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RESPONSE TO THE DISCUSSION PAPER: BOOSTING COMMERCIAL RETURNS FROM RESEARCH

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Foreword

QUT welcomes the opportunity to comment on ways to increase the economic impact of publicly funded research.

Australia's Chief Scientist, Professor Ian Chubb, recently warned that Australia is falling behind other comparable nations in the translation of research efforts into economic or social benefits.[1] One of the contributing factors that has been identified is the low rate of collaboration between industry and the research sector.[2]

In this paper we recommend measures to increase collaboration and transfer rates through direct incentives for research collaboration, and by creating a research environment that fosters knowledge transfer, collaborative research infrastructure, use of best practice models in dealing with university generated intellectual property, and industry relevant training of higher degree research students.

[1] Office of the Chief Scientist. 2014. *Science, Technology, Engineering and Mathematics: Australia's Future.* Australian Government, Canberra. http://www.chiefscientist.gov.au/wp-content/uploads/STEM_AustraliasFuture_Sept2014_Web.pdf.
[2] Data on collaboration available at OECD, 2013. "Research and Development Statistics Database". www.oecd.org/sti/rds; OECD, based on Eurostat (CIS-2010) and national data sources, June 2013. http://dx.doi.org/10.1787/888932891359.

QUT response to the discussion paper "Boosting the commercial returns from research"

1. Executive Summary

QUT argues that we need to strengthen the direct incentives for both industry and universities to collaborate. We recommend a rebalancing of the metrics used to distribute the Research Block Grant (RBG) and use of the Research and Development (R&D) Tax Incentive scheme as measures that have the greatest potential to create or increase the desire for collaboration between industry and universities.

Beyond incentivising individual collaborations, the Government should also continue to foster a research environment that is conducive to long-term collaboration. The continuation of the National Collaborative Research Infrastructure Strategy (NCRIS) programme is one crucial element of this environment, as is policy and programme certainty for other funding programmes directed at sustained industry-research collaboration.

As to the question of access to intellectual property (IP) developed by universities, it should be acknowledged that a number of universities already use flexible models, which facilitate uptake by industry or transfer of knowledge to end-users. Similarly, universities have developed several well functional models of industry relevant research training schemes. These approaches should be investigated for their application throughout the sector, and if found appropriate, used as the basis for developing best practice models.

These measures if introduced, will ultimately lead to higher rates of collaboration, co-creation of knowledge, and translation of research outcomes into economic impacts.

2. Industry-research collaboration

a) Framework for collaboration

Australia has an existing framework for industry-research collaboration that offers industry and other research end-users options that range from long-term collaborative schemes, which can address sector-wide issues and improve the competitiveness of an industry, to shorter-term programmes that allow an industry player or a small group of businesses to engage with universities to address more focussed challenges. The Commonwealth Scientific and Industrial Research Organisation National Research Flagships (CSIRO Flagships) and the Cooperative Research Centres (CRC) Programme are examples of long-term funding programmes. Collaborative grant schemes such as the Australian Research Council (ARC) Linkage Programme, the National Health and Medical Research Council (NHMRC) Partnership Projects and the Rural Research and Development Corporations (RDCs) provide access to research collaborations of mid-term length (2-5 years). Programmes such as Research Connections[3] allow individual businesses to engage with researchers

[3] The Research Connections programme is part of the Department of Industry's, Entrepreneurs' Infrastructure Programme; Department of Industry. 2014. "Research Connections". Accessed November 26, 2014. http://www.business.gov.au/advice-and-support/EIP/Research-Connections/Pages/default.aspx.

to provide short-term assistance (up to 12 months) to improve the business's outputs or products. In addition to these formal Government co-funded schemes, universities have developed their own strategies to facilitate engagement between researchers and industry. Industry funded or co-funded professorial chair positions are a model used to embed researchers within industry and to build an ecosystem of research personnel that are working with industry, on industry defined challenges[4]. Most universities also have internal structures and systems that facilitate direct engagement with industry to undertake research and consultancy activities.[5]

We would caution against a consolidation of the existing collaborative programmes. Each of the schemes has a particular purpose as they address collaborations of different scale, respond to a variety of needs and expectations and overall complement each other.

We believe that the answer to the question of how to increase research collaboration does not lie in a restructure of the existing collaboration framework but in creating more incentives for collaboration.

b) Demand for collaboration - interest in collaboration

Data shows that even businesses classed as 'innovative', access universities for only a fraction of their collaborative innovation endeavours,[6] whilst the majority of collaborations are conducted in business to business dealings (e.g. their most common collaboration partners are suppliers of equipment, materials, components or software). Only 13% of SMEs collaborate with publicly funded Australian research organisations[7]. Anecdotal evidence suggests that SMEs often don't have the time or resources to engage with universities, or may need better information and third party support to access university research. Larger companies predominantly tend to conduct research on an in-house basis, and do not take full advantage of longer term developments coming out of universities.

In the university sector there seem to be substantial disincentives to collaborate with industry outside of the Category 1 collaborative programmes, such as the ARC Linkage or NHMRC Partnership schemes.

The Excellence in Research Australia (ERA) initiative, which plays a role in determining a portion of the Research Block Grant (RBG) funding allocation (and is now often used as an unofficial university ranking scheme in Australia), encourages a narrow focus on academic publishing in peer reviewed journals. This potentially detracts from the role of universities in supporting economic transformation and social progress. The ERA initiative evaluates the quality of university research outputs, either through citation counts or in some disciplines through a process of peer review. The measure of quality employed in this exercise is essentially the extent to which the research is valued by academic communities. Currently, research impact (beyond academic communities) is not

[4] For example QUT established professorial chair positions in Airport Innovation, in Spatial Information and in Retail Innovation. The University of Queensland and University of New South Wales are other examples of institutions that use the concept of industry or co-funded professorial chairs.

[5] Data on both the number and value of transactions is available on pages 27-31 of *The National Survey of Research Commercialisation 2010-2011* report; Department of Industry Innovation, Science, Research and Tertiary Education. 2012. *The National Survey of Research Commercialisation 2010-2011*. http://www.industry.gov.au/innovation/reportsandstudies/Documents/2010-11NSRCReport.pdf.

