Australian Government

Department of Industry
Tourism and Resources

Submission to the House of Representatives Standing Committee on Science and Innovation

Inquiry into Pathways to Technological Innovation

May 2005

Table of Contents

Executive Summary

This paper has been prepared in response to the Standing Committee on Science and Innovation call for submissions to its inquiry into pathways to technological innovation.

To aid the Committee's deliberations, the submission provides information about the role of the Department in analysing and facilitating the pathways companies take in getting a technological innovation to market, including working with companies to overcome barriers or market failures.

The introduction provides information about the role of the Department of Industry, Tourism and Resources (DITR), industry sectors that are being assisted through government action, and the innovation activity of Australian industry. Information sources include the Department's Innovation Scorecard, which compares performance against relevant OECD indicators, and the recent Australian Bureau of Statistics (ABS) Innovation in Australian Business survey.

Information about Australian industry, innovation performance and incentives to support business is provided according to the following areas of Committee inquiry:

- pathways to commercialisation;
- intellectual property (IP) and patents;
- skills and business knowledge;
- capital and risk investment;
- business and scientific regulatory issues; and
- research and market linkages.

As the inquiry progresses, if the Committee wishes, the Department will provide further input on the specific issues and case studies that the Committee decides to examine in more detail.

Introduction

Growing innovative and globally competitive Australian firms, which create new products, services and processes, and increase productivity and jobs for Australians, is a key priority for the DITR.

As the benefits from macro and micro-economic reforms are realised, developed countries are turning more and more to innovation as a crucial driver of global competitiveness. Significant effort is being directed to ensuring that national innovation systems are operating effectively to provide the best opportunity for social, economic and environmental outcomes. Figure 1 depicts the Australian innovation system.

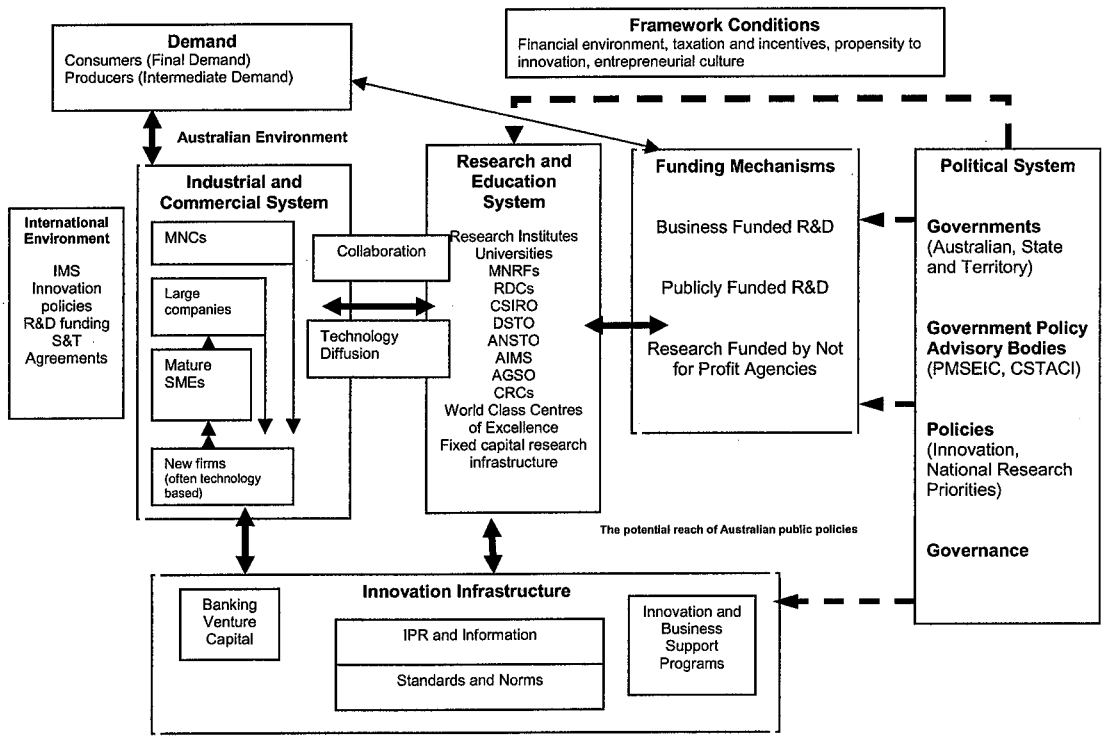


Figure 1: Australia's innovation system

An effective innovation system depends not only on the capacity of the various actors (eg business and research institutions) in the system but also on the effectiveness of linkages between the various players in the system (eg between researchers and businesses), access to appropriate financial investment and the smooth translation of ideas to commercial and environmental end use.

The DITR is responsible for supporting the growth of Australian firms and industries through facilitating innovation, encouraging investment and building international competitiveness. The Department particularly aims to improve industry innovation through strengthening the volume and quality of research and development (R&D), facilitating commercialisation in a global setting, providing structural adjustment support for specific industry sectors, and building small business skills development and services.

Monitoring Australia's innovation activity

The Innovation Scorecard provides a snapshot of Australia's innovative activity by comparing 16 performance indicators to the OECD average. The Scorecard includes input (business expenditure on R&D (BERD) and Venture Capital (VC)) and output indicators (United States (US) patents per capita). As the Committee will appreciate, some caution is needed in comparing Australia's performance with other countries by using such indicators as countries have different industry structures with different innovation intensities, and these realities are not captured by the Scorecard. However indicators are useful in monitoring changes in performance over time.

