THE UNIVERSITY OF MELBOURNE

RESPONSE TO THE

JOINT SELECT COMMITTEE ON TRADE AND INVESTMENT GROWTH

INQUIRY INTO AUSTRALIA'S FUTURE IN RESEARCH AND INNOVATION

FEBRUARY 2015

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A. Introduction and overview

The University of Melbourne welcomes the opportunity to provide a submission to the Committee's inquiry into the trade and investment growth opportunities possible through expanded research and innovation outputs.

The Australian Government's announcements in the *National Innovation and Science Agenda* (NISA) provided a strong starting framework for advancing the national dialogue on innovation and identified an effective mix of measures to transform our national research and innovation capacity. NISA recognises that universities, Government and industry are crucial participants and partners in the process of building, operating and leveraging Australia's innovation ecosystems. To achieve the goal of a prosperous and thriving research and innovation sector, as a means to generating the business and jobs of the future and supporting high living standards, Australia needs new practice models, fresh thinking and clever partnerships. Delivering on – and exceeding – the expectations of NISA will require governments, businesses and research organisations to pursue complementary and interdependent but distinct roles.

Priority areas for attention include:

1. Resources and translation infrastructure to drive forward commercialisation, particularly targeting the post-discovery but still pre-investable stage of the commercialisation pipeline;
2. Co/investment in coordinated measures to scale-up the impact of publically funded research;
3. Gateway resources and programs to boost knowledge transfer, collaboration and engagement between key sectors.

Australia is still in the early stages of building self-sustaining innovation ecosystems and shaping a national culture that values and embraces entrepreneurship, unlike countries such as Israel that have been investing over the last 25 years to have the system it has today. For the Australian economy to function optimally in the digitally transformed world, it must continue to produce world-leading research, turn more public research into commercial outcomes, generate higher levels of business research and development (R&D), adapt and diffuse new technologies and skills and participate more effectively in global value chains.

As in all developed economies, these drivers of future economic growth will depend upon entrepreneurialism and the creation of distinctive intellectual property, high-quality research infrastructure and technological talent. Securing these benefits will require continued and significant investment in science, research infrastructure and research training, including growing investment in basic research as it is central to the nation's economic, social and environmental progress.

Future economic growth also depends on maintaining our robust research base, which is critically important to supporting knowledge translation. Universities are the pillars of Australia's rich and comprehensive research base, as places where intellect and exploration can flourish and the next generation of innovative researchers are educated.

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The University of Melbourne ('the University) is a world-class research-intensive university. In 2014 the University's expenditure on research was around $1 billion, reflecting a sustained effort to grow investment in research. Our annual cohorts of research higher degree graduates amount to nearly a tenth of Australia's total research higher degree graduates. We are a pivotal part of a renowned biomedical precinct in Parkville, hosting over 10,000 of the world's brightest scientific minds. The University is advancing a strategic program of scaling-up our research and innovation capability as we seek to derive ever more economic and societal value from our world-class research in engineering, basic science, life sciences, social science and humanities.

The University is implementing fundamental changes at the campus level to drive innovative research and engagement with industry. These measures include developing our innovation and technology precinct Carlton Connect, as well as making significant investments in our commercialisation operations and capabilities and building infrastructure to support and enable these endeavours. We are drawing on international experience to accumulate the economic, physical and networking assets that are essential ingredients for building a successful research and innovation district. These measures and others are outlined in Part B of this submission.

The University recognises the complementarity between its strategic focus and measures included in NISA. The University particularly welcomed the announcement of secure funding for the National Collaborative Research Infrastructure Strategy (NCRIS). NCRIS is the bedrock of Australia's research and innovation system, enabling the crucial research facilities and intellectual networks behind our world-class research outputs.

Other NISA measures with tremendous potential to boost the research impact of universities and other public research institutions are the Chief Scientist's review of future infrastructure funding; the Commonwealth Scientific and Industrial Research Organisation (CSIRO) Innovation Fund, expanded ON innovation program and the Biomedical Translation Fund; the ARC-led consultation on measures of impact and engagement; further support for graduate and postgraduate placements through the broadened Innovation Connections program; expanded options for permanent visas for STEM and ICT postgraduates; and the Global Innovation Strategy. These measures are well-crafted to substantially build up capability across Australia's economy while leveraging the existing strengths of universities.

In the University's view, there are further ways in which Australia's innovation framework can be enhanced to strengthen the relationship between our innovative businesses and our research organisations to ensure Australia's economic success in coming decades.

Foremost, the University highlights to the Committee the ongoing gap in supportive infrastructure at the earliest *venture catalysing* phase of the research commercialisation pipeline. Namely, that part of the pipeline when research discoveries have been made with recognised commercial potential, but it is still too early to attract commercial investment. This 'pre-investable' stage in research translation is not owned by any one party; as such the skills necessary to traverse this terrain, and the modest funding needed to resource the gap, are generally not available in universities.

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As our submission reiterates in Part D, there is a great need for long-term infrastructure support at the very earliest stage in the process of turning world-class research into applied research with commercial viability and momentum. Measures that catalyse the bridging of this gap – targeting technological, scientific and commercial skills and resources like establishing investor-quality laboratory support, prototype development and production strategy capability – would unleash new volumes of fundamental deal-flow from public research institutions that venture capitalists could then take further along the commercialisation pipeline and, ultimately, to market.

Co-investment with universities in measures targeting this crucial translational step would complement and strengthen the Government's NISA commitments to building venture capital opportunities, such as the Innovation and Biomedical Translation Funds.

This recommendation and others are explained in more detail in Part D of this submission. The overarching focus of our submission is on aspects of Australia's innovation system in which Universities have a direct role, centring on research and research training, industry collaboration and boosting commercialisation outputs. In summary, we recommend:

1. **Resources and translation infrastructure to drive forward commercialisation**, including co-investment with universities in mechanisms such as Venture Catalysts to support early stage proposals, as well as effective operation of the CSIRO Innovation Fund, Biomedical Translation Fund, and expansion of the CSIRO's ON innovation and accelerator program.