[6] Australian Bureau of Statistics. 2012. "Innovation in Australian Business, 2010-11" (8158.0). Accessed November 26, 2014. http://www.abs.gov.au/AUSSTATS/abs@.nsf/Latestproducts/B2B276CE6215B77ECA257A6200136B57?opendocument.

[7] Innovative Research Universities. 2013. *Engage Collaborate Innovate*, p 5. Accessed November 26, 2014. http://www.iru.edu.au/media/41927/engage%20collaborate%20innovate%20-%20web%20version.pdf.

incorporated into the evaluation framework, and the same applies to other key university ranking schemes.

A further disincentive for collaboration is the importance placed on Category 1 funding for the distribution of RBG funding. Whilst this encapsulates ARC Linkage, NHMRC Partnership and RDC funding, it excludes all other collaboration with industry. Research evaluation exercises based solely on this academic perception of quality, have been shown to create a strong disincentive for academics to collaborate across disciplinary boundaries or with end-users. This is due to the view within academic communities that interdisciplinary research and end-user applied research is less valuable.[8] Anecdotal evidence from academics suggests that the current focus on ERA and Category 1 funding, can lead to supervisors discouraging academic staff from participating in projects outside of Category 1 funded research, and that the income obtained from non-Category 1 sources such as contract research or CRCs, does not attract the same rewards in university promotion processes as Category 1 funding. The current rules relating to the ERA initiative and Category 1 funding drive academics to an exclusive focus on academic outputs that meet these narrow measures of quality and don't fully capture the quality of applied research or the impact of engagement between universities and end-users, which both are a necessary requirement for an improved Australian innovation system.

c) Incentives for collaboration

i. Directed at universities

It is our view that collaboration with industry would be significantly encouraged if the metrics used to distribute the RBG and the ERA initiative were restructured and simplified in a way that better balances the requirements for quality research (which can be both fundamental research or applied research) with genuine industry or end-user engagement. Currently 56% of the RBG funding is allocated based on measures related to research student completion and research student load.[9] Around 24% of the RBG funds[10] are allocated on metrics related to "quality", including Category 1 funding and ERA.[11] Only 20% of the RBG funds[12] are allocated on the basis of metrics that (partly) relate to engagement. [13]

[8] Rafolsa, Ismal, Loet Leydesdorff, Alice O'Harea, Paul Nightingalea and Andy Stirling. 2012. "How journal rankings can suppress interdisciplinary research: A comparison between Innovation Studies and Business & Management." *Research Policy,* 41(7): 1262-1282. doi: 10.1016/j.respol.2012.03.015.

[9] In the 2014 RBG allocations, 56% (or $969,548,980) of the total pool of funding available ($1,721,873,284) was allocated to measures related to research student completion and research student load, such as the Research Training Scheme (RTS), Australian Postgraduate Awards (APA), and International Postgraduate Research Scholarships (IPRS) schemes; Department of Education. 2014. *2014 Research Block Grant Allocations*. http://docs.education.gov.au/system/files/doc/other/2014rbgallocations.pdf; Department of Education. 2014. "Research Block Grants – Calculation Methodology". Accessed November 26, 2014. https://www.education.gov.au/research-block-grants-calculation-methodology.

[10] In the 2014 RBG allocations, 24% (or $406,326,765) of the total pool of funding available ($1,721,873,284) was allocated to measures related to quality, such as the Research Infrastructure Block Grant (RIBG) and Sustainable Research Excellence (SRE) schemes; Department of Education. 2014. *2014 Research Block Grant Allocations*. http://docs.education.gov.au/system/files/doc/other/2014rbgallocations.pdf.

[11] The Research Infrastructure Block Grant (RIBG) and Sustainable Research Excellence (SRE) Base grant amounts, and the SRE Threshold 1 element, are all based on an institution's performance in attracting Category 1 income. Conversely, the SRE Threshold 2 element draws funding from two pools, one calculated using a transparent costing exercise (40%) and the other, an Excellence index (Ei) exercise (60%) that is based on an institution's ERA rankings; Department of Education. 2014. "Research Block Grants – Calculation Methodology". Accessed November 26, 2014. https://www.education.gov.au/research-block-grants-calculation-methodology.

We argue that the engagement metrics need to be reviewed and given greater weight. Focus needs to be placed on collaborative efforts in order to incentivise researchers to engage with industry, and industry engagement should play into the ERA process. This type of engagement is also a measure of research quality, quality that is measured by a "value" determined by third parties (i.e. industry, community, beneficiaries of the research, etc.), rather than by academic peers.

One model could be to combine the funding currently spread across the Sustainable Research Excellence (SRE), Research Infrastructure Block Grant (RIBG) and Joint Research Engagement (JRE) schemes, and divide the funding equally between an academic index and an engagement index. The academic index could be measured by Category 1 income and ERA outcomes. The engagement index could be measured by engagement income which includes contract research income (Categories 2, 3 and 4 income), consulting and licensing income, and income from customised education. Data on university consulting and licensing income is already available.[14] If additional metrics are required for the engagement index, then other commercialisation activities, papers published with industry or end-user co-authors or papers cited in granted patents should be considered.

In the context of the evaluation of research income across both the quality and the engagement indices, consideration could be given to weight Category 4 income and income from collaborative Category 1 schemes such as the industry funding component of the ARC Linkage Programme, higher.[15] CRC and ARC Linkage projects are more likely to require research staff to work together with industry personnel in the creation of research outcomes. These "engagement" programmes and projects also place a higher workload burden on academics as they require significant investment of time and relationship building in order to achieve a quality outcome.

With regards to ERA, a possibility would be to modify the ERA rules to limit the number of outputs that can be submitted for each researcher, to only four outputs over five years, which may free up academic time to focus on undertaking more industry or end-user related research. The UK equivalent of ERA (the Research Excellence Framework (REF)) incorporates such a limit. The absence of a limit in Australia potentially causes academics to be driven to produce as many academic outputs as possible, leaving them with very little time to engage with industry or end-user partners for industry focussed collaborative research.