Since 2002, Australia's Scorecard performance has improved on most indicators, with investment in VC, scientific and technical articles, and internet usage all increasing significantly. Australia has significant government and higher education expenditure on R&D, a highly educated workforce, widespread use of the internet, a high proportion of foreign affiliates in manufacturing R&D, and a high level of multi-factor productivity (MFP) growth. However, our trends are lower in the areas of patenting levels in the US, BERD, and the breadth of international science and engineering collaboration.

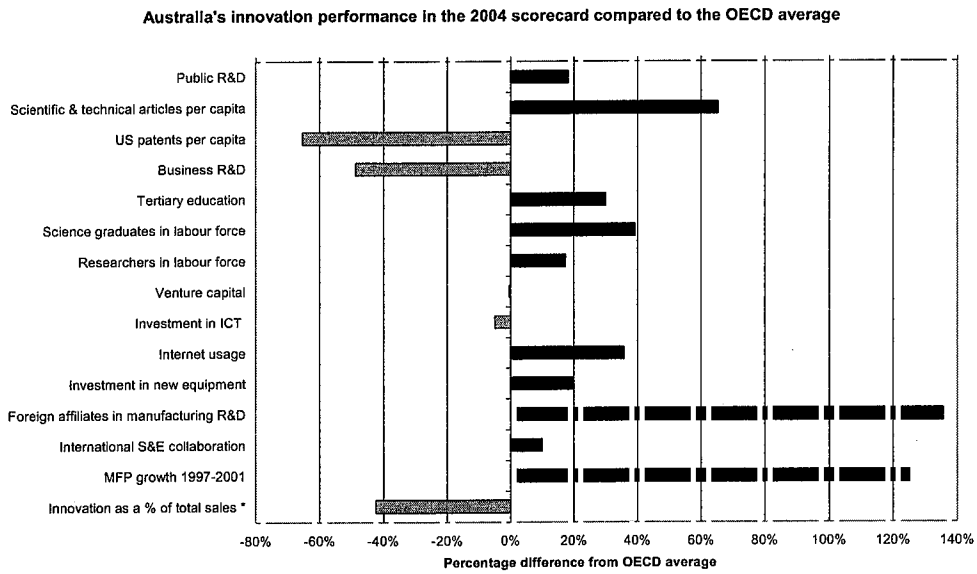


Figure 2: DITR Innovation Scorecard

Another important tool for monitoring Australian business innovation is the ABS Innovation in Australian Business survey. The latest survey was released in February 2005 and covered the period 2001-03. It is a very comprehensive measure of business innovation and covers investment in R&D, the introduction of new products and the implementation of new processes. As the Committee would appreciate, much innovation does not specifically involve R&D but rather may involve adoption or adaptation of technologies developed elsewhere. The case study below shows how innovative use of the internet can deliver significant returns.

Wotif.com: An example of service and adaptive innovation

Wotif.com is a last-minute online accommodation service developed by Graeme Wood, a marketing and software entrepreneur. The company was founded in 2000 and now has a turnover of $200 million a year and is continuing to expand into overseas markets.

Before Wotif.com, the hotel industry did not follow yield management, a practise that began in the aviation industry in the 1970s when that industry began to maximise efficiency by ensuring all seats were occupied before take-off. Graeme saw the potential for the short-term accommodation industry to increase profits by selling vacant rooms at reduced rates rather than not selling them at all. He saw a gap in the market.

Graeme spent $200,000 in start-up costs to develop the Wotif.com website and designed a prototype version to market the concept to hotel operators. He used his own technical knowledge to develop the web site, as well as using highly-specialised external IT contractors.

Graeme says that "I don't think innovation is about high technology. Whether you have a big or little idea, creativity is the foundation of innovation".

Key findings of the ABS Innovation in Australian Business survey that may be of significance to this Committee are:

- process innovation is important to Australian businesses. Around 35 per cent of businesses surveyed undertook innovation activity with 23 per cent of businesses implementing new or significantly improved processes, and 17 per cent of businesses introducing new or significantly improved goods or services. Of the $20 billion spent by businesses on innovation activity, approximately $7 billion was spent on R&D;
- the number of firms innovating increases as income increases. Innovation activity is costly and complex, and so small and medium enterprises (SMEs) often have difficulty in accessing capital and skills;
- the highest proportion of innovating businesses are in the communication services, electricity, gas and water, and manufacturing industries;
- drivers of innovation are increased company revenue, customer needs and greater productivity;
- barriers to innovation include cost and market related barriers;
- while 27 per cent of innovating businesses were involved in some form of active collaboration, the proportion of businesses collaborating with universities, government and research institutes was 6.5 per cent compared with collaboration with suppliers, clients, competitors and consultants at 21.5 per cent; and
- Australia ranks seventh among European countries for the proportion of businesses innovating: ahead of Finland, Sweden, Norway and the United Kingdom.

Pathways to commercialisation

Commercialisation is the part of the innovation process where the results of investigations, adaption of existing or new technologies or R&D are taken through to the market. Often a considerable amount of cost is involved in trialling, testing and finalising the product before being launched onto the market place. Exploitation may involve licensing and sale of IP, product development and marketing, and utilisation in more efficient process. Thus commercialisation activities may include market testing, certification, standards development and IP protection.

The Government undertook an assessment of commercialisation activity in Australia as part of its Mapping Australian Science and Innovation Report[1] released in 2003. This report includes information on the barriers to commercialisation such as cost, sources and availability of funding, and entrepreneurial and innovation management skills.

Innovation pathways

Pathways to commercialisation vary depending, on the type of innovation. For example, the commercialisation pathway for new product innovations arising from R&D will differ from the commercialisation pathway for innovative organisational practices and innovative production processes.