2. **Co/investment in coordinated measures to enhance the impact of publically funded research**, including support for scaling-up successful start-up incubators on campus, modification of the R&D Tax Incentive to make it work as intended, complementary support for university-led reforms of academic incentives and rewards for research impact, and new 'third stream' funding to support collaboration.

3. **Gateway resources and programs to boost knowledge transfer, collaboration and engagement** between key research sectors, including investment in co-location opportunities and further consolidation of intellectual property arrangements.

The future Australian economy will include a role for universities not just as places of education and research, but as economic players providing fertile ecosystems for translating ideas into prosperity. The university environment encourages creation and sharing of intellectual property. The campus offers a place for experimentation and the safety to fail. These hubs of entrepreneurial enthusiasm will generate new businesses and industries, and so strengthen the small and medium enterprise backbone of Australia's economy.

The University warmly invites the members of the Joint Select Committee to visit our campus and observe first-hand the University's world-class research community in action.

For further information or to discuss our submission, Professor James McCluskey, Deputy Vice Chancellor (Research) can be contacted on dvc-research@unimelb.edu.au or (03) 03 8344 3238.

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Summary of recommendations:

Resources to support translation infrastructure and commercialisation mechanisms

1. Co-invest with universities in mechanisms such as Venture Catalysts to address the translation gap currently faced by early stage research commercialisation proposals in public research institutions.
2. Consult with Australian research institutions on the development of operating principles and models of governance for the CSIRO Innovation Fund and Biomedical Translation Fund.

Co-ordinate measures to optimise the impact of publically funded research

3. In addition to the NISA expansion of the CSIRO ON Accelerator Program, scale up support for successful accelerator programs on university campuses and effective incentives for industry to sponsor places in these programs.
4. To complement existing opportunities led by universities, expand opportunities through Innovation Connections or complementary programs for academic secondment to industry, two-way mobility programs for researchers, industry-based postdoctoral opportunities and flexibility in research scholarships.
5. Develop a new or 'third stream' of funding, separate to that which supports the research base, to create appropriate incentives for universities and other commercial actors to collaborate. Here, even modest recalibration of the R&D Tax concession could be a useful incentive to drive industry collaboration with research providers like universities (see point 8).
6. Support universities to create stronger internal incentives and rewards structures for academic researchers to build engagement with end-users and strengthen impact while retaining fundamental research excellence and discipline depth.
7. Modify research evaluation systems and research excellence metrics in consultation with universities to place a greater emphasis on knowledge translation.
8. Modify the R&D Tax Incentive to improve collaborative research outcomes and ensure optimal return on public investment.

Provide gateway resources and programs to boost knowledge transfer, collaboration and engagement

9. Partner with universities and industry to develop large-scale innovation infrastructure to support co-location of research efforts between universities, industry and other partners.
10. Develop and publish a consolidated intellectual property framework to operate under a single Ministry, similar to that implemented in the UK, to provide clearer guidance for Australian innovation agreements in academia and industry.

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B. The University of Melbourne's approach to building research and innovation impact

The University has invested in crucial foundation pieces for accelerating our own innovation and research practice. This section of the University's submission draws on that experience to highlight our current research and innovation capability and future intentions.

Building innovation precincts on campus

Every successful innovation ecosystem around the world has, at its core, at least one world-class research institution and a number of successful multinational companies operating symbiotically. The research hub is a necessary precursor to generating the environment in which start-ups and small business can thrive. The University of Melbourne is a world-class research-intensive university and we are advancing a strategic program of scaling-up our research and innovation capability.

The University has created a number of precincts and hubs on our campus geared towards enabling cutting-edge research and innovation. Our precincts are the bases for the development and expansion of shared research infrastructure centred on existing geographic centres of research expertise and activity.

For example, the University is a major partner with leading hospitals in the **Melbourne Biomedical Precinct (MBP)**, an internationally significant aggregation of medical research and clinical practice that brings together 10,000 medical and scientific experts to conduct high-impact research, teaching and research training. The MBP houses nationally important NCRIS research infrastructure including the 7 Tesla magnetic imaging system hosted at the Melbourne Brain Centre, as well as other research platforms based at the University's Bio21 Institute for Molecular Science and Biotechnology, Victorian Comprehensive Cancer Centre and the Peter Doherty Institute for Infection and Immunity. The University has strong relationships with companies such as CSL, which is co-located at the Bio21 Institute, and IBM with its supercomputer facility at the Victorian Life Sciences Computing Initiative.

The MBP will soon expand with the completion of Stage 2B of the Bio21 Institute. This development will broaden University's capability in multidisciplinary R&D and industry engagement across biotechnology and life sciences fields. It will also enable the implementation of the Bio21 Institute's 'school to bench to workplace' vision, based on a purposeful collision between academic research, commercial research and a specialist science school for Year 11 and 12 students.

Another of the University's cutting-edge research hubs is Carlton Connect, Australia's premier innovation precinct based on technology and sustainability. Anchored by the University of Melbourne and accommodated in the former Royal Women's Hospital site, Carlton Connect leverages a co-location and collective impact approach to tackle challenges relating to water, urban futures, energy, food security, social equity, pervasive information technology, climate change and adaptation, innovation, entrepreneurship, risk and resilience.

As part of its growing agenda to foster impact, Carlton Connect already hosts and supports a number of key programs and on-site partners, including the Melbourne Accelerator Program (described in further detail below), the proposed Science Gallery Melbourne node, the Victorian Life Sciences Computation Initiative, the University of Melbourne's EU Centre on Shared Complex Challenges, the Australian-German Climate and Energy College and the CO2CRC. Additional programs and high-profile partners are also in advanced stages of development.