In addition, a review of the research student training related RBG distribution metrics, when undertaken at a later point in time, may consider giving additional weight to industry relevant research training. Possible measures here could be to calculate a percentage of the RTS by the number of students who have undergone some form of industry relevant training,[16] have had industry sponsored or co-hosted scholarships[17] or an industry person on their supervisory team.

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[12] In the 2014 RBG allocations, 20% (or $345,997,539) of the total pool of funding available ($1,721,873,284) was allocated to measures related to engagement, such as the Joint Research Engagement (JRE) and JRE Engineering Cadetships schemes; Department of Education. 2014. *2014 Research Block Grant Allocations*. http://docs.education.gov.au/system/files/doc/other/2014rbgallocations.pdf.

[13] The Joint Research Engagement (JRE) scheme is calculated using a performance index which comprises 60% research income from Categories 2, 3 and 4, 30% HDR student load and 10% publications; Department of Education. 2014. "Research Block Grants – Calculation Methodology". Accessed November 26, 2014. https://www.education.gov.au/research-block-grants-calculation-methodology.

[14] Department of Industry Innovation, Science, Research and Tertiary Education. 2012. *The National Survey of Research Commercialisation 2010-2011*. http://www.industry.gov.au/innovation/reportsandstudies/Documents/2010-11NSRCReport.pdf.

[15] With regards to CRC income, this should only be considered in tandem with a move to abolish the option for universities to provide cash contributions to CRCs.

[16] Industry relevant research training is outlined further in Section 5 below.

[17] In addition to providing a student with funding support, some industry funded scholarships that are awarded also require the student to be located in industry for a portion of their time. Some of the industry sponsored scholarships awarded by the Automotive Australia 2020 CRC (AutoCRC) are an example of this.

We would also agree with the suggestion[18] to recognise industry experience in the context of competitive grant applications where applied projects with industry participation are proposed. The composition of assessment panels should ensure significant industry representation on the panels, and industry experience should be taken into account when evaluating the track record of the chief investigators, as well as the industry partner investigators.[19]

Implementing these measures would provide the basis for a culture change in universities by giving collaborative research and industry engagement sufficient standing, and will in its wake, change university KPIs and promotion processes, leading to more individual researchers being encouraged to closely engage with industry personnel in the co-creation of knowledge.

ii. Directed at industry

In order to strengthen the demand for research collaboration in industry, modifications to the R&D Tax incentive, additional support for SMEs who engage with universities and the removal of barriers for access to collaborative schemes all should be considered.

The R&D tax incentive scheme could be modified to strengthen the incentive for investment in research with universities. To this end R&D expenses related to university research could attract a higher tax incentive than R&D expenses incurred elsewhere.

The R&D tax incentive scheme could also be used to provide an incentive for business to employ PhD graduates. Consideration could be given to include the salary expenses for these employees in the calculation of expenses that attract R&D tax incentives. PhD graduates based on their experience of working in the university research environment will arguably find it easier to access research organisations to explore opportunities for application of research in the interest of the business. This may raise the level of collaboration. Overall the measure would serve to lower the threshold for the exchange and transfer of knowledge from academia into business. We would argue that at least as a temporary basis, this tax incentive should also be available for expenses incurred in employing PhDs in managerial positions. Supporting the employment of PhD graduates in management could be a catalyst for opening a company up for employment of an overall more highly qualified workforce, and may help to address Australia's comparatively low rate of researchers employed in business.[20]

It may also be worthwhile to consider how SMEs in particular, could be supported and incentivised further. Evidence shows that SME's have little knowledge of, or engagement with university research. This can be dramatically changed, if SMEs are located in a university environment (i.e. are co-located with university facilities). Examples for such co-location models exist in the Science Parks that are found in the UK and other European Countries.[21] While at much smaller scale, there also are some Australian models such as the Australian Manufacturing and Materials Precinct[22] or Creative

[18] Department of Education and Department of Industry. 2014. *Boosting the commercial returns from research*. Accessed November 18, 2014. https://submissions.education.gov.au/Forms/higher-education-research/Documents/Boosting%20Commercial%20Returns%20from%20Research%20%20-%2024102014.pdf

[19] The same could also be applied in the assessment of qualifications of key (academic) personnel for CRC applications.

[20] Department of Innovation, Industry, Science and Research (DIISR). 2011. *Research Skills for an Innovative Future*. http://www.industry.gov.au/research/ResearchWorkforceIssues/Documents/ResearchSkillsforanInnovativeFuture.pdf.

[21] Tóth and Szücs. 2010. "European Technology, Industrial and Science Parks in the crisis management, preparation of the after-crisis and post-Lisbon strategy period, European Economic and Social Committee." Opinion presented at the European Economic and Social Committee Plenary Assembly, Brussels, July 14-15. http://www.eesc.europa.eu/?i=portal.en.ccmi-opinions.14149.

[22] The precinct is part of CSIRO's Global Precincts programme and accommodates 40% of Victoria's manufacturing companies. CSIRO, Monash University, the Australian Synchrotron and the Melbourne Centre for Nanofabrication are also located in this precinct; CSIRO. 2013. "Australian Manufacturing and Materials Precinct." Accessed November 26, 2014. http://www.csiro.au/Outcomes/Materials-and-Manufacturing/About-AMMP.aspx.

Enterprise Australia, a creative industries business incubator at QUT.[23] Co-location could be encouraged by either granting direct support to SMEs that co-locate, or by including relevant measures into a restructure of the R&D tax incentive scheme.

Other examples of programmes that raise levels of industry engagement in innovation and with universities are the Small Business Innovation Research Program in the United States, a grant programme that encourages SMEs to engage in federally funded R&D,[24] and the so called Patent or Innovation Box model, a model that provides a lower corporations tax rate on profits generated from the exploitation of patented technologies, which is used e.g., in the United Kingdom, France, Belgium and the Netherlands.[25]

The Government should also review existing schemes for industry research collaboration and address features of these programmes that can act as a deterrent for industry, e.g.:

- the requirement for SMEs to provide matching funding under the Research Connections scheme. While arguably appropriate for established companies, this is a problem for start-ups or very small businesses, and may have the effect of excluding them from the scheme. The programme guidelines should be modified to allow for the company's balance sheet to be taken into account to determine if smaller funding amounts from the applicant are appropriate;
- it seems that it is now considered that the industry applicant in the Research Connections scheme has to provide up-front funding of projects.[26] This is a disincentive for SMEs and should be abandoned;
- a fast tracked assessment could be introduced into the ARC Linkage assessment process. Currently it takes around eight months before the outcome of an application is known. This is applied without regard to the complexity of the project or the amount of funding sought. Anecdotal evidence from industry partners interested in the scheme indicates that this makes it difficult to commit funding and staff time at the application stage. Ways to fast track an application for projects with a smaller funding amount (say up to $150,000 per annum) and shorter timeframe (1-2 years), should be investigated.