The pathway to commercialisation is not a linear process.

> *"Several generations of economic models of innovation describe a complex process, bound up with factors such as market linkages and matches with available structures. These evolved from the linear "science push" and "technology pull" models. They now involve a more complex "coupling model" in which innovation is treated as a sequential process linking science with the market place (via engineering, technological development, manufacturing, marketing and sales), but with the addition of feedback loops and variations over time of the "push" and "pull" mechanisms. More recently, this has culminated in a 5th generation innovation process model, which also attempts to express the increasing extent of strategic and technology integration."* [2]

In many cases, successfully developed technology involves collaborations, partnerships and linkages. Large multinational firms are increasingly sourcing their R&D from small firms, sometimes through acquisition.

Additionally, the commercialisation path does not always end with a product; the technological innovation can instead be a valuable intermediary input. See the following case study.

---

[1] Australian Government., *Mapping Australian Science and Innovation: Main Report.*, 2003., page 136.
[2] Department of Industry, Science and Resources., *Shaping Australia's Future Innovation – Framework Paper.*, October 1999., paragraph 3.1.

Softrock Solutions

Softrock Solutions is a WA-based company that develops and installs slope-monitoring software and systems, which enhance safety in open-cut mining operations.

The firm is essentially a systems integrator – it uses off-the-shelf robotic surveying equipment, telemetry and develops hardware and software interfaces so that this equipment can detect and record slop wall movement and relay this information to a central location.

Softrock was founded in 1989. It now has 5 staff, around 68 sites where its software is in operation and it has begun exporting to Africa, South America, Indonesia and Papua New Guinea.

There are also many impediments to commercialisation. For example, some companies will require access to venture capital for R&D and scale-up processes; others will have greater need for business and management skills; and many will ultimately require international partners to ensure the success of the technology and the company.

As a result, the requirements of companies will change over the course of their development and the development of their technology. This environment means that companies will pursue the best commercialisation strategy open to them – and the available incentives, programs and policies must be flexible to assist in that.

In some sectors, an early global focus is vital. The Industry Research and Development Board study of February 2005, *SMEs: Taking Innovation to the Global Market*, found that participation in international markets is important for Australian firms to expand their business. The study found that while Australia's domestic market is strong and growing, it is too small to enable innovation firms to source growth capital, increase sales, and grow their business. A key driver for engagement with overseas markets was the need to raise funds to continue R&D and its commercialisation. Capital for this activity can be less costly and more readily available overseas than in Australia. This is especially the case for capital beyond the A$10 million threshold.

The study also found that timely access to appropriate financial support is vital to bring R&D to market, to maximise the profits of its exploitation and to maintain competitiveness by progressing the development of the next generation of technology. The study found that other benefits of engagement with overseas markets were the support they can gain from global firms such as a local sales and management team, regulatory approval from overseas authorities, and capital for reinvestment.

Taking biotechnology as an example, virtually all biotechnology products must be produced for world markets, and must be able to compete with biotechnology sourced from anywhere else in the world. This tends to limit the range of business models that are likely to be viable. For example, the costs and complexity of meeting the myriad of regulatory requirements to market pharmaceuticals, and other therapeutic goods, means that for many of Australia's human health-focused biotechnology SMEs, the optimal route to that global market would normally be through a collaboration and partnerships with large multinational pharmaceutical companies with 'deep pockets' and regulatory expertise.

A recent *Pharma in Focus* article (31 January – 6 February) listed the benefits gained from strategic alliances as:

- access to a broader or new range of capabilities;
- expanding the capacity of the organisation;
- bringing flexibility to the organisation;
- gaining innovative ideas and approaches to opportunities and challenges;
- enabling a focus on the core activities of the organisation;
- reducing overheads and costs and therefore increasing efficiency; and
- transferring or sharing the risk of investing in an unpredictable marketplace.

Strategic alliances are particularly relevant to companies that possess technological assets and expertise, but who do not have the financial resources to fully commercialise their scientific ideas. For example, many small biotechnology companies aim to develop their technology to a point where it can be licensed to a pharmaceutical company to commercialise. Conversely, biotechnology companies can be attractive research partners for pharmaceutical companies because they can supplement the drug development process and make it more efficient. An example of this is the recent deal between Australian biotechnology company Amrad and pharmaceutical company Merck Sharp & Dohme (MSD).

Collaboration between Merck Sharp & Dohme and Amrad

Melbourne biotechnology company Amrad Corporation Ltd and Merck Sharp & Dohme (Australia) Pty Limited, in June 2003, announced a licensing agreement which would allow Merck to develop Amrad technology for new asthma drugs. It was one of the largest biotechnology collaborations in Australian history, with a potential value of US$112 million plus royalties. MSD, the Australian subsidiary of one of the world's leading research-based pharmaceutical companies, Merck & Co., Inc., signed an exclusive licensing and multi-year research collaboration agreement. Based on the results of the collaboration, Merck will seek to develop drugs with therapeutic potential in areas such as asthma, other types of respiratory disease and oncology.

Under the agreement with MSD, Amrad will receive an upfront payment of $US5 million. Total potential payments to Amrad by MSD based on the successful development of a human health product for all indications would amount to a total of $US112 million. Amrad would also receive royalties for commercialised products. Amrad and MSD will work together to investigate drug candidates, with Merck being solely responsible for all clinical development and marketing.

Amrad developed the technology from basic research conducted at the Cooperative Research Centre (CRC) for Cellular Growth Factors (CRC-CGF) and Melbourne's Walter and Eliza Hall Institute. Amrad's early research on these projects was partly supported by the Australian Government's $300 million Pharmaceutical Industry Investment Program.