The University is also in the process of establishing a **public policy precinct** in Carlton, and is investigating feasibility for a new engineering research campus with a strong industry and high-tech manufacturing focus.

The clustering effect of these precincts supports intellectual convergence, enables interdisciplinary collaboration and further blurs the line between campus and community. Precinct development is the key method being used by many European and North American medical research networks and private companies such as Google. From the University's perspective, our precinct development approach is proving to be highly productive and effective in generating impact. For example, the MBP's collaboration of researchers, clinicians, engineers and mathematicians has already led to imaging breakthroughs through application of physics and engineering research, which are revolutionising the treatment of neurological disorders.

Investing in research

The University is a research-intensive university and one of the largest and most productive research organisations in Australia. We host Australia's largest cohort of research students and outlay research expenditure second only to that of the CSIRO. Our significant investment in research capability attracts the best and brightest to our University and increases opportunities for international investment and collaboration.

The University has a strong record of translating research into important social and commercial outcomes, including:

- invention of the Bionic Ear, bringing hearing to profoundly deaf children and adults
- invention of the Bionic Eye, which will provide unprecedented high-resolution images to thousands with severely impaired vision
- progress of HIV vaccine research
- creation of a vaccine set to eradicate a fatal brain parasite
- development of the NeCTAR Research Cloud, bringing the power of cloud computing to research
- generation of more than $1.8 billion in two years from sales of tech firms built on research from Australian universities, including Fibrotech (up to $500 million), Spinafex ($1 billion) and Hatchtech ($279 million). These spin-outs were all backed by Uniseed, a commercialisation fund jointly owned by Melbourne, Queensland and NSW universities.

Many of these significant breakthroughs – even major commercialisations and product spin-outs – have grown out of years of patient and dedicated fundamental work by academic researchers. For example, the Fibrotech sale in mid-2014 was the result of the 2006 establishment of a university-based biopharmaceutical company to develop a new class of drugs to prevent fibrosis (tissue scarring). **Appendix A** to this submission provides a case narrative of the successful Fibrotech spin-out.

These successes were often due to the ingenuity and dedication of the founding researchers. With systematic translation infrastructure in place (Venture Catalysts) the commercialisation potential of new research will be more readily identified and the conversion rate will be higher.

Ultimately, research is a people enterprise. Therefore, a key resource on our campus is the nearly 5000 researchers enrolled in doctoral programs. As well as supporting University researchers to generate world-class fundamental research, the University is working hard to build up transferable skills for many of these researchers to move between the university and industry or other end-users.

Reforming our Research Training System

Efficient delivery of quality research higher degree (RHD) training is critical for the future of Australia's research effort. PhD degrees provide the unique skills mix needed for a career as a researcher and the RHD training system must continue to provide the future research workforce. Although Australia currently produces around 8,000 PhD graduates a year, only a fraction will ever work as an academic. Australia's RHD training system must be reformed to ensure all graduates gain the skills necessary to contribute their unique capabilities more broadly across Australian industry and society, in roles other than research academics.

The University has been developing ways to integrate further skills training into PhDs, within current program scope and time limitations. For example, doctoral students are offered placements through the Australian Mathematical Science Institute industry internship program. The interns work on a project that attempts to solve a key business challenge for their host company, working on-site with the organisation for half of their working time.

The University supports the development of targeted researcher and RHD student secondment and mobility programs to help overcome cultural barriers between universities and industry. We are taking action on-campus to develop such programs, but require support to scale-up the reforms. Measures in NISA that will be important in supporting universities' efforts in this regard include the Innovation Connections (expansion of Research Connections), which will provide matched grants to support graduate and postgraduate researchers' placement in business, and business researchers' placement in publicly funded research organisations.

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Growing our start-up accelerator and incubator program

The University's precincts are delivering value and results in relation to start-up activity. The University is home to the Melbourne Accelerator Program (MAP), which supports fledging entrepreneurs to translate their ideas into businesses. Established in 2013, it is ranked number 1 in Australia and number 8 worldwide by the UBI Index of university start-up incubators. In 2015 MAP supported eight new start-ups, created two new places in their accelerator program, and secured partnerships or institutional support from the Nasdaq Entrepreneurial Center in the US, Australia Post, ANZ, Minter Ellison and Google, amongst others.

MAP has contributed important qualitative gains for locally-based innovation ecosystems by establishing productive links with international and corporate networks. For instance, the Nasdaq Entrepreneurial Center partnership will facilitate student exchange and alumni networking opportunities in Silicon Valley. The engagement of Australia Post with MAP will sponsor two new places in the start-up incubation program, which will be geared towards seeking out emerging, disruptive e-Commerce practices that Australia Post can accelerate at their business end.

Rewarding collaboration and engagement

The University recognises the importance of strong research-industry collaboration and is implementing a suit of initiatives which promote incentives structures and other enablers of collaboration for our researchers, including:

- **Establishment of an Enterprise Professorship program**, through which appointees are selected who can make a distinctive, significant and active contribution, through their specialist industry, business or professional knowledge and exposure, to the University's mission and activities.
- **Sabbaticals and secondment program models**, which facilitate flexible study leave, secondments and exchanges that are a key element of academic career building to reward high performance and replace ordinary academic duties with specialised experience.
- **Prioritising and embedding engagement activities** within teaching and learning, research, leadership and service activities and outputs across the university, through consistent application of principles that recognise engagement as a core and integral element of many disciplinary contexts.