In addition, the Government could in the context of the review of the CRC Programme, look at identifying best practice models for SME engagement in CRCs and encourage broader uptake of these features throughout the CRC Programme. One example worth a closer investigation is the SME company of the CRC for Spatial Information, 43 pl. It provides a structure that allows SMEs to join a

[23] QUT Creative Enterprise Australia. 2014. http://www.creativeenterprise.com.au/.

[24] The US Small Business Innovation Research (SBIR) programme requires eligible governmental agencies to set aside a percentage (i.e. 2.9% in 2015) of the extramural budget to fund SMEs to engage in R&D activities that have strong potential for commercialisation. To date, over USD $16 billion has been awarded by the SBIR programme since it was established in 1982. Eleven agencies have SBIR programmes and administer their own programmes, identifying R&D topics to inform proposals; National Institutes of Health, U.S. Department of Health & Human Services. 2014. "What are SBIR and STTR?" Accessed November 26, 2014. http://sbir.nih.gov/about/what-is-sbir-sttr.

[25] The UK Patent Box provides a reduced corporation tax rate of 10%, for companies that are exploiting patented inventions and certain other botanical and medical innovations. The lower tax rate is applied to the proportion of the company's profits derived from exploitation of the patented technologies; HM Revenue & Customs, Gov.uk. 2007. "Corporation Tax: the Patent Box." Accessed November 26, 2014. https://www.gov.uk/corporation-tax-the-patent-box; PricewaterhouseCoopers LLP. 2013. "European patent box regimes." Accessed November 26, 2014. https://www.jetro.go.jp/world/europe/ip/pdf/european_patent_box_regimes_en.pdf.

[26] The Research Connections Grant (under item 4.1 of the Customer Information Guide) requires that the applicant is able to fund the total costs of the project before claiming of the grant funds; Department of Industry. 2014. "Customer Information Guide: *Entrepreneurs' Infrastructure Programme – Research Connections.*" Accessed November 26, 2014. http://www.business.gov.au/advice-and-support/EIP/Research-Connections/Documents/CustomerInformationGuide-ResearchConnections.pdf.

CRC as a participant and to benefit from a broader engagement, without requiring a long term funding commitment.[27] Another approach is demonstrated in the pending bid for the Innovative Manufacturing CRC, which has adopted an industry portal model, and counts three such portals as participants (the Australian Industry Group, Australian Manufacturing Technology Institute and STC[28]). Through these portals, a large number of SME firms have expressed interest in working with the CRC.[29]

iii. Environment for collaboration

Collaboration between the industry and research sectors would further benefit from increased policy and programme certainty, and increased industry responsiveness of programmes.

Applications for long term collaborative projects such as for CRCs, ARC Centres of Excellence, ARC Industrial Transformation Research Hubs or Industrial Transformation Training Centres, require at least 12 months of preparation. It is difficult to attract interest from industry for these initiatives if there is uncertainty as to whether the scheme will be available in the coming years, or which priorities are expected to be addressed. We do not argue for multiple renewals of established centres beyond their original funding purpose, but for an increased certainty of the existence of programmes such as the CRC, ARC Centre of Excellence, ARC Linkage and ARC Industrial Transformation Research programmes to allow industry and research organisations to engage effectively in the long term planning process that is required for successful applications.

The environment for collaboration could also be improved by ensuring that existing industry-driven collaborative programmes address industry needs. One explanation for low levels of collaboration between industry and universities is the substantial disconnect between research expenditure by business, and the research activity in universities.[30] The newly proposed Industry Growth Centres could play a central role in addressing this mismatch. One of the overarching activities for all Growth Centres is the development of 'knowledge priorities to help inform the research sector of industry needs and commercialisation opportunities'.[31] The boards of the Growth Centres could in this context, identify areas of research and innovation that would enhance the productivity of their respective industry sector. Where the productivity increase can be achieved through short term and small scale collaborative research efforts, this could provide guidance for programmes like Research Connections. Where the identified challenge requires longer-term, large scale, collaborative research, development and commercialisation efforts, the Government could call for targeted CRC applications that address the industry identified challenges.

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[27] 43pl is a unit trust that SMEs can become a member of. Members have access to the CRC's IP and its research, training and education activities, and to a network of relevant government agencies, larger companies, potential clients and research organisations. Members are expected to pay cash contributions from $3,000 annually, and may determine the length of their membership. In our experience this model is very attractive to SMEs who consider involvement in a CRC; CRC for Spatial Information. 2014. "Partners - 43pl." Accessed November 26, 2014. http://www.crcsi.com.au/partners/43pl/.

[28] STC is an incubator for small technology companies; STC. 2014. "About Us." Accessed November 26, 2014. http://www.stcaustralia.org/about-us/.

[29] A similar portal model is employed by the Maastricht University through its Service Science Factory; Service Science Factory, Maastricht University. 2014. "What We Do." Accessed November 26, 2014. http://www.ssf-maastricht.nl/work.

[30] As an example, in 2012 businesses spent 47% of their R&D expenditure on engineering, whilst universities only spent 10%. Businesses spent 30% on Information and Computing Sciences, whereas universities spent only 3%. Conversely, in the medical and health sciences and biological sciences, universities spent 38% of their research expenditure on this field of research, whilst business spent only 6%; Australian Bureau of Statistics. 2013. "Research and Experimental Development, Business" (8104.0). Accessed November 26, 2014. http://www.ausstats.abs.gov.au/ausstats/subscriber.nsf/0/E0B2439FD99C0183CA257BDD001170EE/$File/81040_2011-12.pdf.

