments to resist the logic of this trade off (not least their many decades of public support amounting to many billions of dollars apiece), it ought not to be not impossible to transcend it beyond the Go8 as well.

Queensland's apparent success in Linkage projects is driven primarily by UQ and QUT (and their combined approximately 2000 research leaders) and above average application rates (as indicated by the regression line in Figure 5.11 of the discussion paper, on p. 29). In comparing Figures 5.8 (p. 25) and 5.11 it is interesting to note that in Queensland only UQ is above average for both Linkage and Discovery applications. QUT rates above average for Linkage, but below average for Discovery projects. The primary reasons for this are related to:

- Relative size, which enhances both the breadth and scale of research expertise – as UQ is 50% larger than QUT it is more likely to be a "one-stop shop" for industry partners; and
- QUT's historical context as an applied university and its "real world" focus.

These trends are not unique to Queensland. RMIT has a similar size and history to QUT and demonstrates similar application trends in Discovery and Linkage. However, UNSW has grown beyond its "red brick" history and, like UQ, is above average in both Discovery and Linkage projects. This suggest that there are unlikely to be universal predictors of success. Rather, it should be left to specific universities to develop their reputation for fundamental research expertise in addition to their acknowledged expertise in applied research.

Table 5.1 in the discussion paper (p. 30) highlights Linkage Project research leaders (investigators with ten or more projects) with a history of success in industry engagement and pure research. Further research should be conducted on these investigators to determine their success in the

Discovery Projects program and what skills and capabilities developed can lead to success across both programs. (A research centre on research policy and practice, as discussed at Question 5 above, would be ideally situated to conduct such an analysis.)

Applied outcomes should be demonstrated on a national level. Universities have a role to play in demonstrating the benefits they provide to government and industry, whether that is driving competitive advantage or solving large-scale, complex, societal challenges. The enhancement of the already strong collaboration between universities, business and industry through seed funding and the formation of strong transdisciplinary research teams would establish a fundamental platform to improve success in Linkage Projects. Further, a pilot funding scheme enabling universities and research partners to undertake pre-application research would help better demonstrate research application and benefit.

8. It appears that Queensland is facing increasing challenges in winning NHMRC Project funding, with success rates below the national average and high numbers of unsuccessful applications. On the other hand, Victoria seems to be increasing its level of competitiveness. Are there any lessons from Victoria's success that could be adopted in Queensland? More generally, how can Queensland achieve a state-wide improvement in the quality of its NHMRC applications?

(Please note there is considerable overlap between this question and Question 3 above – please cross-reference our responses.)

The MRFF appears to be investing significantly in Victoria over time. There is a significant amount of inertia in the grants system, and grant success typically leads to more grant success. Between 2000 and 2016, Victoria received 40-43% of the national NHMRC funding. During the 2000-2016 period, Queensland gradually increased its share from 12-15%, but still remains at approximately 1/3 the level of Victoria.

The university-only shares of funding have been largely stable since 2000, as have the MRI-only shares of funding. The latter is where the large gap is seen, with Victoria taking approximately 60% of this share, and Queensland and NSW approximately 15%. Victoria and New South Wales have a strong focus on medical research in their institutes, which are often strongly connected with hospitals. This focus is explained significantly by the sheer number of medical research institutes in Victoria (16) and NSW (18), dwarfing Queensland (6), South Australia (4) and Western Australia (3), leading to more applications overall, and relatedly more successful applications.

There is greater health and medical research intensity in Victoria. A product of significant investment from universities, medical research institutes and the Victorian government, this drives a greater critical mass and enables greater collaboration in key disease areas across in Victoria. The higher critical mass and cycles of success contribute to the differences between Victoria and Queensland. The Advance Queensland initiative (and previous SMART State funding) was very supportive of capacity building and building infrastructure, but otherwise Queensland has not seen the major direct medical research funding for scientific infrastructure – essential to quality NHMRC project applications and impactful health and medical research outcomes – seen in the southern states.