Fostering entrepreneurship

Grassroots change occurs when entrepreneurial talent connects with scientific and technical ideas. This can be accelerated if universities focus on creating entrepreneurial talent through the courses and programs they provide, especially those engaged in science, medicine, engineering, IT and mathematics. While teaching entrepreneurship is a core piece of the puzzle, the University is also working to foster a broadly entrepreneurial culture including dynamic networking of students, researchers and industry leaders. For instance, the University is considering embedding entrepreneurship students in the venture catalysing stage of our research commercialisation

pipeline, by requiring them to contribute to the development of a commercial value proposition and business development strategy for university-developed intellectual property. Similarly, the University's accelerator programs encourage interdisciplinary teams to build business acumen and potential for success.

In line with this approach, the University has launched a Masters of Entrepreneurship to train students in commercialising products and services and help them to launch their first business or build the strength of future businesses. The Wade Institute of Entrepreneurship at the University's Ormond College delivers the course with the Faculty of Business and Economics, incorporating lectures and mentoring from entrepreneurs and business leaders in co-operation with investment bank Credit Suisse, Australia Post and global law firm Corrs Chambers Westgarth.

Transforming our practice to align with social, economic and industry imperatives

The University has made a major investment in a new Research, Innovation and Commercialisation (RIC) capability. The purpose of RIC is to facilitate research relationships for the University, as well as attracting the necessary resources and building internal capacity for successful commercialisation, which in turn reinforces our ability to conduct world-class research. This sophisticated business development resource has been put in place centrally and across every Faculty to work with leading academics to develop and nurture industry collaborative relationships, assist in broadening global networks and to identify basic research with the potential for translation into applied research and commercialisation.

The University already collaborates with around 300 industry partners across activities including innovative research, major institutional partnership, internship and education and access programs. Our *Research @ Melbourne* strategy will see the University aim to double our funding from industry and international sources by 2020 and guide the University's research investment towards innovative, interdisciplinary and collaborative enterprises.

Some of the industry partners or collaborators the University already works with are CSL Limited, Siemens Hearing Instruments, Colgate Palmolive, Ford, Rio Tinto, Rode Microphones, Australian Energy Market Operator, Cadbury Enterprises, GC Australiasia, Sanofi Pasteur Inc, Procter & Gamble Australia, Bega Cheese Ltd, Seagull Technologies, Alcatel-Lucent (Bell Labs), Nasdaq, Asics Oceania Pty Ltd, IBM Australia, Think Spatial, Google, Microsoft Australia, Microsoft Research, Kraft Australia, Mondelēz International, Bluescope Steel, Telstra Corp Ltd, Australia Post, Westpac, TD Securities, PWC, Jobs Australia, Ostara Australia, Workpower Inc, Wise Employment, the Personnel Group, Matchworks and 18 health institutions including major metropolitan hospitals, amongst many others.

Recognising that effective collaboration transcends national borders, the University has increased the number and value of its national and international industry collaborations, with a strategic emphasis on China, Germany, India and Latin America. The University has agreements with a majority of the world's 50 top-ranked universities. The University also has widespread international

collaborations to leverage teaching and research potential, maintaining 239 international agreements with universities around the world.

The next phase in our strategy will see a significant focus on building engagement with industry and accelerating our commercialisation pipeline. The steps we are taking to build commercialisation prospects are outlined in more detail below.

C. Scaling-up successful innovation and research

The Australian Government's current policy activity, mastheaded by the NISA framework, responds to the existing challenges facing Australian innovation. Currently, Australian enterprises are not scaling-up like firms in comparable economies, particularly in the world of technology start-ups; only 4.8 per cent of start-ups of any kind in Sydney and Melbourne successfully scale up to become profitable businesses, compared to 8 per cent in Silicon Valley and 6.6 per cent in New York. These rates are too low for investors with a portfolio of start-up investments, which contributes to the challenge of local capital-raising. Meanwhile, the UK Trade and Investment's Sirius Program, Enterprise Ireland's International Startups Fund, and active efforts in Singapore and New Zealand are courting talent from the Australian tech sector.

As this trend gains momentum, Australia risks an entrepreneurial brain drain as other nations draw foreign entrepreneurs to their shores by opening up diverse opportunities for value creation. There is much progress to be made on building a bridge between higher education and industry:

- Between 2008-2010 Australia ranked 33 out of 33 countries on the proportion of large businesses collaborating with higher education institutions or public research agencies on product or process innovation.
- In 2014, just 4 per cent of large Australian firms collaborated with researchers from higher education institutions, compared with Finland where 70 per cent of large businesses and 30 per cent of small-to-medium enterprises (SMEs) collaborate with higher education. In the UK, 30 per cent of both small and large businesses collaborate with researchers in higher education institutions.
- Australia has an average of 8.6 R&D personnel per 1,000 people employed. This compares to Singapore with 10.7 R&D personnel per 1000 people, Denmark with 14.9 and Finland with 15.7.[i]

It is clear that these statistics do not align with the economic future the Australian Government has articulated in NISA and elsewhere. The University is keen to play its part in boosting the relationship between universities and industry. We are working to ensure that the right people are across the right opportunities at the right time.

Our unilateral efforts to improve research outcomes will be enabled and indeed amplified by a major policy effort to change the business-as-usual practice across all key sectors. Improving innovation and research outcomes will present a number of challenges to different stakeholders in the system, including government, universities and industry:

- Governments' challenge is targeting limited public resources for the best return on public money and understanding what problems the State is best placed to solve.
- Universities' challenge is funding the full cost of research and growing the impact of high-quality research.
- Industries' challenge is improving commercial outcomes and, where necessary, through working with the highest quality researchers including those at publically funded institutions.

Collectively and strategically, the Australian focus must be on high-growth, high-value industries that are critical to securing our future as a competitive, dynamic and outward-looking economy. Medical technologies and pharmaceuticals, new energy technologies, international education and other services – which are all sectors of research excellence and significant growth for our University – are the global industries of the future. As a nation, we must identify our strengths in this emerging landscape and move swiftly to build capacity around those strengths. International education is Australia's largest service export and our fourth largest export overall after iron ore, coal and natural gas. The higher education sector has been demonstrably successful in growing the export of education.