[31] Department of Industry. 2014. "Industry Growth Centres Initiative." Accessed November 26, 2014. http://www.industry.gov.au/industry/Pages/Industry-Growth-Centres.aspx#header.

3. Research Infrastructure

a) Continuing Support for Infrastructure Programmes

Quality research infrastructure is a critical component of Australia's national innovation system that facilitates partnerships between university, industry, and government sectors. Investments made to date through the Major National Research Facilities Program (MNRF), the National Collaborative Research Infrastructure Strategy (NCRIS), the Education Investment Fund (EIF), the Super Science Initiative (SSI), and the interim Collaborative Research Infrastructure Scheme (CRIS), have provided researchers with access to major research facilities, and the supporting infrastructure and networks necessary to undertake world-class research.

As part of the 2014-15 federal budget, the Government announced that EIF would be terminated on 1 January 2015.[32] The termination of EIF funding will also coincide with the conclusion of the limited two-year support made available for priority projects under CRIS.[33] Funding support for NCRIS does not currently extend beyond 30 June 2016,[34] is limited to the support and maintenance of existing facilities, and will be allocated based on a current Government review of infrastructure capabilities.[35]

Uncertainty about ongoing funding for existing facilities and lack of funding for new research infrastructure may hinder future collaborations. We would welcome ongoing, sustainable funding support by the Government for the NCRIS programme, including the proposed strengthened focus on outreach to university and industry sectors, and the need for a new infrastructure roadmap. We considered NCRIS to be an efficient, effective and appropriate model for funding medium to large scale, capability based infrastructure in Australia.

As outlined in the 2010 Evaluation Report of the NCRIS programme,[36] the funding model has consistently emphasised the importance of collaboration from the outset, most notably through the consultative road mapping and development processes that were applied to the establishment of the facilities. This emphasis has continued through to the operation of the facilities, through the incorporation of obligations into NCRIS funding agreements that ensure merit-based access is available to both researchers and industry, discounted access rates are offered to publicly funded researchers, and the inclusion of performance indicators that measure the extent and nature of the resulting collaborations. All these measures further encourage research collaboration.

An identified strength of the NCRIS programme is the availability of funding support for operational costs. It was a criticism of investments made under the EIF and SSI schemes that funding was provided only for the creation and development of the infrastructure, and not for the associated ongoing operational costs of the facilities. The lack of operations funding was found to reduce the

[32] Department of Education. 2014. "Education Investment Fund". Accessed November 26, 2014. https://www.education.gov.au/education-investment-fund.
[33] Department of Education. 2013. "Collaborative Research Infrastructure Scheme (CRIS)". Accessed November 26, 2014. https://education.gov.au/collaborative-research-infrastructure-scheme-cris.
[34] Department of Education. 2014. "National Collaborative Research Infrastructure Strategy (NCRIS)". Accessed November 26, 2014. https://education.gov.au/national-collaborative-research-infrastructure-strategy-ncris.
[35] Department of Education. 2014. "Researchers FAQs". Accessed November 26, 2014. https://www.education.gov.au/researchers-faqs#faq23.
[36] Department of Education. 2010. *National Collaborative Research Infrastructure Strategy: Evaluation Report*. Accessed November 17, 2014. http://docs.education.gov.au/system/files/doc/other/national_collaborative_research_infrastructure_strategy_evaluation_report_2010.pdf.

utility and cost-effectiveness of these infrastructure investments.[37] Through the provision of ongoing support for operational expenditure under NCRIS, costs for university and industry sectors to access the infrastructure are reduced, which lowers the threshold for collaboration. Consideration should also be given to making funds available to upgrade existing research infrastructure, to ensure that it continues to be world-class and meets current research expectations.

Future versions of the NCRIS programme should continue to build upon the existing model, and should further strengthen research infrastructure that has already been invested in. A sustainable funding model will need to be established to support the programme, preferably utilising new funds that are not drawn from existing Research Block Grant funding pools.[38]

b) Facilitate increased collaboration and access

One approach for using infrastructure support to increase collaboration between industry and universities is to incentivise the co-location of research infrastructure facilities with industry, and the development of incubator precincts.

For example, QUT's Mackay Renewable Biocommodities Pilot Plant (MRBPP) is unique pilot scale R&D infrastructure that was co-funded by NCRIS, the Queensland Government and QUT. The MRBPP specialises in the conversion of cellulosic biomass into renewable transport fuels (bioethanol) and high value biocommodities in an integrated biorefinery, and aims to link innovations in product and process development with the assessment of commercial viability to enhance the uptake of this technology in Australia. The facility is hosted by Mackay Sugar Limited, one of Australia´s leading sugar manufacturers, on the site of the Racecourse Mill in Mackay, Queensland. In addition to sugarcane bagasse and trash which is readily available from the sugar factory, the facility is also capable of processing a wide range of biomass feedstocks, with many of these feedstocks able to be sourced from partners throughout Australia. Under NCRIS funding guidelines, the MRBPP is available for public and private sector research use. To date, the MRBPP has been successful in attracting collaborations with both local and international, industry and university partners.

A recent report prepared by Deloitte Access Economics and Corelli Consulting,[39] demonstrated the economic potential to establish a biorefinery industry in Queensland. The study, which estimates the economic impact from seven potential biorefinery projects in Queensland alone would be more than $1.8 billion annually, and create more than 6,640 jobs over the next two decades. QUT has since developed a blueprint for the Australian biorefinery industry[40] which focuses on key areas including creating business opportunities, developing and attracting the best technologies and people, developing biorefinery hubs, and supporting commercial developments.

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[37] Department of Education. 2010. *National Collaborative Research Infrastructure Strategy: Evaluation Report*. Accessed November 17, 2014. http://docs.education.gov.au/system/files/doc/other/national_collaborative_research_infrastructure_strategy_evaluation_report_2010.pdf.

[38] The interim Collaborative Research Infrastructure Scheme (CRIS) was established with $60 million in funding that was redirected from Research Infrastructure Block Grant (RIBG), Joint Research Engagement (JRE) and Sustainable Research Excellence (SRE) initiatives in 2013 and 2014.

