

6.

**Enhance
Commercial
Pathway to Impact**

6. ENHANCE COMMERCIAL PATHWAY TO IMPACT

6.1 Introduction

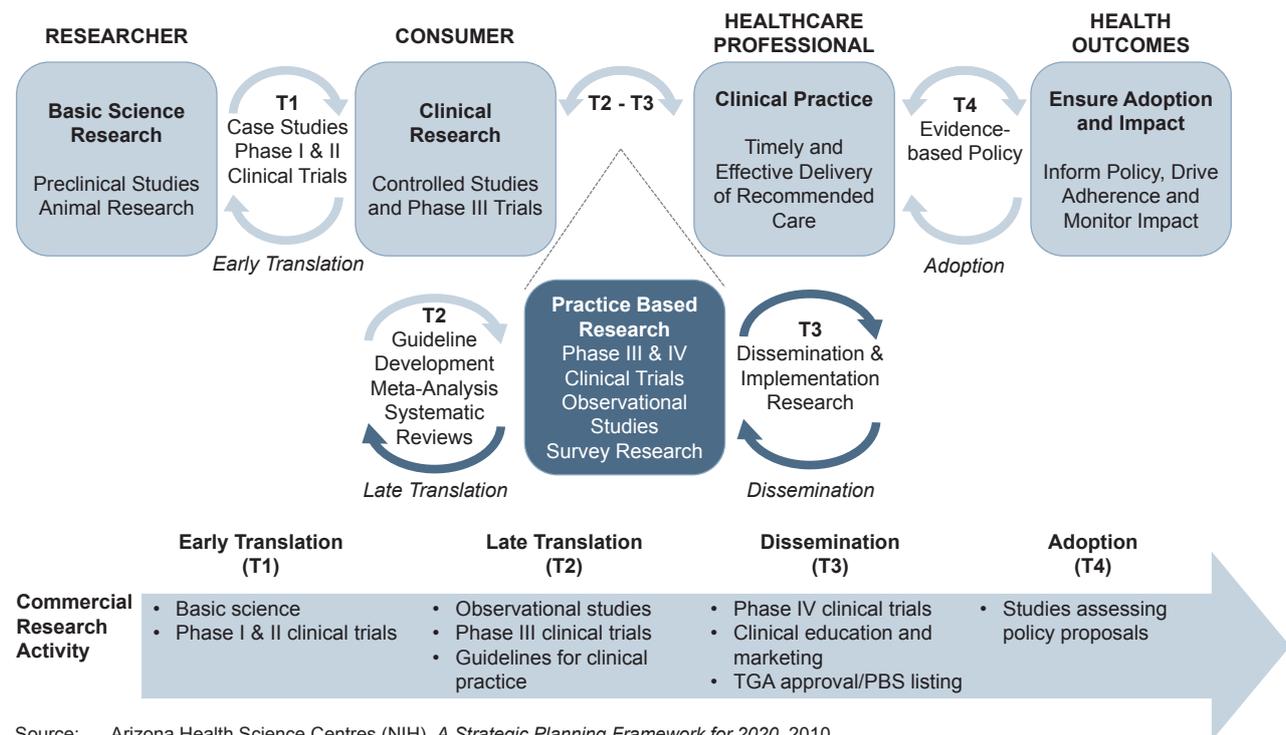
As described in Chapter 5, HMR can be translated into a range of health, economic and social benefits, for individuals, communities and governments. The two main pathways to these impacts—non-commercial and commercial—both have their place in driving benefits, and both have their difficulties. The framework for commercial translation is similar to the one for non-commercial translation described in the previous chapter, though with a different flow of activities. In commercial translation, the four phases of the framework are defined by NIH as:

- T1 – basic science, and phase I and II clinical trials
- T2 – observational studies, phase III and IV clinical trials, and guidelines for clinical practice
- T3 – clinical education, conferences and marketing, and Therapeutic Goods Administration (TGA) approval, and Pharmaceutical Benefits Scheme (PBS) listing)
- T4 – studies assessing policy proposals.

Exhibit 6.1

The NIH Research Translation Framework can be applied to commercial translation

NIH Research Translation Framework



Source: Arizona Health Science Centres (NIH), *A Strategic Planning Framework for 2020, 2010*

The translation of research outcomes in the T1–T4 framework applies both to commercial research (e.g. drugs, medical devices) and to non-commercial research (e.g. health services, health economics). For example, in the stages of research and translation that brought about the cervical vaccine Gardasil, T1 was the discovery phase, T2 saw clinical trials that resulted in the production of guidelines for use, T3 saw adoption by clinicians and T4 was a government-sponsored vaccination program to the wider population. In a generalised epidemiological example, T1 assesses potential health applications by using clinical and population studies, T2 assesses

the efficacy of interventions to improve health and prevent disease by using observational and experimental studies, T3 assesses the implementation and dissemination of guidelines into practice, and T4 assesses the effectiveness of interventions on health outcomes.¹²⁸

Within this framework, commercialisation is a necessary part of the process of delivering the benefits of research to the community. It can result in new and improved diagnostics, medical devices, therapeutic drugs, and a range of services. With commercial translation, financial benefits not only come to the commercialising entity through local sales and export income, but the processes and end products can also provide:

- high-value jobs in Australia;
- royalties to research institutions;
- returns to Australian shareholders of successful biotech and medical devices companies; and
- incentives and rewards to scientists and clinicians.

The process of commercialisation spans from proof-of-concept research to generating profits, and encompasses research organisations, clinical settings, business development offices, venture capital and innovation investment funds, and corporate entities. For commercialisation processes, the promise of profits means that champions may be far more numerous and forthcoming than for public-good translations. There remain, however, major barriers to the commercial translation of research into marketable drugs, devices and services, particularly in Australia. Further, it is important to ensure that researchers have a clear view of the end-user during research rather than as an afterthought.

Benefits of commercialisation. There is clear value in supporting the commercialisation of HMR in Australia along the developmental chain, especially in the preclinical and early clinical trial stages where appropriately-targeted support could provide the necessary stimulus to convert ideas into real products and services.

“ *Australia is the leading location for biotechnology companies in the Asia-Pacific with over 1,000 biotechnology companies and 450 therapeutics and diagnostics and 600–1,000 medical technology companies ... As reported in February 2012 there were 100 ASX-listed life-sciences companies, with a market capitalisation of \$31.4 billion. Australia offers world-class science, capacity for international partnerships, cost effectiveness, and a transparent and efficient regulatory system. In July 2011, Australia was ranked number five globally by Scientific American's World View.*

*AusBiotech*¹²⁹

The combined biotechnology and pharmaceuticals sector currently provides over 40,000 Australian jobs,¹³⁰ and there are over 10,000 people employed in the medical technology sector.¹³¹ The biomedical industry is Australia's largest high-technology exporter with almost \$4bn in export value in 2010–11,¹³² surpassing the size of the automotive industry, and is the highest manufacturing industry investor in R&D (\$1bn in 2009–10).¹³³ Publicly-listed life-sciences companies have consistently outperformed the broader equities market over the last 12 years.

Australia has clearly produced some great commercialisation successes such as CSL Limited, Resmed and Cochlear (Exhibit 6.2), but these have been too few and value creation is predominantly concentrated among these few large companies.