An empowering Queensland science strategy will call on the Federal Government for changes to the NHMRC process, and a more equitable and rational distribution of MRFF investment. More Queensland researchers should be represented on the NHMRC grant review panels. There should be more transparency in how MRFF funding is allocated, and its processes should be driven to a much greater extent through peer-review.

This question will need revisiting later in the year when the outcomes from the restructured NHMRC schemes are announced. The restructuring was performed with the intent of addressing some of the issues with the distribution of funding. More broadly, the EU has an arrangement with the

NHMRC and shortly with the ARC to provide Australian researchers opportunities to join teams in Europe for up to 12 months (https://eeas.europa.eu/delegations/australia_en). Mobility is key here, so the state government could consider partnering with the ARC and NHMRC to provide more funding to Queensland researchers via their schemes.

Another area of focus to remedy this imbalance could be the deliberate attraction of people with strong track records in NHMRC funding to Queensland, in collaboration with the universities acting collegially and with funding support from the state government.

9. It appears that Queensland attracts relatively low levels of grant income from domestic not-for-profit groups and overseas entities. How might Queensland's performance be improved in these areas? Are there issues in common with Queensland's performance in ARC and NHMRC programs?

The critical mass of both medical research and population in Queensland versus other states, particularly Victoria, explains the relatively low level of grant income from domestic not-for-profit groups and overseas entities (which are often targeted to health issues). It is likely that Victoria may also benefit from increased organisational collaboration. By contrast, Queensland does not have the large philanthropic organisations important to launching research projects, and the current Advance Queensland approach is appropriately focused on benefits to Queensland industry, which reduce the incentive for international collaborations of this kind.

A Queensland science strategy providing greater incentives for international collaborations could help Queensland universities to attract more funding from overseas not-for-profit organisations. Queensland can increase visibility in the relevant not-for-profit and overseas spaces:

- Queensland houses large numbers of small not-for-profits – QUT suggests that incentives be developed to encourage not-for-profits partner in university research;
- Philanthropic support through trusts and foundations is a space where we could collaborate across key areas and strengths – these types of organisations require a more personalised approach than typical grants schemes, and while this is a heavily contested space, successful examples of the Team Queensland approach to schemes include partnership with the Bill and Melinda Gates Foundation;
- Researcher exchange schemes that enable researchers to engage more meaningfully with overseas partners and from there leverage into funding opportunities, which would be particularly useful for early- and mid-career academics; and
- Promoting a more collegiate and robust collaboration between its institutes, universities and hospitals to forge research partnerships at the state level.

10. It appears that Queensland's performance in the Cooperative Research Centres program is not as strong as in earlier years. What are the main factors driving this and what can be done to improve Queensland's CRC program outcomes in the future?

Happily, there is some evidence that the premise of this question no longer obtains, with strong evidence that Queensland universities have already acted to turn around this trend. QUT alone is involved in 4 of the 5 recently announced CRCs. It take a while for successful changes of approach and method to wash through to outcomes, with a 2-3 year time lag inherent in category 4 funding, to prepare a CRC bid, go through the selection process, await Ministerial approval and announcement, open for business, then distribute the category 4 funding to the partner universities.

Notwithstanding this, it is germane to consider these issues closely in order to sustain this recent level of success. CRC buy-in requires a large initial university investment and CRC success therefore depends heavily on investment by industry partners and state and local governments. There is currently no Queensland government funding to support the substantial costs of

developing CRC bids. Direct costs of a successful bid can total in excess of $500,000 plus a large amount of in-kind support. The costs are associated with funding dedicated people to drive and coordinate the bid, engage consultants, and run workshops nationally to develop the research programs.

Given external partners' reluctance to commit to a long-term engagement through a centre, Queensland's universities are finding it increasingly difficult to secure funding for CRC bid development. Other state governments are investing cash at that early stage in order to attract new CRCs based in their states. For example, the SA Government provides funding under their Research, Commercialisation and Start-up fund (https://innovationandskills.sa.gov.au/upload/rcsf/RCSF-Guidelines.pdf). The Queensland government has not supported a similar scheme in recent times.

Queensland can improve its CRC outcomes by increasing support in CRC bid development, pushing investment in the CRC program and aligning its investment policies more closely with national policies.

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