Looking locally, international education is also Victoria's largest export sector. However the Victorian medtech and pharmaceuticals sector is another key driver of economic activity for the state, employing more than 20,000 people and generating over $10 billion in revenue, largely through exports to global markets.[ii] As global demographics change significantly, the demand for high-quality health goods and services and new technologies to reduce health spending and improve quality of care will rise. For Australia, this is an opportunity to capitalise on global demand and build up exportable supplies of the innovative thinking, new intellectual property, skills in R&D, design, prototyping, clinical testing, data analysis and management that flow out of the rising demand.

D. Challenges and recommendations

Support for translation infrastructure and commercialisation mechanisms

The NISA announcement of an expanded CSIRO Innovation Fund, incorporating a $20 million expansion to the CSIRO ON accelerator programme for publicly funded research organisations to more rapidly prepare their research for commercial adoption, is a welcome advancement. The University looks forward to provision of the implementation details of these measures and clarification of eligibility. The NISA framework also establishes some important new incentives for investment at the seed funding or venture capital stage, as seen in the Tax Incentives for Angel Investors and New Arrangements for Venture Capital Limited Partnerships measures.

The University observes that these worthy measures are targeted at the commercialisation phase *after* the very early stage translation gap identified in this submission. As such, the University urges the Australian Government to consider complementary actions to also address this earlier gap in the commercialisation continuum in public research institutions and, subsequently, in Australia's

innovation ecosystem. Provision of support at the very early stage is critical to building a flowing source of potential commercialisation ventures that can go on to bid for seed and venture capital funding.

The translation gap will *not* be filled by the market as the nature of the endeavour means that most of these opportunities will never make a commercial return. This is why it is so important for the Australian Government and universities to work together to address this vital phase which immediately proceeds our research outcomes.

The University, for its part, is undertaking actions towards addressing the translation gap. We are examining the feasibility of hiring Venture Catalyst teams and ancillary infrastructure to cover that earlier and inevitable filtering stage of the commercialisation process. Co-investment between universities and Government would enable the Venture Catalyst infrastructure to reach the scale and resourcing levels necessary for success.

Investing in the people to lead the catalytic process is also crucial. The skills and experience necessary to achieve great scientific breakthroughs are very different to those required for translating technologies into compelling products and services. At our University we have many world-class researchers, but we also need to build world-class commercialisation teams. While some researchers naturally possess both research and commercial skills, not all do and nor would all researchers be expected to have commercial skills.

This is why public research institutions need to build reservoirs of management and business skills to complement scientific and technical skills. For every dollar spent on the research to develop a new product, at least $100 will ultimately be spent on the downstream development and marketing activities necessary to successfully bring the product to market.

Identifying the challenges: Unlike the US, and increasingly the UK, Australian research is seldom funded far enough to present viable investment opportunities. As a result, companies and investors seeking to leverage university-sourced intellectual property have access to better developed propositions in the US and UK. It is therefore unsurprising that those countries lead the world in accelerating the development of products or services from new inventions to commercial viability by providing specialised skills and resources to support the critical pre-Proof of Concept and pre-clinical junctures.

The translation gap in the commercialisation pipeline restricts the development of research ideas into prototypes suitable for commercialisation. At this early stage, the invention tends not to attract the dedication of a suitably skilled, experienced entrepreneur to plan and execute its commercial trajectory because the risks are considered too high by venture capitalists and corporate investors.

A good example of why this early gap funding can make or break a commercialised invention is the biopharmaceutical company **Fibrotech**. Fibrotech develops new drug treatments to prevent the massive health burden associated with tissue scarring. The venture grew out of a number of high-quality interrelated research endeavours led by a University of Melbourne academic, Professor

Darren Kelly, and would not have succeeded without his highly enterprising activities, personal acumen and the significant backing of universities and others.

Importantly, the product at the centre of Fibrotech was enabled to advance through early pre-clinical and clinical development by fee-for-service income, followed by crucial investment from Uniseed, a venture fund operating at the Universities of Melbourne, Queensland and New South Wales, and AustralianSuper, Medical Research Commercialisation Fund (MRCF), and Brandon Capital Partners. In May 2014, Fibrotech announced it had reached an agreement with Shire Plc, a global company, under which Shire agreed to purchase Fibrotech for an upfront payment of $75 million. We refer again to the case narrative on Fibrotech attached at **Appendix A.**

The Fibrotech sale was followed by equally impressive deals with Spinifex and Hatchtech, with both University spinouts attracting BigPharma investment. More than $1.8 billion has been raised in two years from sales of tech firms built on research from Australian universities.

These examples of university-born spin-outs demonstrate the positive track record and significant potential of university inventions. These positive outcomes could be substantially scaled-up with timely and sufficient public investment. They also demonstrate the importance of commercial skills and resources during the early translation phase, in order to identify the best opportunities for turning world-class research and IP into commercial outcomes and delivering on that potential.

To respond to the translation gap, the University is considering new university-led mechanisms to enable continuous and accelerated progress along the knowledge translation and commercialisation pipeline. One option is for universities to hire experienced business developers, often referred to as Venture Catalysts, to advance a portfolio of commercial opportunities and work with university-based inventors to package opportunities to meet investor expectations. The Venture Catalyst, in the form of a pool of capital with attached capacity and personnel, would become an essential gateway between industry and academia. This hands-on model would leverage the skills and experience of seasoned business builders across multiple projects to find the shortest path between the starting point and the point at which commercial investors might find the opportunity attractive.

In this model, the investment community would be motivated to monitor Venture Catalyst activity given the deal flow potential but, equally importantly, the Venture Catalyst would be constantly engaging with industry to bring market intelligence into the institution. Given that the challenge of commercialisation is global in nature, universities may look for bilateral or multilateral partnerships in establishing Venture Catalysts.