128 As described in MJ Khoury, M Gwinn and JPA Ioannidis, 2010, op cit.

129 Source: <http://www.ausbiotech.org/content.asp?pageid=25>.

130 Commonwealth of Australia, Pharmaceuticals Industry Strategy Group, Final Report, 2008.

131 AusBiotech URL: <http://www.ausbiotech.org/content.asp?pageid=25>.

132 ABS Catalogue 5368.0, International Trade in Goods and Services, Australia 2010–11.

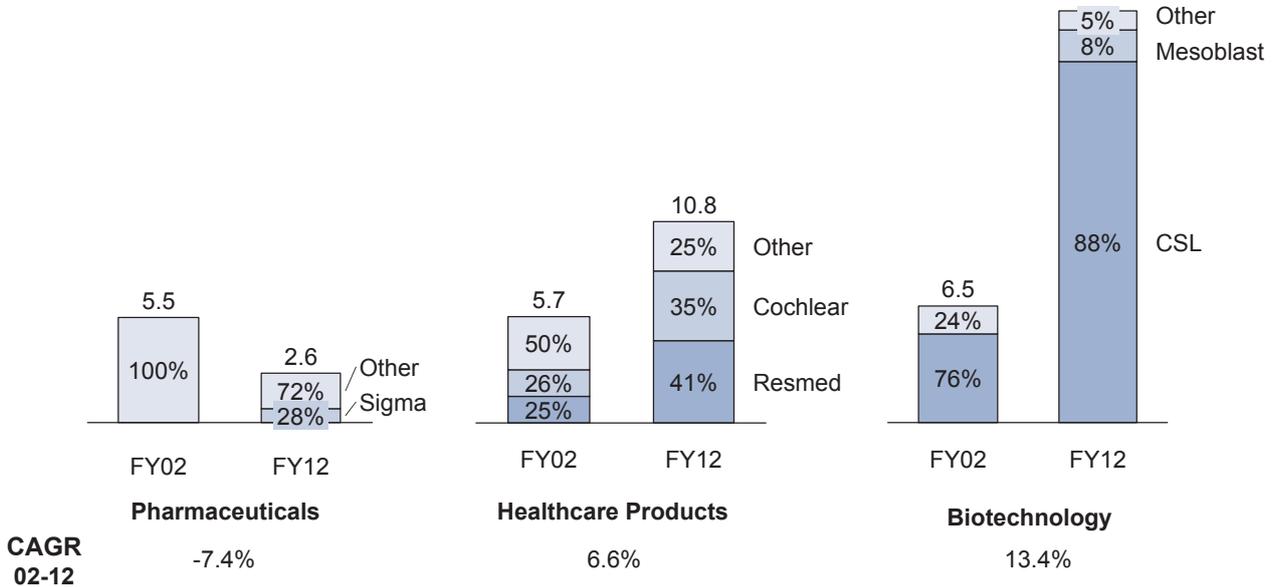
133 ABS Catalogue 8104, Research and Experimental Development by Socioeconomic Objectives, Australia 2009–10.

Exhibit 6.2

Value creation remains highly concentrated, particularly in healthcare products and biotechnology

ASX All Ords HMR-related Sectors Market Capitalisation

\$bn



Source: Bloomberg

The venture capital landscape has seen the largest injection of capital over the last six years in the healthcare and life sciences sector, with more than \$400m invested over this period (Exhibit 6.3).

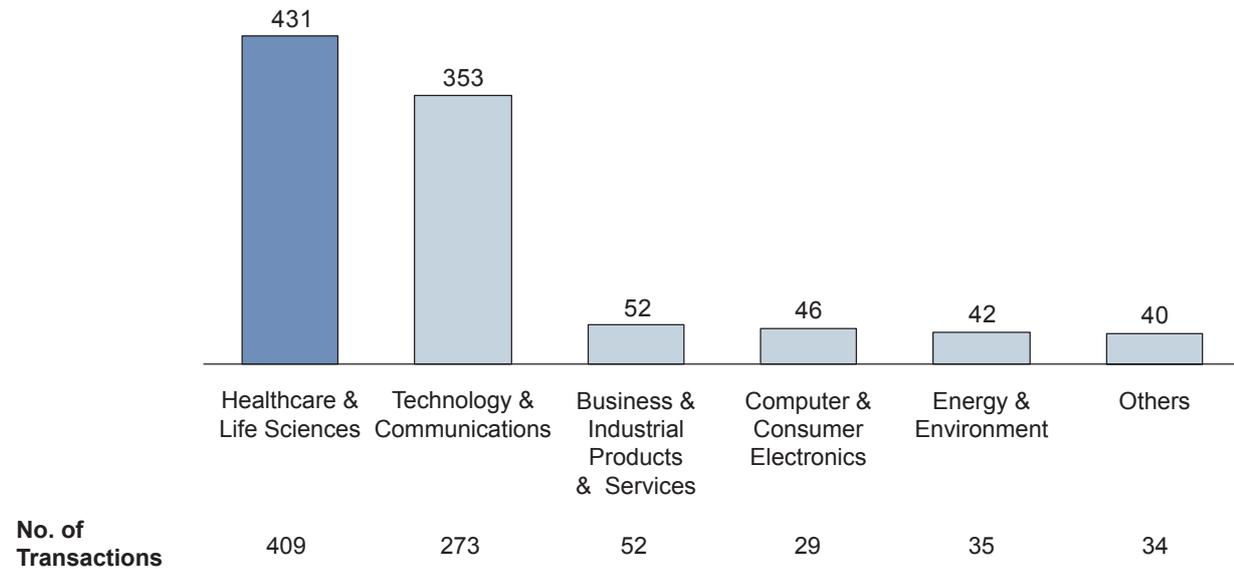
Exhibit 6.3

Healthcare and life sciences investment is the largest venture capital sector

Venture Capital Investment by Sector

2005–06 to 2011–12

\$m



Source: AVCAL Pacific Strategy Partners, Deal Metrics Survey, 2012

It is clear that Australia has a very strong HMR capability and superior strengths in a number of specific health and biomedical research areas,¹³⁴ yet Australia has a relatively poor record in the translation of this research into health and commercial benefits, both in the public-good arena (as discussed in Chapter 5) and in the commercial arena. Relative to the number of papers published and patents issued, Australia lags in key global commercialisation benchmarks and in creating significant public companies, commercial products, jobs and income.¹³⁵ This means that, in addition to not gaining health benefits from those innovations, Australia misses out on the commercial and economic benefits that would also become available. The reasons for Australia's failure to sufficiently capitalise on the commercial benefits of its HMR include:

- a lack of funding for preclinical and early clinical research work
- the lack of a major pharmaceutical industry located within the country
- a relatively underdeveloped commercialisation environment in Australia, with limited knowledge of commercialisation principles among researchers, inadequate critical mass within university and MRI business development offices, and counter-productive practices relating to the protection of IP.

6.2 Support Research Commercialisation

Recommendation 16: Support Research Commercialisation. Provide funding to address the twin 'valleys of death' in commercialising research.

- Institute a Matching Development Grants scheme to provide \$0.5m p.a. to each of the 20 consistently most successful NHMRC peer-reviewed grant recipient organisations, contingent on matching commitments and access to business development capabilities.
- Maintain HMR access to the Australian Research Council Linkage Projects scheme.
- Establish a Translational Biotech Fund for early-stage development of around \$250m, funded by the Australian Government and the private sector on a one-to-one matching basis.
- Continue to support the Innovation Investment Fund program.

6.2.1 Introduction

Lack of 'D' in R&D. One of the major reasons Australia lags in research commercialisation is the very small proportion of funding by government to support research translation into commercial products compared to funding for basic and applied research—while over \$8bn is spent annually in Australia on research across all sectors, government support for research commercialisation activities is less than 1.5% of this amount.¹³⁶ Furthermore, many of the Australian Government-funded innovation support programs instituted over the last 10 years have been dropped for reasons mostly relating to their perceived or measured lack of impact. It is the Panel's view that further government support is required to support and accelerate commercialisation, but in a more appropriately targeted form.

134 The 2010 *Excellence in Research for Australia* (ERA) report found that disciplines in the health and medical sector which performed 'well above world standard' were: Cardiovascular Medicine and Haematology; Oncology and Carcinogenesis; Immunology; Medical Physiology; Human Movement and Sports Science; Clinical Sciences; and Pharmacology and Pharmaceutical Sciences.

Source: ARC, *Excellence in Research for Australia 2010 National Report*, Canberra, 2010.

URL: http://www.arc.gov.au/era/era_2010/outcomes_2010.htm.

135 For example, the 2012 INSEAD Global Innovation Index ranked Australia 23rd, behind smaller countries such as Estonia (19), New Zealand (13), and Ireland (9).

136 Australian Government, 2011–12 Science, Research and Innovation Budget Tables (commercialisation-related budget lines), p.3.