The deal demonstrates the value of Amrad's drug discovery program and IP and Amrad's ability to extend and commercialise research undertaken by research organisations. It is an example of how an Australian company can work closely with academia to navigate the pathways to commercialisation. It also demonstrates the role that appropriately targeted instruments of industry policy can play in commercialising Australian research and maximising the return on Australian innovations.

MSD (Australia) Managing Director Will Delaat said the collaboration highlights the value of Australian biotechnology firms joining with global pharmaceutical companies to bring their research from the laboratory to the international market.

In some industries, companies commercialise ideas for a predominantly local market and this may not involve formal alliances.

The capital requirement of firms taking an idea to market impacts on the commercialisation pathway. Funding sources include the Pre Seed funds, VC (private and government-support), partnerships, Initial Public Offerings (IPOs), and government grants. In addition, many firms sell a relatively simple product such as a diagnostic or reagent, or undertake fee-for-service R&D, in order to finance the R&D and associated commercialisation of their primary product lines.

In more established industries and larger companies, cash flow and other commercialisation related resources are more easily available and it is important to remember that much technological innovation occurs within larger firms. One example is the commercialisation of the MIEX® water treatment technology by Orica, a technology that that company is now taking global.

Some of the most successful Australian technological innovations have passed through a variety of ownerships structures – Cochlear and Ambri are both examples where much of the development process occurred within a large Australian company (Pacific Dunlop) before they were spun out from this corporate entity as stand-alone listed firms.

Another strategy that many Australian firms adopt to effectively commercialise products is to establish operations in key markets, particularly the United States (US). The biotechnology industry offers some examples given the size of the US human health related market. In 2004, AGT BioSciences (based in Melbourne and Geelong) merged with California's ChemGenex Therapeutics to form ChemGenex Pharmaceuticals. Similarly, in April 2005, EvoGenix, an Australian protein therapeutic company, acquired Absalus Inc, a Californian based biotech firm. In these cases, corporate strategy and most R&D will continue to occur in Australia and the Californian personnel "will provide links into the key US biotechnology sector." Companies like Stem Cell Sciences have grown from Australia to also have significant operations and laboratories in Edinburgh and Kobe.

Generic DITR support for commercialisation

The DITR provides programs to support the commercialisation activity of Australian firms in all industry sectors.

R&D Start, a competitive grant and loans program to support Australian companies in undertaking R&D with high commercial potential was announced in the 1996/97 Budget to strengthen the pathway to commercialisation for many Australian companies. The program closed for new applications in September 2004 and has been replaced by the Commercial Ready Program. In total, R&D Start has provided funding of $1.01 billion to 1134 companies since its establishment in 1996.

In May 2004 the Government announced the new Commercial Ready program with funding of about $200 million a year to 2011. The program was developed after analysis of commercialisation activity through the Mapping Report, and consultation with industry. It is designed to fill identified innovation system gaps, namely proof-of-concept and early commercialisation phase.

Commercial Ready

Commercial Ready is designed to encourage the growth of innovative Australian companies and to ensure that new innovative products, processes and services make it onto the market. It is a competitive merit-based grant program which supports Australian small to medium enterprises (SMEs) to undertake R&D, proof-of-concept and early-stage commercialisation activities. It also provides support for technology acquisition and encourages market-driven linkages between business partners as well as business and public sector research bodies.

Importantly, Commercial Ready has been deliberately designed to be a flexible program whose support can be adapted to the particular commercialisation pathway of an individual firm. It is anticipated that more than 1,700 SMEs will be supported through the program.

A new $25 million Industry Cooperative Innovation Program (ICIP) was announced on 8 October 2004. It will support cooperative innovation projects by firms to develop and use new technologies, with priority being given to projects meeting strategic industry needs including those identified through an Action Agenda (long term industry strategy developed by an industry sector). ICIP will assist in building collaboration activity to strengthen the innovation capacity of an industry sector. Funding will be made available in two streams: Stream A will provide funds for small scale projects that explore sectoral innovation opportunities and paths to enhance sectoral innovation capacity; and Stream B will provide funds for major cooperative strategic sectoral innovation projects. ICIP is to commence on 2 June 2005.

Business investment in R&D and commercialisation

Private sector investment in R&D is a crucial element of technological innovation and leads to the commercialisation of new processes, products and services. The 2004 ABS BERD survey showed BERD rose by 3.6 per cent to $5.979 billion in 2002–03 (current prices). The Department has a range of measures to encourage and support BERD.

The R&D Tax Concession

The R&D Tax Concession regime includes:

- *a 125 per cent deduction for expenditure on R&D;*
- *a 175 per cent premium deduction (the R&D Incremental Tax Concession) for additional R&D expenditure above a company's average over the previous three years; and*
- *the R&D Tax Offset (Rebate), which allows eligible small companies (i.e. with group turnover under $5 million and annual grouped R&D expenditure up to $1million) to 'cash out' their R&D tax losses.*

At 10 January 2005, more than 5075 companies, with a reported R&D expenditure of more than $6.35 billion, were registered for the R&D Tax Concession for the 2002–03 income year.

An independent evaluation of the R&D Tax Concession undertaken in 2003 for the DITR, which involved input from more than 700 registered firms, found that the main outcomes from R&D supported by the measures included:

- *the development of new and better products, and reduced costs through process improvements;*
- *the development of R&D that is highly novel or that can be used as a 'platform' for innovation through other applications or in other industries; and*
- *a substantial contribution to sales and profits within five years after the claimed R&D activities.*

The Government has given a long-term commitment to these measures through the *Backing Australia's Ability: Building Our Future through Science and Innovation* package released last year.