Recommendations on translation infrastructure and commercialisation mechanisms

1. Co-invest with universities in mechanisms such as Venture Catalysts to address the translation gap currently faced by early stage research commercialisation proposals in public research institutions.

MAJOR INNOVATION FUNDS

As stated above, the University welcomed the inclusion of two innovation funds in NISA, the CSIRO Innovation Fund and Biomedical Translation Fund.

Identifying the challenge: There is opportunity to develop the respective operating principles of these Funds to best address translation gaps and provide a critical mass pathway for deep technology investment across Australia's publically funded research base, including Universities and research institutes.

In particular, the University views important structural features for the operation of the new Funds to be:

- Coverage of translation infrastructure on the basis that it is the missing link in the broader research and investment landscape. By translation infrastructure we mean components such as human capital, skills bases, research quality mechanisms and other resources or policy programs that support the whole value chain of translation.
- Application of clear principles and development of an investment mandate that seeks to address gaps in translation infrastructure.
- Development of fund governance and operating models to attract and retain quality personnel and incentivise active engagement across the research base.

Recommendations on major innovation Funds

2. Consult with Australian research institutions on the development of operating principles and models of governance for the CSIRO Innovation Fund and Biomedical Translation Fund.

Coordinate measures to optimise the impact of publically funded research

INCUBATING IDEAS AND TALENT

Accelerator and incubator programs are a way for universities and partner organisations to cultivate the start-up entrepreneurial culture we need in Australia. The University is leading the charge with incubator programs such as the MAP outlined above. The NISA expansion of the CSIRO Accelerator Program is similarly a step in the right direction for giving Australian researchers the support they need to develop their ideas, test them and take them to market.

Evidence from the US demonstrates a strong economic case for government to support accelerators and incubators as a proven economic development tool for the wider community.[iii] British experience also suggests there is particular value in supporting university-linked accelerators and

hubs because of the role they play in helping to create university culture and capability that is more focused on translating knowledge into economic and social value.

Identifying the challenge: Australian industry is weighted towards small to medium enterprise, which makes it difficult to develop the kind of long-term, large-scale partnerships between industry and universities that deliver jobs, products and systemic capabilities. We see a role for government in providing scaled-up support for successful accelerator programs on university campuses and creating incentives for industry to sponsor places in these programs or co-locate joint research on campuses. At the University we are already embarking on these collaborative models, such as the Australia Post engagement with Carlton Connect, but with greater support and capacity there could be many more such arrangements.

A distinctive feature of the Australian research workforce is that, in comparison with other OECD countries, it is primarily employed by universities rather than hired directly by business, government and not-for-profit organisations. The University sees great potential in a secondment program involving university researchers working within industry and also embedding PhD candidates within new and innovating enterprises as a means to facilitate access to high-quality research while providing industry relevant skills to researchers. The reboot and expansion of Innovation Connections (formerly Research Connections) announced in the NISA package will go some way towards opening up these opportunities.

Recommendation on incubating ideas and talent

3. In addition to the NISA expansion of the CSIRO Accelerator Program, scale up support for successful accelerator programs on university campuses and effective incentives for industry to sponsor places in these programs.
4. To complement existing opportunities led by universities, expand opportunities through Innovation Connections or complementary programs for academic secondment to industry, two-way mobility programs for researchers, industry-based postdoctoral opportunities and flexibility in research scholarships.

EFFECTIVE FUNDING FOR RESEARCH

The University of Melbourne welcomed the Government's announcement of streamlining Australian Research Council (ARC) linkage grants for more regular and flexible applications. ARC linkage grants are an effective and important incentive for collaboration between universities and industry.

Identifying the challenge: While the block grant allocation mechanism now specifically rewards collaboration with industry, international experience shows that a dedicated funding stream can also act as an effective stimulant for collaboration. A new or third stream of funding, separate from that which supports the research base, can create further incentives for universities to collaborate and

conduct knowledge transfer. However, this fund should not come at the expense of current block grants that support the indirect costs of research.

The UK example of 'third stream funding' positively demonstrates this. Since 1999, the UK Government has boosted its third stream funding for the higher education sector, distinct from the two established higher education funding streams for teaching and research. 'Third stream' refers to knowledge-based interactions between higher education institutions and organisations in the private, public and voluntary sectors, and wider society.[iv]

A recent analysis conducted by the University of Cambridge of the impact of accelerated third stream funding showed shifts in culture and attitudes in the wider academic body of the higher education sector, as well as rapidly increased knowledge exchange outputs of 12% per annum nationally. The report noted that 'between approximately £2.9 billion and £4.2 billion out of £10.3 billion generated through knowledge exchange engagements between 2001 and 2007 can be attributed to the UK's third stream funding, either directly or indirectly. However, this almost certainly underestimates the true impact as many of the outputs cannot be monetised'.[v] This change happened without compromising the other missions of higher education providers.

Importantly, the expansion of applied research grants should not come at the expense of fundamental research grants and grants that support the indirect costs of research. These make a significant contribution to the research and commercialisation ecosystem and pipeline of invention. Fundamental research discoveries underpin all the major inventions. Fundamental research and applied research are part of a spectrum and are interdependent in unpredictable ways; the translation of research into outcomes cannot occur if there is nothing to translate.

Recommendations on more effective research funding

5. Develop a new or 'third stream' of funding, separate to that which supports the research base, to create appropriate incentives for universities and other commercial actors to collaborate. Here, even modest recalibration of the R&D Tax concession could be a useful incentive to drive industry collaboration with research providers like universities (see point 8).