In the HMR commercialisation process, funding is required at three key stages—preclinical, early clinical and late clinical (Exhibit 6.4). It is at the first two stages that shortfalls in funding, or inappropriately targeted funding, are frequently experienced. Indeed, the problems at these two points are so profound that they are colloquially known as the twin 'valleys of death'. Targeted government support at these points, in ways that leverage matching support from private sources, is critically needed.

Exhibit 6.4

Commercialisation requires funding across three stages and must navigate the twin 'valleys of death'

Commercialisation Funding Stages

	'Valley of Death #1'	'Valley of Death #2'	
	Preclinical	Early Clinical	Late Clinical
Example	<ul style="list-style-type: none"> Research has identified potential new diagnostic/assay/drug via lab research, initial animal models, etc. 	<ul style="list-style-type: none"> Research has discovered a molecule as drug candidate, evidenced by animal studies 	<ul style="list-style-type: none"> 'In man' clinical trials already through phases I and II (pilot), and addressable market scoped as commercially significant
Funding Required	<ul style="list-style-type: none"> No funding for further lab or animal trials available from grants, but too early for biotech, venture capital or industry investment Requires ~\$200k–\$1m per project over 2 to 3 years 	<ul style="list-style-type: none"> Funding for phases I and II (pilot) clinical trials to collect data that can support proposals to venture capital, biotech and industry Requires up to ~\$10m per project over 5 years 	<ul style="list-style-type: none"> Funding through phases II (well controlled) and III global clinical trials Requires ~\$15–\$500m over 5+ years
Current Funding Sources	<p>Grant Schemes:</p> <ul style="list-style-type: none"> NHMRC Development Grants Commercialisation Australia ARC Linkage Projects scheme <p>Commercial Investment:</p> <ul style="list-style-type: none"> Discretionary MRI and university reserves (~\$2–\$10m p.a.) MRCF (~\$1–\$2m p.a.) Biopharma/other (~\$2–\$3m p.a.) 	<ul style="list-style-type: none"> Innovation Investment Fund (~\$10m p.a.) MRCF (~\$10m p.a.) Other private sector biotech fund managers (~\$5–\$10m p.a.) Small cap public biotech (~\$0–\$20m p.a.) 	<ul style="list-style-type: none"> Innovation Investment Fund MRCF and other private sector biotech fund managers Small cap public biotech CSL and other large pharma (Note: All above source actively, but MRCF and other private sector biotech underfunded)
Recommended New Funding	<ul style="list-style-type: none"> \$25m p.a. 	<ul style="list-style-type: none"> At least \$50m p.a. 	<ul style="list-style-type: none"> Case for government investment not clear given scale; may be better suited to large biopharma investment

Notes: Includes drugs and devices
Source: Panel interviews

“

Because of the complexity and expense of translational activities through to proof-of-concept many potentially valuable projects fail to attract the level of resource required to progress further. For example, at CSL we look at over 100 opportunities each year. Of these, we choose 5-10% for full evaluation and then select only a handful for licensing. While many opportunities are declined because they are unsuitable for further development and commercialisation, we also have to turn down some potentially valuable and exciting projects simply because our available resources are fully allocated to other R&D projects. Some of these projects may be picked up by international companies but, in the process, opportunities to increase returns to Australia are lost.

CSL Limited

Funding at these two stages will help increase the outward flow of 'invisible ideas' that live within the research environment, and assist in unlocking their commercialisation potential (Case Study 6.1). In terms of the third, late-clinical stage, while Australia has an improving level of participation by large pharmaceutical industry investors and some private equity support, the Panel does not believe that there is a strong case for suggesting government funding for this stage, especially given the large cost involved (approximately \$50m per project).

6.2.2 Bridge 'Valley of Death #1' – Preclinical Stage

Preclinical Stage Funding. The first funding 'valley of death' occurs during the development of ideas in the preclinical stage of research (discovery to proof-of-concept) where further funding for laboratory research is generally not available but the research is still too early in the development chain to attract biotech companies, venture capital or industry investment. The amount required at this point ranges from \$200,000 to \$2m per project. The Australian Government provides support for preclinical stage commercialisation through three different competitive grant programs. Modest funding is also provided by some MRIs, universities and privately-managed biotech funds.

- **NHMRC Development Grants scheme** – NHMRC Development Grants provide funding support for commercial development of products, processes, procedures or services that, if applied, would result in improved healthcare, disease prevention or provide health cost savings. In 2010–11, grants totalling \$7.5m were awarded under the scheme.¹³⁷
- **Commercialisation Australia** – Launched in late 2009 as the successor to the Government's COMET scheme, Commercialisation Australia provides matched funding to bring IP to market for early-stage commercialisation. Funding of \$50,000 to \$2m over 24 months is matched on a one-to-one basis with the participant to encourage co-investment. This program has provided early-stage support for health and medical researchers in the fields of biotech, medical devices, software and online tools, supporting more than 64 projects with total grant funding of more than \$25m to date.
- **ARC Linkage Projects scheme** – ARC also has a commercialisation funding scheme, Linkage Projects, which has been a productive translational mechanism for early-phase commercial development in all areas of industry. The scheme provides funding to eligible organisations to support R&D collaboration between higher education researchers and the industry, that is undertaken to acquire new knowledge and involves risk or innovation.
- **Other sources** – These include some discretionary funds from MRIs and industry investment from private sector biotech fund managers and the bio-pharmaceutical industry. While these investments are considered high risk, they are generally well deployed, particularly in larger research organisations with commercialisation expertise, and successful funds such as the Medical Research Commercialisation Fund (MRCF).

The aggregate of these sources of preclinical 'D' funding is estimated at no more than \$25m p.a. The Panel considers this to be a seriously inadequate allocation in the R&D mix needed for any sustained improvement in the national HMR commercialisation pipeline. A conservative estimate of the funding gap at the preclinical stage is about \$25m p.a. since these existing sources are less than optimally targeted and inadequate in scope.

Issue: NHMRC Development Grants can be further leveraged. An independent evaluation of the Development Grants Scheme commissioned by the NHMRC found that Development Grants have been successful.¹³⁸ The study surveyed all completed and current Development Grants in the 2000–2008 period (estimated to be over 300), and selected 40 grants for further analysis, although the details of the 40 grants and criteria for selection have not been provided.

The Panel's concern, however, primarily lies within the positioning of the Development Grants. Several submissions to the Panel suggested that the commercial criteria required to be met by applicants to the scheme are too onerous and are unrealistic for such early-stage developments. In addition, the panels assessing these grants appear to place undue emphasis on track record. Very few researchers have achieved commercial success, and most will only do so once. As a result, the bar is inappropriately high and it remains unclear whether the scheme delivers the necessary 'development' part of the R&D process.

¹³⁷ Australian Continuous Improvement Group, *Evaluation of Development Grants Scheme Report*, 2012.

¹³⁸ Ibid.

“ *NHMRC Development Grants are designed to support individual researchers, research teams, or a company in partnership with a researcher/s to undertake work at the early proof-of-principle or pre-seed stage. While we support the intention of these grants, they are largely ineffective because:*

- *funding is too little and far too short a term to make a real difference: \$100-300K per year over 2 years; and*
- *there is no requirement for the researcher to form links with a company capable of, and willing to, assist with advancing the project. A scheme like this needs to encourage strong links between the investigator and a commercial partner to drive it forward.*

CSL Limited

Option: Institute a Matching Development Grants scheme. An option to address the preclinical 'valley of death', particularly early on and prior to engaging a commercial partner, is to institute a Matching Development Grants program that provides, for example, 2% of a moving three-year average of NHMRC Project Grants to host organisations such as the 20 consistently most successful NHMRC peer-reviewed grant recipients. The grants would require host recipients to:

- match the stapled grant dollar-for-dollar with their own or third-party funds;
- have an established business development office or demonstrated use of an outsourced commercialisation service provider (and include a requirement to screen inventions for potential market relevance before filing patent applications);
- select proof-of-concept and development projects (instead of NHMRC); and
- audit funds to ensure they are only used for development purposes.