[39] Centre for Tropical Crops and Biocommodities, QUT. 2014. *Economic impact of a future tropical biorefinery industry in Queensland.* Accessed November 24, 2014. http://www.ctcb.qut.edu.au/documents/dae-corelli-biorefinery-report.pdf.

[40] Centre for Tropical Crops and Biocommodities, QUT. 2014. *Blueprint for a Biorefinery Industry in Australia.* Accessed November 24, 2014. http://www.ctcb.qut.edu.au/documents/dae-corelli-biorefinery-report.pdf.

One model for capitalising on economic opportunities like this would be for the Government to facilitate where appropriate, the establishment of incubator precincts based around existing or new research infrastructure. By providing a base level of infrastructure for the precinct, industry collaborators would be attracted to utilise the research infrastructure to demonstrate their technologies at pre-commercial and commercial demonstration scales, and would have access to services that could support the commercialisation of these technologies. This could be supported by direct funding, R&D tax incentives, or obligations for industry co-location to be included in future research infrastructure funding agreements.

4. Access to Research

a) IP in collaborative settings

A recent consultation paper for IP Australia identified the management of IP, and the negotiation of provisions related to IP ownership and use, as key challenges for collaborations between the industry and university sectors.[41] QUT's IP Policy provides a framework to enable innovation and knowledge transfer that is beneficial to both the university and the broader community, and allows the university to be flexible in its approach to IP ownership and use rights in collaborations.

IP policies that incentivise university staff, researchers and students, to actively engage with the technology transfer process are now the norm for the university sector. Incentives offered to inventors (or any other staff or students involved in the development of the IP), may include a share of any net commercialisation income received. This share is generally capped at one third of the net commercialisation income received by the university.[42] QUT however, has the discretion to go beyond this standard income distribution model, and in exceptional circumstances may reward highly engaged researchers with up to one half of the net commercialisation income received.[43] Few universities currently offer the possibility of such generous incentives. As one approach to further incentivise commercialisation and knowledge transfer this model could be considered (if suitable), to be more widely adopted in the university sector.

In recent years, the university sector has widely recognised that income generated from traditional commercialisation activities is relatively small in comparison to income received from other collaborative research and consultancy activities that the sector undertakes.[44] As such, universities have moved away from the one-size-fits-all approach of insisting upon IP ownership during

[41] IP Australia, Department of Industry. 2014. *IP Toolkit for Collaboration: Consultation on a toolkit of practical resources for PFRO and industry collaborations*. Accessed November 19, 2014. http://www.industry.gov.au/industry/IndustryInitiatives/IPtoolkit/Documents/IP%20Toolkit%20for%20Collaboration.pdf.

[42] Under current university policies, exemplar models for financial incentives noted on page 20 of the "Boosting the commercial returns from research" discussion paper, provide incentives to researchers of 30% (in the case of Monash University, http://www.monash.edu.au/migr/research-degrees/handbook/chapter-six/6-2.html), or 33.33% (in the case of the University of Queensland, https://ppl.app.uq.edu.au/content/4.10.13-intellectual-property-staff-students-and-visitors) of any net proceeds of commercialisation received by the university.

[43] Queensland University of Technology. 2014, "D/3.1 Intellectual property policy". Accessed November 24, 2014. http://www.mopp.qut.edu.au/D/D_03_01.jsp.

[44] Data from *The National Survey of Research Commercialisation 2010-2011* report shows that in 2011 universities generated $54.081 million from their commercialisation activities (i.e. licensing, options and assignments). In the same year, universities entered into contract research and consultancy agreements collectively valued at $978.904 million. Commercialisation activities represented only 5.2% of the combined income received from these activities; Department of Industry Innovation, Science, Research and Tertiary Education. 2012. *The National Survey of Research Commercialisation 2010-2011*. http://www.industry.gov.au/innovation/reportsandstudies/Documents/2010-11NSRCReport.pdf.

collaboration negotiations. In 2013, a UK-based study[45] showed that IP ownership is now seen to be less important than other issues, such as access and use rights to IP that are necessary to ensure researchers are not constrained from furthering their research, are able to publish without restrictions, and may engage with other collaborators. Anecdotal evidence suggests that a similar shift in view has also occurred in Australia. This approach leads to more flexible negotiating positions, which seek to acknowledge both the contributions of all parties involved in the collaboration, and the ongoing research and business objectives of each party.

b) Use of IP guidelines and toolkits

Although the university sector has adopted a more flexible approach to negotiating models of IP ownership and use rights in their research collaborations, there is still a view in the broader community that universities are inflexible in their dealings. More needs to be done to publicly educate the community on this policy shift in the university sector.

In March this year, IP Australia released a discussion paper that sought consultation on a toolkit of practical resources aimed at assisting universities and industry to establish the terms of their collaborations.[46] Toolkits and template agreements are a positive initiative, and template agreements can serve as a starting point for the negotiation of collaborative arrangements. In our experience they assist with focussing the discussion on the central points of IP and commercialisation, by taking care of all non-IP related issues. Whilst IP ownership and use rights will always need to be negotiated and tailored to suit the specific context of the research and the collaboration itself, a multitude of other legal aspects of collaborations (i.e. rules around funding, reporting, confidentiality, indemnities, and conduct of research in compliance with legislation and regulation) can be dealt with on a more standardised basis.

As an example, the Department of Industry makes available and encourages the use of a template Participants Agreements for CRCs to establish their framework for collaboration.[47] Whilst this template provides a good basis from which to commence negotiations, there is always a considerable degree of negotiation that occurs amongst the participants, in relation to the IP-related provisions. As a result of these negotiations, each CRC will establish a unique IP model that is designed to suit the objectives of the collaboration, and to maximise the transfer of knowledge, for the benefit of Australia.

We argue that it will be difficult to provide template approaches to the IP-related provisions, but negotiation of these terms could be assisted by educational materials, especially materials designed to provide easily accessible information to SMEs (reducing the cost of legal advice). These materials could introduce several models for IP ownership as starting points for negotiations, e.g. models that differentiate by the level of public-industry funding. The following sets out how such a model could be structured:

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[45] Eggington, Elaine, Rupert Osborn and Claude Kaplan. 2013. *Collaborative Research between Business and Universities: The Lambert Toolkit 8 Years On.* https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/311757/ipresearch-lambert.pdf; Research commissioned by the UK Intellectual Property Office and carried out by IP Pragmatics Limited.