Industry Action Agendas

The DITR promotes and encourages growth of innovative industries through industry Action Agendas. Action Agendas are long term industry strategies to assist industries to identify their strengths, weaknesses, and to map new opportunities to achieve sustainable development and export growth.

They are a partnership between government and industry sectors that provide a comprehensive insight to issues faced by particular sectors. Action Agendas can identify commercialisation issues at the sectoral level. An analysis of the recommendations from various Action Agendas highlights some of the commercialisation related policy areas raised:

- venture capital;
- IP management;
- management capabilities;
- skills and education issues;
- industry research and development;
- collaboration with public sector research organisations; and
- commercialisation initiatives.

All recognised the importance of innovation and have developed strategies for increasing their industry's innovation capacity. In many cases this has resulted in a substantial increase in investment by industry. For example, over $600 million has been committed by Action Agenda industries in support of CRCs.

There are further examples throughout this submission of the outcomes of Action Agendas. In addition, Appendix A illustrates the types of barriers to innovation that need to be addressed by sectors. Of the twenty four completed Action Agendas, some 80 per cent identified commercialisation as an industry priority. Most of these industries are technology based, and require ongoing innovation to ensure competitiveness.

One way to examine the pathway to commercialisation for technological innovations is to look at specific sectors. Information is provided below on the following sectors:

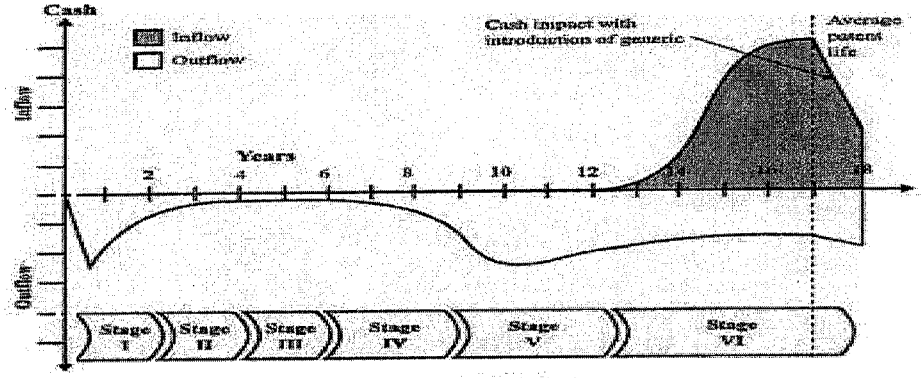
- pharmaceuticals;
- environment;
- mining technology services;
- electronics; and
- energy.

Pharmaceuticals

A study by Bruce Rasmussen from the Centre for Strategic Economic Studies at Victoria University shows that alliances are vital for pharmaceutical discoveries and technology. Alliances with global companies represent the prime development path for Australia's biomedical companies and research institutions.

Current estimates of the cost and time taken to develop a new medicine and to take it to market are as high as $US800 million and 15 years. This schematic diagram outlines the pathway to commercialisation of an innovator drug.

Chart 3.4 ***simplified model of the cash flows of an original ethical drug***



Stage I	Screening (1–2 years): Review of 10 000 substances
Stage II	Chemical (1–2 years): Chemical stabilisation for production
Stage III	Biological (1–2 years): Toxicological study; review of remaining 20 substances
Stage IV	Clinical (3–4 years): Remaining ten substances in human trials
Stage V	Registration (2–3 years): Government approval and acceptance; bioequivalence
Stage VI	Market entrance: production control; packaging; patent protection

Source: Weiss 1995, p. 10

To strengthen the commercialisation pathway for the pharmaceuticals industry, the Government introduced the Pharmaceuticals Partnership Program (P^3).

Pharmaceuticals Partnership Program

The Australian Government $150 million five year Pharmaceuticals Partnerships Program (P^3), aims to encourage partnering between multinationals and Australia's biotechnology and pharmaceutical companies. P^3, which commenced on 1 July 2004, aims to help keep our best ideas in Australia and to develop them here. P^3 provides pharmaceuticals companies from all points of the value chain with up to $10 million for increasing their eligible pharmaceuticals R&D expenditure above a base level. P^3 will encourage more partnerships like the one between Amrad and MSD and help to commercialise technology to develop medicines for global markets. Eighteen pharmaceuticals companies are either participating in the program or have received offers of participation.

P^3 provides a 30 percent subsidy for the cost of any eligible additional activity undertaken by participants including R&D done in house and in collaboration with other companies and researchers. The emphasis on partnerships provides multinational companies with the financial incentive to partner with Australian companies and researchers. This feature of P^3 provides Australian companies with a smoother path to commercialisation and reflects the increasing trend within the industry of outsourcing R&D.

Companies are selected through a competitive assessment against four merit selection criteria including: the track record and capabilities of the applicant; scope and nature of partnerships and linkages; the technical merit of the proposed activities; and the level of benefit to the Australian economy. This assessment is undertaken by the Industry, Research and Development Board through its Pharmaceuticals Committee.

Environment Industry

The Environment Industry Action Agenda launched in 2000/01, focussed on the industry's pathway to commercialisation and it identified actions that would enhance commercialisation:

- collaboration with public sector research agencies;
- diffusion of knowledge;
- commercialisation skills; and
- identification of the critical enabling technologies from which enterprises can seize emerging business opportunities.

Recommendations in the Action Agenda demonstrate the commitment of the environment industry to overcome commercialisation barriers.