The advantages of this scheme include the potential to significantly increase the development funding for early-stage discovery and shifting the review and selection burden from the NHMRC back to the recipient organisations while maintaining or increasing the likelihood of success given the requirement for co-investment 'skin in the game'. Small research institutes would not be excluded from accessing these grants, although they may need to collaborate with larger MRIs and university groups to access business development capability, or otherwise with third parties that have such skills (for example, large pharmaceutical companies, Commercialisation Australia or venture capital enterprises).

Funding for the new NHMRC Matching Development Grants scheme of up to \$10m p.a., to be matched with \$10m in development funding by recipient host organisations, could be expected to enable the advancement of up to 50 projects each year—projects that would otherwise languish and expire in the first 'valley of death'. The scheme may be suitably funded by a modest reallocation of existing NHMRC funds while more than doubling the aggregate of development funding.

Issue: Greater alignment between commercialisation schemes is needed. There is also some overlap in activity between NHMRC Development Grants and Commercialisation Australia, and to some extent the ARC Linkage Projects scheme, all of which provide funding for preclinical proof-of-concept and development projects. Given the infancy of the Commercialisation Australia program, operating for just over three years, it is too early to comprehensively evaluate its performance. It is clear, however, that Commercialisation Australia has built capability and expertise in providing commercial development advice in addition to funding. This capability has strong potential to be leveraged by others involved in the development process.

“ *Schemes such as NHMRC Development Grants, Commercialisation Australia and ARC Linkage Grants need to be complementary and support the translation of research without leaving gaps, particularly at the early stages of translation where there is often a gap between 'discovery' and 'development'. These schemes need to be expanded to fill the void left by the critical shortage of venture capital in this country. Coordination between government agencies and departments is critical.*

University of WA Researchers' Association

Option: Increase coordination between existing schemes. Increased alignment and coordination between existing schemes is recommended. As noted by the NHMRC Development Grants evaluation report recommendations, the NHMRC should consult with Commercialisation Australia and appropriate agencies in other jurisdictions on options for greater coordination between Development Grant projects and publicly-funded, early-stage, proof-of-concept opportunities.¹³⁹

Issue: ARC Linkage Project grants are no longer readily accessible to the HMR sector. ARC recently introduced significant restrictions to health and medical researchers' eligibility to apply for ARC funds. This rendered all preclinical research ineligible, completely discriminating against commercial development in this sector. In contrast to feedback on the NHMRC Development Grants, submissions to the Review suggested support for the partner-leveraged approach of the ARC Linkage Projects scheme which appears to have effectively supported preclinical development. Hence, the loss of ARC Linkage Projects grants to the HMR sector is significant as it shuts down a large section of early commercial translation.

Option: Restore access to ARC Linkage Project grants for HMR sector. Commercialisation of HMR as part of the DIISRTE portfolio is as important as commercialisation in any other sector. Maintaining HMR access to ARC Linkage Projects scheme grants is important, as many current medical devices and treatments were only enabled by the basic science discoveries that underpinned them. The Panel therefore recommends that DIISRTE ensures that the HMR sector has full access to ARC Linkage Projects grants, Cooperative Research Centre (CRC) funding and other DIISRTE development and commercialisation programs, particularly those relevant to multi-disciplinary projects spanning engineering, IT, HMR, physics, nanotechnology and other disciplines.

	Implementation Tasks	Responsibility	Timeframe
16a.1	Institute a Matching Development Grants scheme for preclinical stage research that provides block-grant funding of \$500,000 to each of the 20 largest NHMRC peer-review grant-recipient research organisations, as measured by the moving average of the most recent three years of grants. Ensure that recipients satisfy the following three criteria of: <ul style="list-style-type: none"> • appropriate internal business development resources • agreed access to NHMRC-approved external business development resources (e.g. Uniquist, Medical Research Commercialisation Fund) • providing matching cash commitments. Allow recipient organisations to select prospects for development and require them to submit annual acquittals to NHMRC. Encourage smaller organisations to collaborate with the larger block-grant recipients.	NHMRC	2014–15
16a.2	Evaluate the success of the Matching Development Grants program at the end of the first five-year period.	NHMRC	2019–20
16a.3	Increase coordination between existing commercialisation schemes, particularly NHMRC Development Grants and Commercialisation Australia.	NHMRC	2014–15
16b.1	Clarify that DIISRTE is the Australian Government department responsible for commercialising research and covers HMR.	DIISRTE	2014–15
16b.2	Ensure that HMR has access to and support from the ARC Linkage Projects scheme, CRC and other DIISRTE commercialisation programs.	DIISRTE	2014–15

¹³⁹ NHMRC, *Evaluation of Development Grants Scheme*, Canberra, 2012.

CASE STUDY 6.1

CSL is one of Australia's greatest commercialisation stories and its success has been underpinned by sustained R&D investment

Background. CSL Limited is a global leader in the research and development of bio-pharmaceutical medicine and is Australia's largest biotechnology company and one of the country's greatest commercialisation success stories. CSL makes a significant contribution to the Australian economy with a market capitalisation of over \$27bn,¹ sales revenue of over \$500m and over 1,700 employees². Globally, CSL employs over 10,500 staff in more than 25 countries, generating sales of over \$4.4bn in 2012—a 19% annual increase over the last 15 years.

Much of CSL's success has been driven by its significant investment in R&D, which has grown from \$37m in 1997 to \$355m in 2012. CSL maintains a number of long-standing, strategic partnerships with Australian research organisations.

Through its Australian operations, CSL has pioneered a number of medical interventions that have had global impact, including:

- Gardasil – the first vaccine designed to prevent a cancer
- Panvax H1N1 – H1N1 influenza vaccine
- Fluvax – influenza vaccine
- Intragam P – immunoglobulin used to treat immunodeficiency
- Biostate – coagulation therapy

Key Lessons:

1. **Research commercialisation creates national wealth and new jobs.** CSL generated sales in Australia of over \$510m in FY12 and currently employs more than 1,700 Australian workers.
2. **Sustained investment in health and medical research leads to innovation and wealth creation.** Investment in HMR ensures Australia continues to deliver internationally competitive research discoveries that can be translated to evidence-based care and maintains a critical mass of highly trained and skilled researchers to undertake basic research and foster translation.

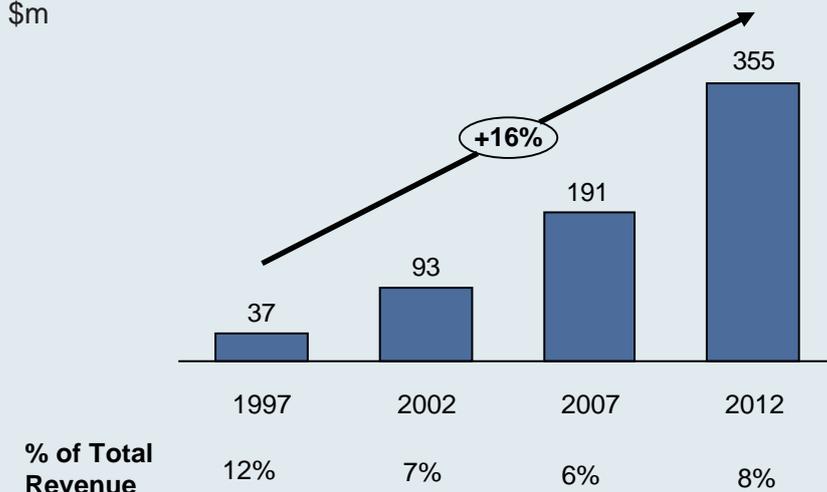
Note: 1. As at 31 December 2012

2. Full-time equivalent employees

Source: CSL Limited: www.csl.com.au; Bloomberg

CSL Global R&D Investment

\$m



6.2.3 Bridge 'Valley of Death #2' – Early Clinical Stage

Current Funding Sources. In the early clinical development stages, funding is needed to collect data to support late clinical stage development proposals that would seek funding from venture capital, biotechnology and industry corporations. The current funding sources for early clinical stage work are estimated at \$40m p.a. and comprise several sources.