[46] IP Australia, Department of Industry. 2014. *IP Toolkit for Collaboration: Consultation on a toolkit of practical resources for PFRO and industry collaborations*. Accessed November 19, 2014. http://www.industry.gov.au/industry/IndustryInitiatives/IPtoolkit/Documents/IP%20Toolkit%20for%20Collaboration.pdf.

[47] Cooperative Research Centres (CRC) Programme, Department of Industry. 2012. *Participants Agreement for an incorporated entity*. Accessed November 26, 2014. http://www.business.gov.au/grants-and-assistance/Collaboration/CRC/for-crcs/Documents/Selection-Round-16-Participants-Agreement-for-an-Incorporated-Entity.pdf.

- Where the research is publicly funded (e.g. competitive grants awarded by the Australian Research Council and National Health and Medical Research Council, etc.), the starting position for negotiations could be that universities own the IP. However this may vary depending upon both the context of the research, and a university's relationship with individual collaborators. Regardless of what the final ownership model looks like, as the research has been publicly funded, universities should retain access and use rights, to enable further research activities.
- In situations where the research is co-funded by industry and universities,[48] models for IP ownership can vary considerably, and should take into consideration the substantial contributions both sides make to the collaboration. For example, where an industry partner may be granted commercialisation rights to the IP and generates income from exercising this right, the industry partner may also be obligated to distribute a small share of the income back to the university by way of royalty payments. An additional approach is to negotiate the inclusion of safeguards in a collaboration agreement to prevent IP from being locked away should the industry partner fail to commercialise the IP (e.g. performance clauses for commercialisation that provide that the IP is assigned back to the university if performance obligations are not met). This approach is designed to ensure that the IP, which has been co-funded with public funds, is still accessible and may be transferred into the broader community through another mechanism (e.g. the university researchers would be free to engage with other partners to further develop the IP).
- Where the cost of research is fully funded by industry partners,[49] ownership of IP could vest with the industry partner. In some instances however, it may be appropriate for a university to retain use rights to fields that the industry partner has no interest in pursuing.

Such a model highlights the need for flexibility, to ensure that access to IP is granted to those that will make the best use of it. We would encourage complementing the toolkit and template agreements, with a suite of educational materials that discuss these models.

5. Industry relevant research training

One of the key issues that impacts industry collaborations and the mobility of academic researchers into industry, is a lack of foundational knowledge of relevant transferrable and industry relevant skills by researchers. That is, many researchers have little knowledge of or training in the professional skills[50] which would enhance and catalyse interactions with industry, leading to commercially beneficial outcomes. Indeed, a 2010 study[51] found researcher knowledge gaps, in areas important to the business context and to researcher effectiveness in engagement with this

[48] Co-funding by universities may take the form of direct cash contributions (e.g. to CRC projects) or of subsidies in form of the provision of overhead costs (i.e. use of infrastructure and facilities, administration costs, etc.). Whilst direct costs of staff and equipment may be funded by the collaborator, universities often contribute substantial overhead costs to projects that are not recouped from the collaborator.

[49] The term 'fully funded' refers to the full direct and indirect costs of the research (i.e. staff time, overheads, administration costs, infrastructure and facilities costs, etc.), which have been funded by the industry partner.

[50] For example, professional skills such as intellectual property protection, knowledge transfer, project management, negotiation and legal skills, leadership and communication skills, and other management areas.

[51] Allen Consulting Group. 2010. *Employer Demand for Researchers in Australia*. http://www.industry.gov.au/research/ResearchWorkforceIssues/Documents/EmployerDemandforResearchersinAustraliareport.pdf; Report prepared for the Department of Innovation, Industry, Science and Research.

sector. Moreover a Go8 report[52] of higher degree research (HDR) graduates 7-10 years after completion, found that graduates felt that they were not provided sufficient training during their PhD in these key skills. This data would suggest a paucity of relevant training for research staff and students in skills related to engagement with business and industry.

The research training experiences of HDR students in Australia varies significantly both across institutions and within each institution, mutually in quality of resources provided and the support provided within the research environment according to recent studies.[53] Almost all organisations now provide HDR students with ongoing access to resources related to these skills (e.g. workshops, ad hoc seminars, guest lecturers, etc.) during candidature, and corresponding professional development training resources for staff. However use of these resources is almost always voluntary, and cultural norms or KPIs often prevent students and staff from feeling that they are supported in participating in training events that are not deemed 'necessary'. This is despite an express need and acknowledgement of the lack of knowledge in key areas.[54] In recent years, some organisations have made changes to address this. Some of the models employed in Australia are described here to demonstrate differing approaches.[55]

Cooperative Research Centres (CRCs) have historically been leaders in providing training and education programmes to students, and have the aim of fulfilling professional development needs and creating industry ready graduates. Research into the career development of CRC students suggests that they experience more contact with industry, gain more industry relevant skills outside their direct academic field, and are more likely to take up employment outside academia than their non-CRC peers.[56]

The e-Grad School (Australia) (eGSA), a collaborative initiative of the Australian Technology Network (ATN) group of universities, provides training to HDR students via flexible online five week modules focusing on discrete skill sets (e.g. research commercialisation, entrepreneurship, project management, public policy, etc.), in addition to award courses[57] offered in Research Commercialisation and Research Management. Since its launch in 2003, eGSA has processed over 8990 registrations for its courses from students from over 15 universities, with expectations that this figure will rise to over 10,000 in 2015. These courses are increasing in popularity, with students often

[52] Western, Mark, Paul Boreham, Matthias Kubler, Warren Laffan, John Western, Alan Lawson and Denise Clague. 2007. *PhD Graduates 5-7 Years Out: Employment outcomes, job attributes and the quality of research training* (J5001). The University of Queensland Social Research Centre, Brisbane; Report prepared for the Department of Education, Science and Training (DEST).