Environment Industry Action Agenda Recommendations

Recommendation 10 – industry and government to leverage off the significant public investment in R&D by establishing collaborative networks across the research community and business communities to improve commercialisation of environmental R&D and diffuse environmental technologies to grow new businesses in Australia.

Recommendation 11 - government and industry to work together to promote commercialisation of R&D by:

- *encouraging SMEs and researchers to obtain and use the knowledge needed to become investment ready; and*
- *providing information to the investment community to inform them of business prospects and initiate business matching.*

Recommendation 12 – industry to work with governments to prepare a Technology Roadmap of the environment industry to identify the critical enabling technologies from which enterprises can seize emerging business opportunities over the next five to ten years, identify future technology gaps and needs, and establish investment priorities.

The environment industry is continuing to implement key recommendations and is making steady progress towards the Action Agenda vision of $40 billion in annual turnover by 2011. The industry has been focussing on the commercial uptake of new environmental technologies by preparing innovation road maps for two key sectors of the industry: water use and recycled organics.

Mining Technology Services

The 2001 Mining Technology Services (MTS) Action Agenda has a number of recommendations to increase the commercialisation of R&D. Government and the industry are working to implement these recommendations.

Mining Technology Services Action Agenda

Recommendation 2 calls for a variety of actions to improve the access of the MTS sector to R&D services and commercialisation mechanisms. These actions include:

- *the MTS sector and the R&D community to work together to road map selected technologies with a view to developing R&D priorities for the sector and appropriate R&D clusters;*
- *working with government to explore options for greater inclusion of SMEs in the CRC Program; and*
- *support for existing efforts of the R&D community to introduce proposed collaborative projects that pool public R&D investment for focussed research projects.*

Electronics Industry

A prerequisite for the future sustainability and global competitiveness of Australia's electronics industry, as well as many other Australian industries for which electronics is a key enabler, is successful commercialisation of its R&D. That is, 'design realisation' or the experimental development, testing and 'design and manufacture' stage of the process of creating a product to satisfy a marketplace need in a way that is innovative and competitive.

Through the Action Agenda development process, the electronics industry found a significant gap between product concepts and the use of leading edge design tools and design concepts to create production prototypes needed for globally competitive markets. This gap was identified as existing in the product commercialisation processes of publicly funded research bodies such as CRCs, the Commonwealth Science and Industrial Research Organisation (CSIRO) and the product development processes of many SMEs.

In order to reduce the existing commercialisation barriers in the electronics industry, the Action Agenda recommended a range of initiatives (see summary in the box below) and these are currently being implemented.

Electronic Industry Action Agenda: Commercialisation initiatives

Industry supports the pursuit of excellence across the whole innovation chain (from research to experimental development, design and manufacture), including through the National Research Priorities setting process.

Industry will promote the pursuit of world leading and market focussed electronics research under Australia's National Research Priorities.

Industry supports a rebalancing of R&D spending towards development and commercialisation activities. It will work to encourage the Government to increase the support directed to applied and developmental research projects through Government research support programs and priorities.

Energy

Australia's energy sector spans the production and supply of stationary energy (such as electricity and gas), transport energy (mainly petroleum based fuels) and energy for export. It includes, for example, the conversion of raw, primary energy sources into final energy sources such as electricity and refined petroleum fuels and their delivery and marketing to final consumers.

On 15 June 2004, the Prime Minister launched the energy white paper, *Securing Australia's Energy Future*, which outlined the Australian Government's commitment to attracting investment in the efficient discovery and development of our energy resources and to encourage development of cleaner, more efficient technologies that will underpin Australia's energy future.

Securing Australia's Energy Future included the establishment of the Renewable Energy Development Initiative (REDI). The program is aimed at strengthening the pathway to commercialisation of new technologies within the energy sector. It will do this by supporting the commercial development of new renewable energy technology products, processes or services. REDI will provide matching competitive grants totalling up to $100 million over seven years to commercial entities to undertake development of renewable energy technologies. REDI will provide support for R&D, proof-of-concept, and early-stage commercialisation activities.

Intellectual property and patents

A strong intellectual property (IP) system helps promote innovation, investment, trade and economic growth. The IP system in Australia applies to patents, trade marks, copyright, registered designs, as well as plant breeder's rights and circuit layout rights. Intellectual property rights (IPRs) refer to the various rights accorded by law for the protection of creative effort and economic investment in creative effort.

IP is generated through research both in private sector enterprises and the public sector in organisations such as universities and the CSIRO.

IP protection is critically important for some industries. Any realistic commercialisation strategy for technological innovations must be based on a strong proprietary position.

Protecting R&D results through patents has a bearing on the value of a company. Patents can internalise the benefits of R&D outcomes to the firm and increase its market value. In addition, patent data can provide a useful measure of innovation. It should be noted that not all technological innovations result in the seeking of patent protection, and therefore, patent data can underestimate the level or degree of innovation in an economy.

The ABS Innovation in Australian Business survey found that formal methods of IP protection (eg. patents, registration of design, copyright or trademark) were used by 21.5% of innovating businesses to protect IP. Informal methods (eg secrecy) were used by 36.6% of innovating businesses.

Government protection of IPRs is a means of providing incentives for efficient investment in innovation, and a pathway to commercialisation of inventions. IPRs provide the necessary protection of products of creative effort, which by their nature can lend themselves to easy copying and replication at relatively low cost, denying the creators or inventors of IP the opportunity to recoup the cost of their considerable effort and their investment in research and development, and commercialisation of inventions.