- **Innovation Investment Fund (IIF) (\$10m p.a.)** – The IIF is a co-investment scheme that uses a competitive process to license private sector fund managers and provide them with capital for investment at a matched ratio (currently 1:1). The program is not sector specific and investments are made in the field of expertise of the fund rather than the sector. Each fund manager pools their capital and invests in early-stage companies that are commercialising Australian R&D. The government also incentivises investors by allocating 90% of the profits of a successful exit to the private sector partner. Since its inception in 1998, the IIF has supported 47 HMR companies with \$124m in investment, representing about 40% of the total fund.
- **Medical Research Commercialisation Fund (MRCF) (\$10m p.a.)** – MRCF is managed by Brandon Capital and has been sponsored by state governments and private superannuation funds. It searches for potentially attractive research ideas for review and brings together member MRIs across the country to share technology and propose possible investment opportunities.
- **Other private sector biotech fund managers (\$5–10m p.a.)** – Examples of biotech fund managers who provide support for early-stage development and commercialisation of medical technologies by bringing together research institutes, healthcare providers and investors include Starfish, Southern Cross, Coates Myer and GBS Ventures.
- **Small-cap public biotechnology company equity issues (up to \$20m p.a.)** – While capital raisings also provide a source of investment at this stage, this is more towards the later end at which point the research has largely been proven.

Issue: Insufficient funds to support early clinical stage ventures. Funding for this stage is also considered to be inadequate, and a conservative estimate of the additional requirement is in the order of \$50m p.a., supporting an average of five additional projects each year at \$10m per project. While IIF has been successful and delivered returns to the Australian Government, it does not cover the second 'valley of death' gap in funding for HMR. The performance to date of bioscience funds in Australia has not been sufficient to warrant continued institutional support without additional risk-mitigation measures. There is therefore a compelling case for the Australian Government to provide a mechanism to stimulate private institutional investment.

Option: Create a Translational Biotech Fund. What is needed to bridge the second 'valley of death' is a Translational Biotech Fund (TBF) that would provide support from the end point of the NHMRC Matching Development Grants program (or ARC Linkage Projects scheme), through the early clinical stage (clinical trial phase I or II). The TBF would be a \$250m fund seeded with class B equity capital of \$125m by the Australian Government (callable over five years), and matched by industry sources (for example, large superannuation funds). The TBF should be styled along IIF lines, and managed by a well-qualified external manager with experience in the biosciences sector in Australia (and possibly in collaboration with off-shore bioscience venture capital firms).

CASE STUDY 6.2

Investment to commercialise research insights has taken VitroGro® from the lab to the cusp of delivering impact

Background. VitroGro® is the culmination of a commercial partnership between researchers at The Queensland University of Technology (QUT) and investment by Tissue Therapies. VitroGro® is a patented biomimetic scaffold comprised of portions of naturally-occurring proteins that facilitates attachment of skin cells and restores wound healing.

VitroGro® development began in 2001 at QUT but it was not until a chance meeting between Professor Upton of QUT and investor Greg Baynton at a Toronto biotechnology conference in 2002 that VitroGro® was set on the path to commercialisation. Mr Baynton arranged for seed funding of \$250,000 and incorporated Tissue Therapies, the commercialisation vehicle for VitroGro®. Tissue Therapies was then publicly listed in 2004 and is currently in the final stages of gaining approval for VitroGro® in Europe with clinical trials expected to start in the US in 2013.



Tissue Therapies expects VitroGro® to be used in the treatment of chronic wounds, which are expensive to treat and can result in amputation. Each year more than 3,000 Australians are forced to undergo amputation as a result of diabetic ulcers, while in the US the cost of diabetic ulcer treatments is estimated at US\$6bn annually, with amputations accounting for US\$1bn.

Key lessons:

- 1. Research leads to medical innovations that deliver better health outcomes and can reduce healthcare costs.** VitroGro® is designed to be applied to burns, ulcers and surgical wounds to replace the degraded wound matrix and restore healing. This new treatment can significantly improve the treatment of wounds, with a particular focus on treating chronic wounds, a condition that reduces quality of life and can lead to amputation, and is costly to treat.
- 2. Investment during the early stages of commercialisation is critical to ensure translation of Australia's health and medical discoveries.** The chance meeting between researcher and financier resulted in early-stage investment and the formation of Tissue Therapies to help VitroGro® navigate the commercial 'valleys of death' and provide funding support for animal and human trials to be conducted on VitroGro®.

Note: Image courtesy of the Institute of Health and Biomedical Innovation, Queensland University of Technology

Source: Tissue Therapies: <http://www.tissuetherapies.com>; Biotechnology Innovation: www.biotechnology-innovation.com.au/innovations/pharmaceuticals/vitrogro.html

The manager would:

- be selected via a competitive tender process to build a portfolio of investments with a target minimum of 25 proof-of-principle-in-man projects;
- be required to raise half of the \$250m from superannuation funds or other private sources which would be issued class A equity, matching the Government dollar-for-dollar, but ranking ahead of class B for the first \$125m in distributions from the fund; and
- receive a private equity-style fee of 2% p.a. on managed funds, plus 25% of net realised profits over the 15-year investment life of the fund.

The TBF proposal can be expected to receive strong support from the industry, including the Australian Private Equity and Venture Capital Association (AVCAL): 'we strongly endorse the recommendation for a \$250m early-stage development fund ... we would recommend that the fund be administered in the form of a biomedical-dedicated round of the existing Innovation Investment Fund (IIF) co-investment program. The IIF program is well-understood by industry participants and would, in the long-term, enable the funds to be part of a revolving, self-sustaining program'.¹⁴⁰

As noted by AVCAL, in addition to closing the funding gap, the TBF also has the potential to generate returns for the Australian Government that could be reinvested in the sector. The success of the TBF, and successful commercialisation of Australian biotechnology R&D as evidenced over time, should be evaluated within 10 years following establishment against its ability to:

- demonstrate the advancement of HMR projects from early clinical stage to commercially viable outcomes
- maximise IP returns in Australia
- accelerate growth in profits, exports, job creation (including in clinical trials activity) and taxation benefits
- achieve venture-capital-style investment returns for the investors in the fund.

	Implementation Tasks	Responsibility	Timeframe
16c.1	Establish a new \$250m Translational Biotech Fund (TBF) for early-stage development, funded by the Australian Government and the private sector on a matching basis, structured to incentivise superannuation fund investors but not require government investment until the third year (refer to detailed terms sheet in Exhibit 6.5), and managed by a selected fund manager from the biosciences sector.	Department of Health and Ageing, DIISRTE	2014–15
16d.1	Continue to support the Innovation Investment Fund and ensure access for HMR development projects.	DIISRTE	2014–15

¹⁴⁰ Response to Consultation Paper from the Australian Private Equity and Venture Capital Association.

Exhibit 6.5

Draft Terms Sheet
Proposed Translational Biotech Fund (TBF)

Purpose:	<p>Provision of venture capital for commercialisation of Australian medical research.</p> <p>Investment will be targeted to fund entities with projects at the phase I or II clinical trials stage with novel drug candidates or medical devices.</p>
Size of Fund:	<p>\$250m</p> <p>Estimated average investment is expected to be \$10m per project or portfolio company, with total number of investments expected to be 20 to 25.</p> <p>The TBF may invest in minority or majority voting and equity positions.</p>
Term:	<p>The TBF has a 15-year vesting period, with an investment period of 7.5 years.</p>
Structure:	<p>The TBF could be either a venture capital limited partnership or a managed investment trust, subject to final tax advice.</p> <p>This is designed to accommodate Australian and offshore investors.</p>
Manager:	<p>The TBF will be managed by an experienced biotech fund manager pursuant to a competitive tender process.</p> <p>Criteria for selection will include:</p> <ul style="list-style-type: none"> • commercialisation track record and reputation; • knowledge of the medical research and biotech sector; • evidence of collaboration with offshore biotech venture managers; and • experience in fund raising. <p>The Manager will be majority owned by Australian residents.</p>
Investors:	<p>The Australian Government will be required to subscribe for \$125m in the Fund. This will be in class A units subscribed as and when called by the Manager during the 7.5 year investment period. No government funding would be required until year three of the fund, estimated in 2015–16.</p> <p>Institutional investors will be invited to subscribe for \$125m in the Fund. This will be in class B units subscribed \$ for \$ with the A units.</p>
Distributions:	<p>The B units enjoy preferred distribution rights over the A shares as follows:</p> <ul style="list-style-type: none"> • first \$125m distributions made to B units • next \$250m distributions made to A & B units in ratio 50/50 • thereafter distributions made to A & B units in ratio of 25/75.
Manager Fees:	<p>Management fees will be 2% p.a. of committed capital for the first five years and 1.5% p.a. of invested capital for next five years.</p>
Manager Carry:	<p>Manager's carry will be 25% of net realised distributions (NRD) by the Fund. NRD is defined as distributions after all invested capital in the Fund compounded by the annual Reserve Bank rate together with the sum of all management fees have first been returned to the A&B class investors.</p>
Governance:	<p>The investors will appoint an investment advisory board.</p>

6.3 Enhance Commercialisation Environment

Recommendation 17: Enhance Commercialisation Environment. Improve commercialisation capability, culture and practices.