INCENTIVES TO SUPPORT COLLABORATION AND METRICS FOR RESEARCH IMPACT

Australia consistently places amongst the top OECD nations with respect to its research performance, producing around four per cent of the world's published peer-reviewed research. Despite this impressive record, Australia ranks poorly on popular measures of collaboration and engagement between universities and industry. This engagement gap serves to inhibit objectives such as effective translation of research to products and services with social and economic returns for the nation, strategic direction of research efforts and diversification of research resourcing.

Cultural recognition of research impact is growing at universities, many of which are codifying how applied expressions of scholarship are part of mainstream academic activity. The University now gives explicit recognition to industry collaboration in career progression and promotion criteria for academics. We have implemented a suit of initiatives which promote incentives structures and other enablers of collaboration, including (as outlined earlier): establishment of an Enterprise Professorship program; roll-out of industrial sabbaticals and secondment program models; prioritising and embedding of engagement activities.

This momentum on campuses could be accelerated if sensible measures of impact become part of research grant assessments. The University therefore strongly welcomed the NISA announcement that the ARC will work with relevant sectors and stakeholders in 2016 to develop quantitative and qualitative measures of impact and engagement.

The University is continuing to examine the complex question of incentives to drive academic behaviour to support collaboration with research end-users, whether the innovation partners are in Government, industry or not-for-profit sectors. While universities clearly have a responsibility to lead the response to this challenge, a holistic and long-term solution will require active partnerships and efforts by government and industry alike.

Evidence from Sweden and the US exemplifies the challenge in devising effective mechanisms to drive collaboration with research end-users. Both countries have invested significant public resources into university R&D but have followed distinct models for commercialisation. Despite strong research performance in both countries, the crucial difference informing successful commercialisation rates in those countries was the presence of effective bottom-up mechanisms. Effective bottom-up mechanisms which change the national collaboration culture require persistent and partnered effort by universities, Government and industry.

Identifying the challenge: the academic labour market is global and the markers of academic achievement – particularly peer-reviewed research and citations – are internationally dominant. Career advancement for academic researchers in Australia, as in many countries, is largely driven by the quality of research reflected in published papers and citations. Moreover, in the Australian context significant reward and recognition is typically attributed to the extent to which academics successfully obtain HERDC Category 1 funding, typically from ARC and NHMRC grants.

Changing KPIs and reward structures within Australian universities are one part of the overall refocussing effort but, implemented without other bottom-up and culture changing drivers, will not achieve long-term changes in innovation outcomes.

While global rankings of peer-reviewed research and citations have a widely understood objective value, there are no equivalently influential metrics for innovation and research impact. Measuring and rewarding broader engagement contributed to a distinct shift in British universities. The Australian national effort to measure research excellence and impact, including the NISA inquiry led

by the ARC, should incorporate metrics that capture translation of research through commercial opportunities in addition to existing measures of research excellence.

Recommendations on research impact and metrics

6. Support universities to create stronger internal incentives and rewards structures for academic researchers to build engagement with end-users and strengthen impact while retaining fundamental research excellence and discipline depth.
7. Modify research evaluation systems and research excellence metrics in consultation with universities to place a greater emphasis on knowledge translation.

MODIFY THE R&D TAX INCENTIVE TO TARGET COLLABORATION

Current tax expenditure on the R&D tax incentive amounts to over a quarter of the Australian Government's support for science, research and innovation and is almost equivalent to funding for the NHMRC, ARC and CSIRO combined. This quantum of funds makes the incentive a powerful influencer of behaviour.

The University welcomes the NISA announcement of a review of the effectiveness and integrity of the R&D Tax Incentive to be conducted by the new independent body Innovation and Science Australia (ISA). We look forward to participating in that review process.

Identifying the challenge: This financial year the Government is expected to spend $2.9 billion on the R&D tax incentive that rewards research by industry. The tax incentive exists to support R&D that would not otherwise occur.

This significant funding pool for research could be more effectively targeted to fuel the collaborative research ecosystem desired by Government, universities and industry. The R&D tax concession should be scrutinised to identify where the incentive is having demonstrated impact, where it is leading to collaboration and where it is generating returns on investment through utilisation consistent with the principle of "additionality". In turn, Australia could expect greater research translation into commercial outcomes and, through collaboration, stronger alignment between the interests and priorities of industry and experts in academia. The R&D tax incentive could be modified to:

- make it easier for SMEs to benefit from the tax incentive, especially where they utilise established research providers to solve their problems.
- encourage and leverage collaboration with public researcher providers and public research infrastructure.
- direct skills, resources and other supports for research in the catalytic phase of commercialisation, including in public research institutions.

The University acknowledges the NISA announcements of the ISA review of the tax incentive, and the expanded and refocused Innovation Connections (Expansion of Research Connections) program, which goes some way towards encouraging SMEs to collaborate with university research and innovation. The effectiveness of that program could be enhanced with a higher quantum to support its various components.

Recommendations on targeting the R&D tax incentive

8. Modify the R&D Tax Incentive to improve collaborative research outcomes and ensure optimal return on public investment.

Provide gateway resources and programs to boost knowledge transfer, collaboration and engagement

Co-location is an important factor in innovative partnerships. As the cost of research infrastructure escalates, fewer universities can manage large-scale research agendas alone. This is why the Government's announcement of secure ten year funding for NCRIS was deemed critically important by the research sector to retain our world-class science and research capability.

Collaboration and international partnerships will drive excellent outcomes. Co-located precincts and hubs bring together government and researchers, established industry and start-up companies to address global problems and generate outputs that contribute to national prosperity. The University already works within a number of precincts, as outlined above. Co-investment in collaborative research precincts would be a significant gateway investment to address constraints in resources and capacity at the university-end and greatly expand the outcomes of research engagement.

Secondly, there may be further gateway reforms to intellectual property (IP) that would enhance outcomes in collaborative research. The University is a research and teaching organisation with significant expertise in IP law, with extensive ownership of patents and utilises copyright, trademarks and online investment in digital media.