Overview of the IPR system

At present, IP rights are territorial. They are granted by each country independently and have effect only in that country. However, because both the goods and services embodying IPRs and the IPRs themselves are traded globally, the Government through IP Australia plays a key role with other nations in shaping the development of the increasingly important international IP framework. This includes the Trade Related Aspects of Intellectual Property Agreement (TRIPS), which requires minimum standards of IP protection for countries to become members of the World Trade Organisation (WTO); and the World Intellectual Property Organisation (WIPO), where harmonisation of IP regimes is continually being negotiated.

The effective operation of the patent, trade marks, plant breeder's rights and designs systems is important for the competitiveness of innovative Australian companies in domestic and international markets. The benefits of the exclusive rights to society are the promotion and diffusion of innovation that is the major source of economic growth; the costs are losses in allocative efficiency and some secondary innovation, as well as administration costs. For the net benefits to exceed the net costs it is important that the rights only be granted after high quality examination against appropriately high tests.

None of the statutory IP rights referred to above are mandatory in Australia and other non-legislative means exist for protecting innovation. For example, many companies use trade secrets or confidentiality agreements instead of, or in combination with, patents. Likewise, the common law tort of 'passing of' may be used instead of registered trade marks.

Overview of the Australian IP system

The main purpose of a patent system is to stimulate industrial invention and innovation by granting limited monopoly rights to inventors in return for full disclosure to the public of the invention, thereby increasing public availability of information on new technology.

Under current Australian patent law (*Patents Act 1990* and associated regulations and case law), a patent may be granted on a new, non-obvious and useful invention, including improved products and processes. The area of exclusivity ('scope') of the patent is defined by the claims of the specification. To be patentable, the claims must satisfy threshold tests required by the Act, the most important of which are:

- the invention must be a 'manner of new manufacture' within the meaning of Section 18 of the Act and relevant case law;
- the invention must be novel in the sense that it has not been previously performed or published;
- for a standard patent, the invention must be inventive and not merely an advance that would be obvious to a person skilled in the field of the invention;
- for an innovation patent, the invention must involve an innovative step, in that there is a difference between the invention and the prior art which makes a substantial contribution to the working of the invention; and
- the invention must be useful.

A patent gives the patentee the exclusive right, during the term of the patent, to 'exploit' the patented invention in Australia, including the right to make, hire, sell, use or import the invention, and/or authorise another person to do so. In Australia, a standard patent lasts for up to 20 years, with a further five year extension possible for pharmaceuticals. Annual renewal fees are payable from the fifth year.

The innovation patent system is a second tier system directed to lower level and incremental inventions, particularly those by SMEs, which may not meet the higher inventive threshold requirements of the standard patent system. In addition to the lower inventive threshold and shorter term, there are a number of differences between the standard patent and innovation patent. In particular, there are additional exclusions to patentable subject matter and a limit of five claims. Also, the innovation patent can be obtained more quickly than a standard patent and it is less costly to obtain. An innovation patent may last for up to eight years, with annual renewal fees payable from the second year.

Applications for patents must be filed with the Patent Office, which forms part of IP Australia. The application must fully describe the invention, and state the scope of the desired patent rights. This involves a description of the invention in sufficient detail that a person familiar with the technology ('skilled in the art') could perform the invention without undue experimentation. The description must include the best method known to the applicant for performing the invention. These requirements are often characterised as part of the bargain (*quid pro quo*) between the applicant and society. In return for the applicant's limited exclusive right, society gains through the disclosure of the invention, which allows others to build on the invention or work around it during the exclusion period, and to use it directly after the exclusion period expires.

Processing an application for an IPR involves a significant number of stages over a significant period of time. For example, the main stages in IP Australia for receiving and maintaining a standard patent are receiving the application, processing formalities, examination, acceptance, opposition hearing if requested, patent grant and fees for renewal. Each of these processing stages involves a number of sub-stages many of which attract separate fees. The process until grant of a standard patent can take up to 5 years. Applicants may drop out of the process at any stage.

As in many other countries, Australia encourages easier entry into the IP system, particularly by SMEs, by minimising the official fees charged early on in the process when the commercial value of the innovation is uncertain and so funding may be difficult. Higher official fees are then charged later in the IPR's life if the innovation is sufficiently successful commercially. The patent maintenance fee structure set out in the Patents legislation is designed to encourage patent holders in all technologies to relinquish patents for which a commercial advantage is no longer gained. Annual maintenance fees for the standard patent increase from $180 on the fifth anniversary to $1200 on the twentieth anniversary.

Due to the skill required to prepare patent applications, and the potential for significant losses to the applicant if a mistake is made, many applicants choose to use the services of a patent attorney to pursue their application. The patent attorney charges make up the major component of the costs associated with obtaining and maintaining a patent in Australia.

The average life of a standard patent is 8.5 years for most technologies, however, the average life of a biotechnology patent in Australia is around 12 years from filing and pharmaceutical patents usually run the full allowable term.

Strengthening Australia's IP system

Over the past several years, some major changes have been introduced to the Australian IP system in order to align it more closely with the systems of Australia's international trading partners. These changes include:

- implementing a 12-month grace period to protect a patent application against invalidation by self-publication and prior public use of the invention;
- strengthening the thresholds for meeting the statutory requirements of novelty and inventive step tests for granting of patents;
- up to five-year extension of pharmaceutical patents to compensate for long lead time often required for regulatory approval of drugs;
- introduction of the *Designs Act 2003*, which provides for a completely new registration system for industrial designs;
- introducing the innovation patent to cover lower-level inventions; and
- acceding to the Madrid Treaty protocol to provide a simplified and less expensive process for the international registration of trademarks.