- a. Foster a culture of commercialisation through freer interchange between researchers and industry, and recognise commercialisation achievements through institutional rankings and industry awards.
- b. Encourage research organisations with sub-scale or no business development offices to engage larger institutions/precincts for commercialisation requirements.
- c. Protect valuable intellectual property (IP) by strengthening Australia's IP system and encouraging researchers to seek sound advice on the commercial value of their IP before filing patent applications.
- d. Implement clinical trial reforms as an urgent national priority (see Recommendation 5).

6.3.1 Introduction

Australia has a relatively underdeveloped culture for commercialisation of its innovation, with limited knowledge and skills among the research community. There is a lack of infrastructure to assist startups, including necessary incubation assets (for example, flexible shared space without requirements for major capital or cash-flow commitments). In addition to lack of funding support for commercialisation, these knowledge-based and infrastructure constraints further hamper business development in the HMR sector. Overall, Australia suffers from a lack of critical mass and the absence of a strong culture of innovation compared to other countries.

There are four key initiatives required:

- foster a culture of commercialisation
- leverage scale and expertise
- protect valuable intellectual property
- attract clinical trials.

While this is a broader issue, there are some actions the HMR sector can take to help improve the flow of investable ideas. Successful models are typically focused around 'product' (partnering with industry and licensing) or 'platform technology' (setting up a spin-out company to develop potential applications).

“

... there is significant room for improvement in Australia's commercialisation culture. Gains from basic research and proof-of-concept activities are still being lost because start-ups and small firms have inadequate access to advice and funding.

GlaxoSmithKline

6.3.2 Foster a Culture of Commercialisation

Commercialisation expertise among researchers. Despite a strong, government-supported push 10 to 15 years ago for Australia to move into the knowledge economy through establishment of Biotechnology Australia and other innovation-based initiatives, commercialisation skills and expertise are still in short supply. Many researchers are not commercially savvy, and are not focused on potential commercial applications for their research. Commercial outcomes of research are generally unpredictable and often arise from basic research that is not necessarily driven by a desire for a commercial outcome. The core skill set for scientists is obviously discovery, but if Australia is to capture more commercial benefits from its high level of investment in research, much more support is needed for researchers to help them recognise the practical application of their research, identify commercial opportunities and negotiate commercial outcomes.

Issue: Poor incentives for researchers to commercialise discoveries. There are few incentives for researchers to commercialise in Australia. Indeed, there are strong disincentives as the time taken for commercialisation activities reduces a researcher's chances of producing high-impact publications that are essential for grant success. In addition, the commercialisation approaches in Australia often provide inadequate opportunity for investors to financially benefit. Brilliant research and successful commercialisation must not be viewed as mutually exclusive pursuits. The linkages between academic researchers and industry in Australia are weak. There is generally poor communication between the two groups and inconsistencies in approaches to commercialisation.

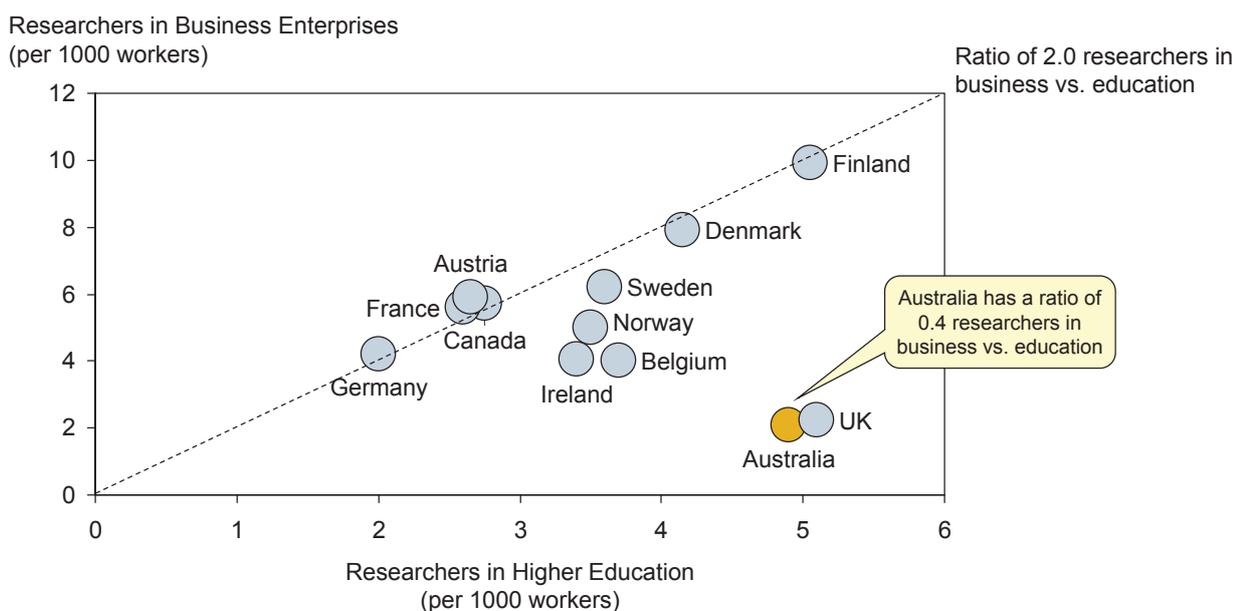
Compared with other countries, Australia and the UK are notably characterised by having the minority of their researchers employed in business relative to higher education, with a ratio of about 0.4 (Exhibit 6.6). Most developed countries have a ratio of around 2.

Exhibit 6.6

Australia and the UK have a minority of researchers employed in business relative to higher education

Researchers in Business vs. Higher Education

Researchers per 1000 workers



CASE STUDY 6.3

Commercial investment in Australian Nanopatch technology is expected to revolutionise the delivery of vaccinations

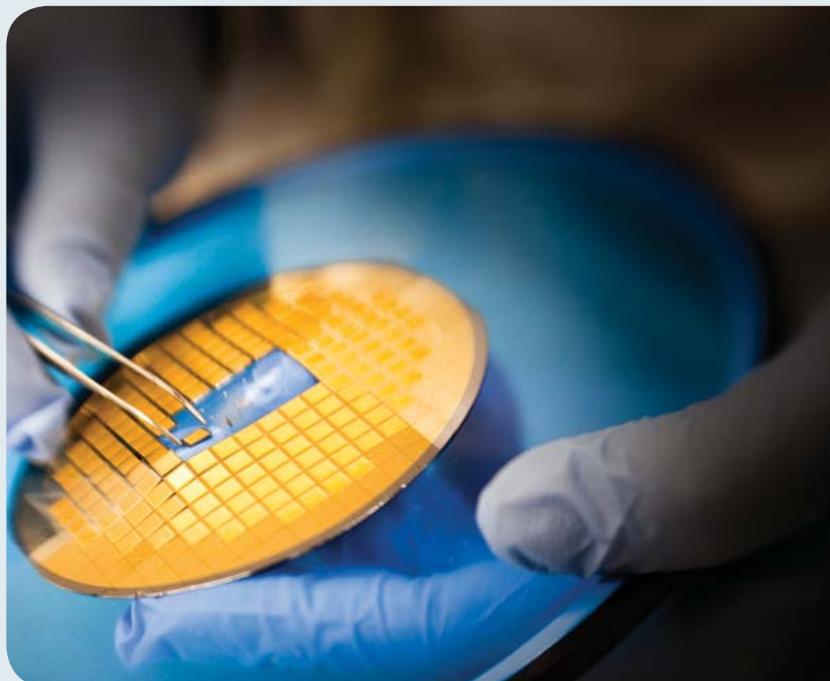
Background. Vaxxas is a startup company established to commercialise the Nanopatch, originating from Professor Mark Kendall's research at The University of Queensland's Australian Institute for Bioengineering and Nanotechnology. Vaxxas' proprietary technology provides a needle-free vaccine solution, utilising a Nanopatch with thousands of projections which perforate the skin quickly and painlessly delivering the vaccine payload. This application varies markedly from the conventional needle and syringe injection approach, requiring as little as one hundredth of the dose and not requiring refrigeration during transportation and storage.