The University welcomed the prospective IP changes highlighted in the NISA and the release in September 2015 of the Australian IP Toolkit for Collaboration. To further simplify and streamline IP in Australia for the benefit of unlocking innovation, the Australian Government could explore the potential benefits of regulatory consolidation, as well as specific issues of existing overlap relating to copyright and design, trademarks, patents and consumer protection legislation.

Identifying the challenge: Regarding IP, the higher education sector is in a unique position because they are not only producers and consumers of IP but must share outcomes for public good and community engagement. However, the changing nature of the research funding environment and

the imperative of collaboration has encouraged new modes of research practice between universities and industry, and added complexity to IP interests.

The University recommends the consolidation of expertise into one agency that is responsible for IP, under the control of a single Minister. Currently, IP Australia in the Department of Industry, Innovation and Science is responsible for patents, trademarks, designs and plant breeders' rights, while copyright, circuit layouts, and arts resale royalties are part of the portfolio of the Minister of Communications. In other countries, one agency with a single Minister is responsible for these portfolios. This would enable greater co-ordination in policy review and more practical aspects of processing of rights.

Recommendations on gateway steps to knowledge transfer, collaboration and engagement

9. Partner with universities and industry to develop large-scale innovation infrastructure to support co-location of research efforts between universities, industry and other partners.
10. Develop and publish a consolidated intellectual property framework to operate under a single Ministry, similar to that implemented in the UK, to provide clearer guidance for Australian innovation agreements in academia and industry.

THE UNIVERSITY OF MELBOURNE

APPENDIX A:

From bench top to boardroom (and back): the Fibrotech story

Darren Kelly is an endocrinology researcher, who is developing drug therapies to treat cardiovascular disease, at the University of Melbourne. He is also a successful businessman, having created a biotechnology company, Fibrotech, to commercialise his own research. In 2014, Fibrotech was sold for more than $600M, while Darren continued his research and co-founded another company, OccuRx, which he now heads. Darren shares insights on how he has managed to sustain successful academic and commercial careers.

When Darren Kelly submitted his PhD thesis in the early 1990s, he was already on his way to commercial success. Through his research, Darren had developed a new animal model for diabetic kidney disease: a hot focus for global pharmaceuticals then and now.

"Basically, it was a new animal model that developed progressive diabetic kidney disease, which means that it develops all of the clinical symptoms seen in patients," said Darren, adding that such models are essential to proving preclinical efficacy for new drugs.

Initial publications generated a lot of excitement and, importantly, a request from the French pharmaceutical company, Servier, to test their drug Perindopril – a drug that went on to become a multibillion-dollar blockbuster.

"We weren't in a position to commercialise the model," Darren said. "But once we had published on it – and because we had all this know-how – pharmaceutical companies started coming to me to test their compounds."

During the next few years, the lab tested more than 20 products for various companies, some of which are now marketed to treat hypertension, diabetic complications and kidney failure. Among those tested, Darren's model was used in preclinical screening of Valsartan for Novartis and Ruboxistaurin for Eli Lilly.

"Academic papers were important. But my postdoc supervisor, Richard Gilbert, and my PhD supervisor, Mark Cooper both were in many ways visionary back then – going against the grain by doing work with industry," Darren said. "So once we had the model, we were able to establish industry links quickly and very early on".

In each case, the pharmaceutical paid the lab to test the drug on the animal model. This fee-for-service income was so significant that, alongside NHMRC program grants, it ensured the lab was well funded and secure. Importantly, it also ensured that when Darren came to launch Fibrotech, there was a pool of money he could use as seed investment.

Importantly, the work with industry did not impede Darren's academic career. In fact, it greatly enhanced it:

"The industry links gave me the latest research tools to work with and increased my profile internationally, because I was investigating novel drug treatments that had impact on human health," Darren said. "We were publishing more than 15 papers a year for around 12 years – a very productive group. We were always able to publish and never had any resistance – though sometimes we had to wait until there were patents."

The experience also gave Darren unique access to pharmaceuticals, which gave him a deep understanding of how they worked and what products they needed. These skills and insights proved critical to Fibrotech.

In the late 1990s, Darren was working with Richard Gilbert on a drug called "Tranelast". Using their model, they were able to show that Tranelast reduced fibrosis in diabetic kidney disease. This work was primary academic research and not fee-for-service. However, Tranelast was off-patent and not commercially viable.

"So several years later, I started a collaboration with Spencer Williams [BIO21 founder and leading chemist] to try and modify Tranelast and make it a new chemical entity that was more anti-fibrotic and also significantly less toxic. "

Darren saw the commercial potential in the product and formed the company, Fibrotech, in 2006 to advance the product through pre-clinical and clinical development. From 2007 to 2014, Darren raised AU$7.2M from a consortium of investors – including Uniseed, the Medical Research Commercialisation Fund (MRCF), and Brandon Capital Partners – to advance the product to clinical proof of concept.

In the meantime, Darren continued to regularly publish in academic journals and his university research team maintained an NHMRC program. In 2013, Darren began looking for a licensing partner, which culminated in Shire Pharmaceuticals acquiring Fibrotech for more than A$600M – the single largest private Australian biotech deal at the time and one of the largest commercial deals to emerge from University research in recent years.

Despite Fibrotech's success, Darren hasn't hung up his lab coat – he is still a leading University of Melbourne researcher.

Nor has Darren retired from business. In 2014, Darren became founding CEO of Occurx, a biotech company that is developing products from Darren's research to treat retinal diseases.

For Darren, commercialisation has been a natural extension of his research. But he recognises that industry collaboration isn't for every academic.

"Those wanting to link in with industry need to realise the objectives are highly defined milestones that are focused on getting products to market," Darren said. "That's why I went in to research – to develop new drug treatments."

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[v] Ibid p. 20.