[53] Council of Australian Postgraduate Associations (CAPA). 2010. *Minimum resources for postgraduate students 2010*. http://capapre.files.wordpress.com/2011/12/minimum_resources_2010_full.pdf; CAPA .2009. *The research training experience in 2009*. http://www.academia.edu/4122722/The_Research_Education_Experience_in_2009. Report prepared for the Department of Innovation, Industry, Science and Research, 2009.

[54] Results from a 2012 survey of HDR students across Australia showed that 70% had no knowledge or understanding of contract negotiation, 72% had no knowledge or understanding of legal processes, 51% had no knowledge or understanding of Intellectual Property protection, and 42% had no knowledge or understanding of the advantages of collaborations; e-Grad School (Australia). 2012. Survey of HDR students across Australia. Unpublished data.

[55] An international model is the Danish Industrial PhD Programme that provides for a three year industry focussed PhD. The student is employed by industry partner and enrolled at the university. All working time is spent on the project, with their time divided between university and industry; Innovation Fund Denmark. 2014. "The Industrial PhD Programme". Accessed November 18, 2014. http://en.innovationsfonden.dk/the-industrial-phd-programme/.

[56] Manathunga, Catherine, Rachel Pitt, Laura Cox, Paul Boreham, George Mellick and Paul Lant. 2012. "Evaluating industry-based doctoral research programs: Perspectives and outcomes of Australian Cooperative Research Centre graduates." *Studies in Higher Education* 37 (7): 843-858.

[57] Award Courses were discontinued in 2014 due to the loss of the Commercialisation Training Scheme funding which supported students enrolling in these courses.

commenting that they believe such training should be mandatory[58]. However the success of these courses is limited by enrolment numbers which are regularly waitlisted due to funding limitations, and their voluntary enrolment status which means training only reaches those student cohorts who are interested in further training outside their discipline.

Monash University, through its Monash University Institute of Graduate Research (MIGR)[59] has recently changed its training model for PhD students, to deliver training and professional development encompassing a range of transferable skills applicable to industry, academia, government and the community. From 2015, all PhD students will be required to undertake a Graduate Research Individual Skills Training Plan which encompasses three months of coursework (both core and elected) that is designed to provide professional skills outside of the student's research discipline. This training will be compulsory and must be done prior to the student's pre-submission seminar.[60]

Another ATN initiative is the ATN Industry Doctoral Training Centre in Mathematics and Statistics (IDTC).[61] This virtual centre offers a four year PhD programme to prepare high level Mathematics and Statistics graduates. A feature of this programme is that students are partnered with an industry organisation and work on a research problem of the industry partner. Students are also linked to peers and industry via networking events (i.e. national conferences), and undertake coursework that provides transferrable industry relevant skills (i.e. communication, project management, commercialisation or entrepreneurship). The programme combines rigorous disciplinary academic training, typical of traditional PhD programmes, with an outcome focussed approach to research that is suited to industry.

There are also examples of short-term project based programmes aimed at industry exposure of students. The Australian Mathematical Science Institute (AMSI) offers an intern programme for postgraduate students, AMSI Intern, which links postgraduate students with industry partners for short-term (4-5 month) tightly, focused partner research internships.[62]

An example of project based industry training at the undergraduate level is the CEED Program conducted by QUT. CEED provides industry with an easy, structured and managed way to access a wide range of university students, for the completion of specific industry-based projects. Since 1992, CEED students have successfully completed almost 1000 industry-based projects, mainly located around South-East Queensland.[63]

These models indicate a wide disparity in organisational approaches to transferrable skills training for research staff and students. Hence, despite the interest and evidence that would suggest that researcher training benefits organisations, by improving intercultural knowledge and industry preparedness, it is apparent that there is no unity from Australian research organisations in meeting

[58] An example of eGSA student feedback: "*I'm starting to think that all PhD students should be made to do a course like this one - eventually the culture may change if people are at least thinking about it. In other countries it's compulsory to do course work as part of a PhD, so it wouldn't be entirely out of the question to bring in such a requirement...".*

[59] Monash University. 2013. "About the Monash University Institute of Graduate Research (MIGR)." Accessed November 18, 2014. http://www.monash.edu/migr/why-monash/about/.

[60] A student's pre-submission seminar occurs approximately six (6) months prior to the submission of their thesis.

[61] Australian Technology Network. 2014. "About the IDTC". Accessed November 26, 2014. https://www.atn.edu.au/Partners/idtc/About-the-IDTC/; A model for this centre seems to be the Centres for Doctoral Training (CDTs) scheme operated in the UK; Engineering and Physical Sciences Research Council. 2014. "Centres for Doctoral Training." Accessed November 26, 2014. http://www.epsrc.ac.uk/skills/students/centres/.

[62] AMSI Intern. 2014. "About AMSI Intern". Accessed November 26, 2014. http://amsiintern.org.au/about-amsi-intern/.

[63] Corporation Technologies (trading as CEED Program Qld). 2014. "CEED – company based training for students." Accessed November 26, 2014. http://www.corptech.com.au/.

these training needs for research staff or HDR students.[64] Anecdotal data would also suggest that organisational metrics such as ERA rankings and a focus on timely student completions prevent many universities from making training programmes compulsory, due to a perceived added burden that may distract staff and students from their research, and slow down HDR completion rates. Moreover, academic researchers often directly discourage their own students from further optional training, for fear of impact on their own KPIs.

It seems that sector-wide changes are necessary to support a change in Australian research organisations to ensure a more comprehensive sector wide approach to industry relevant research student training. We would recommend that all universities are required to provide mandatory training to HDR students in industry relevant and innovation related skills, which could take the form of a model similar to the MIGR, or a broadening of the IDTC across disciplines and universities. In this context, changes to organisational and research staff KPIs also should be considered, to provide organisations and staff mechanisms, to support students and incentivise colleagues to regularly seek training in skills that would better prepare them for commercial interactions with industry, which may ultimately lead to tangible commercial outcomes.

[64] Manathunga, Catherine, Rachel Pitt, Laura Cox, Paul Boreham, George Mellick and Paul Lant. 2012. "Evaluating industry-based doctoral research programs: Perspectives and outcomes of Australian Cooperative Research Centre graduates." *Studies in Higher Education* 37 (7): 843-858.