Vaxxas was founded by Professor Kendall in 2011 and UniQuest (UQ's main commercialisation company) successfully negotiated the significant \$15 million investment from OneVentures, with co-investors Brandon Capital, the Medical Research Commercialisation Fund (MRCF) and US-based HealthCare Ventures. This crucial investment will allow Vaxxas to advance their commercialisation process, growing a company that has the potential to impact the next generation of vaccines worldwide.

This investment allows Vaxxas to commercially advance the Nanopatch along the clinical testing and development pipeline towards becoming a next-generation, needle-free vaccine delivery device. Vaxxas' focus is on translating the key Nanopatch benefits already observed in preclinical testing (e.g. improved immune responses, no need for vaccine refrigeration, no needle-stick injuries) to a clinically-proven product for widespread use. These translated benefits will improve the reach of vaccines and help reduce the annual death toll of infectious diseases of 17 million people. The Nanopatch could also have a significant impact on the multimillion dollar vaccine industry.

Key lessons:

- 1. Commercial investment is crucial to develop research discoveries that deliver better health.** Vaxxas' ability to attract investment is a crucial achievement, allowing this technology to be developed further with the ultimate goal of distribution and use by consumers worldwide.
- 2. Australia's commercialisation capability can attract global investment.** The global syndicate investment in Vaxxas is reflective of the potential opportunity for Australia's research organisations to partner with global investors to transform research efforts into commercially-viable products. UniQuest's expertise in commercialisation of research has been crucial to this process.



Note: Image courtesy of UniQuest

Source: Vaxxas: <http://www.vaxxas.com>; Australian Institute for Bioengineering and Nanotechnology: <http://www.aibn.uq.edu.au>

Option: Establish stronger linkages between researchers and industry. Greater penetration of understanding of the research community by industry, and vice versa, is needed to facilitate commercial input at critical stages in the research process. A more collaborative approach, such as internships, is likely to foster mutual benefit and assist in the flow of funding from the commercial sector to the research sector. Other actions, such as developing a ranking of institutions on HMR commercialisation success and establishing awards and industry events for HMR commercialisation success, may also assist in fostering a stronger culture of commercialisation of HMR in Australia.

“ *Industry fellowships have been a success from CSL's perspective. They have led to fruitful long term linkages between CSL and research organisations and have often been targeted specifically towards addressing the translational research gap described above. While important and adding significant value, these fellowships cannot be expected to address the full spectrum of translation activities. However, coupled with targeted translational research funding they can help develop specialised skills to support early stage commercial development of potential products.*

CSL Limited

	Implementation Tasks	Responsibility	Timeframe
17a.1	Establish an internship program to enable freer interchange between researchers and the industry (in both directions), possibly targeting NHMRC overseas post-doctoral fellows.	NHMRC	2014–15
17a.2	Include HMR commercialisation success as one of the measures in sector-wide rankings.	Leadership body	2014–15
17a.3	Establish awards and industry events for HMR commercialisation success.	Leadership body	2014–15

6.3.3 Leverage Scale and Expertise

Need for scale and expertise. Over the last 15 years, many universities and MRIs have established their own commercialisation offices and have started to become more sophisticated in the way they manage commercialisation opportunities. Most, however, are still at a point below critical mass, where small commercialisation offices have neither the depth of expertise and experience, nor the resources to provide high-level advice, in a timely manner, to researchers who may have potentially commercialisable assets in their research portfolios. This means not only that smaller research agencies are disadvantaged in their ability to realise the commercial potential of research discoveries, but that Australia overall misses out.

“ *Many research innovations are not progressing beyond the lab because of the lack of expertise and resources to prepare them for investment in the development process. To improve the effective commercialisation of health research outcomes there needs to be improved resourcing and funding of technology transfer offices. The centralisation of these resources would allow for best practice through the provision of a critical mass of commercially experienced professionals, which ideally should be in the order of 20–30 people for maximum effect.*

UniQuest

Issue: Many commercialisation offices are sub-scale. With a few exceptions (such as UniQuest – Case Study 6.4), commercialisation offices are sub-scale and do not have the required level of expertise to assess opportunities adequately in their own domain areas. The difference between the best and second-best resources can be decisive. The range of problems evident across university business development offices includes:

- over-valuation of initial discoveries
- a short-term mindset driven by the need for cost recovery of overheads
- lack of industry skill and understanding
- lack of international business development connections and acumen
- a general failure to recognise the diversity of commercial translation activities that lead to successful outcomes.

In addition, commercialisation skills are in short supply in Australia, particularly in the ability to choose and establish:

- products (molecules, devices, services) where partnerships with industry and licensing arrangements are needed; and
- platform technologies where a spin-off business development company may need to be established.

Option: Promote sharing of commercialisation capacity and resources. Because commercialisation skills are scarce, it is more efficient to have larger commercialisation resources that can be called upon by other institutions, than to have each small institution attempt to build end-to-end commercialisation capability. Some rationalisation is clearly needed. The obvious action is to promote the sharing of resources to leverage the scale of the more successful commercialisation offices. In addition, there needs to be much greater flexibility for researchers to allow them to move between research and commercial roles. Researcher career paths that move between universities, MRIs and industry need to be encouraged and rewarded, and pathways for re-entry to research from commercialisation activities in industry need to be improved. This matter is considered in more detail in Section 4.2.

	Implementation Tasks	Responsibility	Timeframe
17b.1	Encourage research organisations with sub-scale or no business development offices to engage larger institutions/precincts for commercialisation requirements.	Leadership body	2014–15

6.3.4 Protect Valuable Intellectual Property

IP is clearly a valuable commodity in Australia's knowledge-based economy, and skilful IP protection is necessary to ensure inventions are safeguarded. A patent gives its owner the right to prevent others from making, using, importing or selling an invention based on that idea. For medical devices, however, patents are often not a viable source of protection due to the short life of a medical device product (usually 2–3 years). Medical device companies often use contractual methods of protection such as confidentiality agreements, and trade secrets.

Issue: Australia's IP system is weak and not harmonised with international best practice.

The best way to protect valuable IP is by ensuring Australia's IP system is strong, stable, predictable and harmonised with international best practice. This cannot be achieved if policy makers implement undesirable reforms, such as the proposals to ban patents on biological materials and make it easier to obtain compulsory licences. It also cannot be achieved if efforts to harmonise IP standards with global best practice are inconsistent.

CASE STUDY 6.4

UniQuest is one of the largest commercialisation service providers in Australia, combining expertise and scale

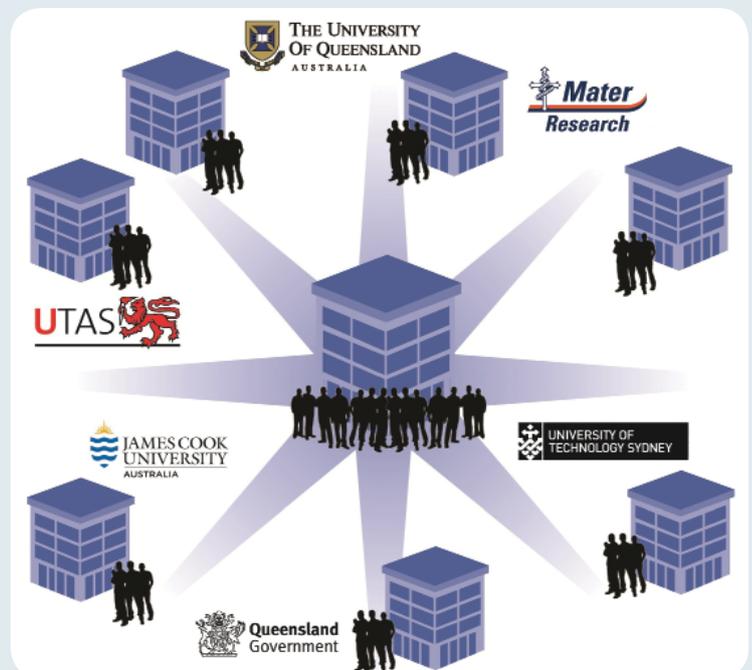
Background. UniQuest is a leading Australian research commercialisation company which specialises in global technology transfer and facilitating access for all business sectors to world-class university expertise, intellectual property and facilities. Formed by The University of Queensland (UQ) in 1984, UniQuest was based on the model of university technology transfers in Silicon Valley and Cambridge, where the co-location of entrepreneurs, universities and industry led to a critical mass that resulted in significant technological outcomes.

Integrating public and private funding is essential to achieving translational research goals. Since 2000, UniQuest and its startups have raised more than \$450m to take university technologies to market. Annual sales of products using UQ technology licensed by UniQuest are running at \$3bn. Its innovation portfolio includes Australia's first blockbuster vaccine Gardasil, pain therapy developer QRxPharma Ltd, the internationally-acclaimed Triple P Positive Parenting Program and UQ's superconductor technology which is used in two-thirds of the world's MRI machines.

UniQuest has commercialised an extensive range of ideas, developed more than 1,500 patents and created over 70 companies. This success is a direct consequence of the culture of collaboration embedded at UniQuest, which facilitates partnerships with Australia's leading Life Sciences research institutions. Innovation and expertise are shared with both the public and private sectors. Ultimately, this leads to significant societal, economic and reputational benefits, both in Australia and abroad.

Key Lessons:

- 1. Successful research commercialisation requires technical expertise, collaboration and scale.** UniQuest specialises in brokering commercial agreements between researchers and sources of funding. It is one of the largest technology transfer companies in the world.
- 2. Public and private funding for university-based innovation is essential to achieve translational research goals.** UniQuest's achievements demonstrate that improved health outcomes can be delivered sooner when governments, universities and industry interact and invest for a common purpose.
- 3. Commercialisation delivers improved health outcomes and generates economic returns for researchers and investors.** UniQuest led the commercial effort to patent the cervical cancer vaccine that became Gardasil, the world's first vaccine designed to prevent a cancer, and negotiated syndicated venture capital funding for QRxPharma, which raised \$50m in its 2007 IPO.



Note: Image courtesy of UniQuest

Source: UniQuest: <http://www.uniquest.com.au>; Vaxxas: www.vaxxas.com

Option: Strengthen and standardise Australia's IP system. There is a need for Australian governments to ensure the strength and stability of Australia's IP system through means such as:

- rejecting calls to exclude biological materials from patentable subject matter
- rejecting calls to make it easier to obtain compulsory licences
- extending the term of data exclusivity to harmonise an important element of the Australian IP system with international best practice.

Issue: Too many low-value patent applications are filed. With patents, timing is vital, and a balance needs to be struck between failing to recognise an idea that should be patented and filing too many patent applications, many of which are not commercially-valuable ideas. While on a global basis, Australia files relatively few health-related patents, too many patent applications are filed prematurely in Australia which wastes time and resources. In addition, by prematurely awarding patents, a monopoly is essentially achieved that actually slows the rate of innovation, collaboration and development. In other instances, over-patenting can be a perverse driver, hindering or preventing commercialisation, especially where it involves too many parties.

Option: Ensure greater rigour when assessing value of IP before patenting. There is thus a need to rigorously screen novel discoveries and inventions for potential market impact before filing for patents and attempting to commercialise them. Researchers should be encouraged to consult business development offices to ensure that IP is suitable for commercialisation before attempting to file a patent application. The assessment should be made by people with commercial experience in patenting.

	Implementation Tasks	Responsibility	Timeframe
17c.1	Strengthen Australia's intellectual property system and harmonise it with international best practice, to ensure that it appropriately supports and encourages investment in R&D, particularly HMR.	DIISRTE	2014–15
17c.2	Encourage researchers to consult business development offices and ensure intellectual property is rigorously assessed for its commercial potential prior to filing patent applications.	NHMRC	2014–15

6.3.5 Attract Clinical Trials

The US accounts for a large part of clinical trial activity and, together with Canada, represent approximately 50% of clinical trial sites worldwide.¹⁴¹ For historical, market and regulatory reasons, virtually all potentially commercial health and medical innovations undergo clinical trials in America, but they may also be trialled in overseas markets. For many years, Australia has been seen as a desirable place for clinical trials to be conducted because of its well-structured health sector, high level of research competence and strong competitive position in terms of time to completion.

For the various reasons described in Section 2.6.1, Australia is now at risk of losing its competitive position for global clinical trials. This is reflected in a recent survey of global companies that indicated expectation that Australia's competitiveness will remain stagnant or decline (Exhibit 2.13). Furthermore, Australia is now one of the most costly countries for clinical trials (Exhibit 6.7). It is, therefore, imperative that clinical trial processes are reformed as a matter of urgency as proposed in Recommendation 5.

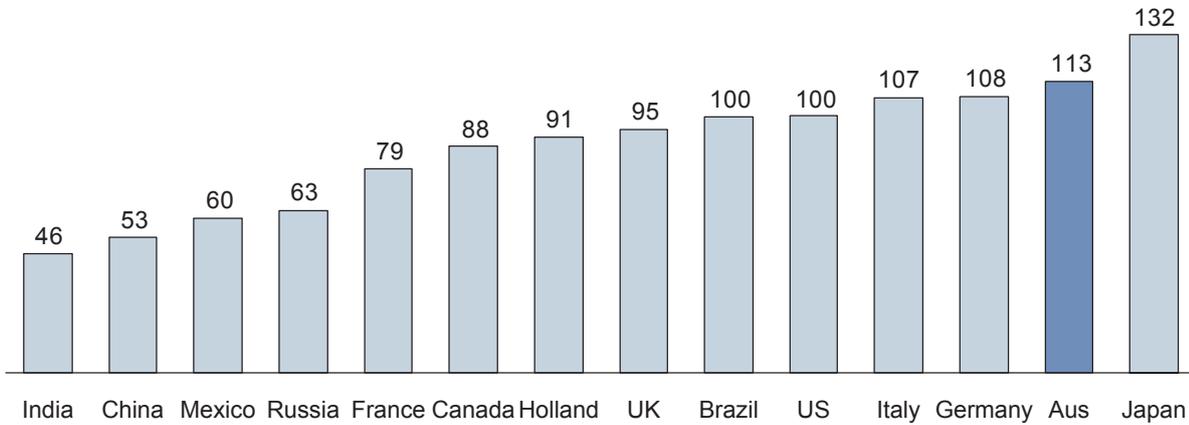
141 Medicines Australia and Pharmaceuticals Industry Council R&D Task Force, *Clinical Trials in Australia – A Report on the Characteristics of the Clinical Trials Industry in Australia*, 2010.

Exhibit 6.7

Australia is one of the most expensive locations in the world for clinical trials

Clinical Trial Costs¹

Cost Index²
2011–12



Notes: 1. Based on operating costs of a clinical trials management firm
2. Indexed to the US
Source: KMPG, *Competitive Alternatives: KPMG's Guide to International Business Location Costs 2012, 2012*

Competitive and efficient clinical trials capacity is of fundamental importance to developing an internationally competitive biotech infrastructure in Australia. Furthermore, it is vital for our ability to deliver translational results that improve health outcomes for Australians and to maximise the value of IP developed locally that builds national wealth and creates new jobs.

	Implementation Tasks	Responsibility	Timeframe
17d.1	Accelerate the implementation of clinical trial reforms as an urgent national priority (Recommendation 5).	Leadership body	2014–15