The Government's *Backing Australia's Ability* (BAA) package announced in January 2001 included support for accelerating commercial application of research results, and IP management processes to enhance Australia's capacity to build and manage innovative enterprises. This support was continued through the *Backing Australia's Ability – Building Our Future through Science and Innovation* announced in 2004.

Education and awareness programs

IP Australia's public education and awareness programs and products target a variety of sectors from tertiary education to small business. These programs help Australian firms appreciate that IP protection is integral to business planning, marketing strategy, and product and service development.

As part of IP Australia's awareness and education role, a number of case studies of innovative Australian firms have been compiled. Some of these case studies are accessible on IP Australia's website at the following links:
http://www.ipaustralia.gov.au/strategies/case_index.shtml
http://www.ipaustralia.gov.au/toolbox/module.shtml
http://www.ipaustralia.gov.au/ipprofessor/casestudyindex.shtml

IP Australia holds additional case studies which can be made available on request.

The importance of IP in certain industry sectors and ongoing initiatives to strengthen IP management, skills and awareness, is demonstrated below.

Biotechnology

For biotechnology firms, IP protection is critically important (more so than in many other industries) and any realistic commercialisation strategy must be based on a strong proprietary position. Patents are the primary mechanism for IP protection, and typically comprise a substantial proportion of a company's value. Licensing arrangements and royalty streams remain a prime source of income for successful Australian biotechnology firms, especially in the human health sphere. Managing IP arrangements within partnerships and collaborations is a critical business skill for the majority of Australian biotechnology firms. Importantly, Australian universities are increasingly ensuring that their bioscience students have an awareness of IP issues.

An example of one successful approach to managing the needs of multiple research and commercialisation partners is encapsulated in the Stakeholder Agreements negotiated for the Australian Stem Cell Centre (ASCC), a key biotechnology initiative under the BAA package. The ASCC has established collaborative partnerships with eight stakeholder institutions across Australia. The Stakeholder's Agreement governs the interaction of parties, treatment of IP and sharing of commercial benefits. It was seen as a breakthrough strategy to complete IP management agreements prior to commencing research and commercialisation activities at the various nodes of the ASCC, and is a model that could be employed by other collaborative research centres. The prior settlement of the Stakeholder Agreement's approach provided a foundation of certainty for all parties to the agreements, as well as, transparency in terms of roles and responsibilities. With the IP agreements in place the ASCC has the advantage of pursuing commercialisation agreements with third parties on behalf of the Centre partners. As a result of this approach, the ASCC has drawn together expertise and infrastructure, creating a critical mass of biotechnology R&D.

Electronics

Exploiting IP received significant attention by the electronics industry in developing its Action Agenda. The DITR is working with the industry to implement three relevant recommendations:

- recommendation 9 – industry will work with universities to incorporate strategic IP management as a core subject in courses that lead to electronics-related careers;
- recommendation 10 – industry and government will work with IP agencies to provide a tool kit, training and mentoring for strategic IP management, particularly for start-ups and small and medium sized enterprises (SMEs); and
- recommendation 11 – industry and government will work with public research institutions to identify ways to facilitate access to IP generated in those institutions.

Mining Technology Services (MTS)

The MTS Action Agenda found that action needed to be taken to raise the level of awareness and understanding of IP within the sector (recommendation 6). This would assist in exploiting the wealth of existing innovations within the sector, thereby ensuring global recognition of innovative Australian MTS products and services. Specific initiatives being undertaken include the development of IP best practice management strategies for MTS firms, and sector specific seminars on IP. The seminars assist MTS firms to identify and protect IP, and also explain in detail the various ways that IP can be exploited (eg. manufacturing, licensing, assignment and franchising).

Skills and business knowledge

The skills and business knowledge needed by Australian high technology firms differ depending on the firm size, length of time the firm has been operating, and innovation type. For high technology start up or spin off companies, the common skills and knowledge needs include business strategic skills, IP management skills and general commercialisation skills. A common theme for these companies is that without these skills they will find it difficult to raise capital to finance their business development.

For companies that have successfully launched a new innovation, the skills set required can be very different. For example, they may need access to export market intelligence or have the skills to identify a global partner and then to negotiate a mutually beneficial alliance or partnership to access international markets and to continue to grow. One common approach that Australian firms take to resolve skills issues is to recruit or repatriate expertise from overseas.

In the late 1990s the Government identified that the lack of commercialisation skills was a constraint in innovative firms to raise capital and to progress their innovations. Particular knowledge or skills gaps identified included:

- management skills
- business planning;
- market research;
- IP; and
- development of working prototypes and proven technology.

It was determined that the best way to assist firms to acquire these skills is through private sector advisers, who deal with these issues on a day to day basis. There has been significant growth in the availability of advice to companies looking to commercialise within Australia. However, small companies still have a challenge identifying appropriate advice to their circumstances (particularly in new or new to Australia technology areas), and can find paying for such advice prohibitive. To address this, the Government introduced the Commercialising Emerging Technologies (COMET) program.

COMET

The COMET program was introduced in 1999/2000 with funding of $30 million over three years. The program was extended in 2001/02 with additional funding of $40 million. It was further extended and expanded in *Backing Australia's Ability – Building our Future through Science and Innovation* with a further $100 million over the next 7 years to 2010/2011.

> ***COMET***
>
> *COMET supports early-growth stage companies, spin-off companies and individuals to commercialise their innovation. It aims to help companies to become ready to commercialise their innovation through: raising capital from business angels or venture capital funds or borrowing; and/or to develop business partnerships through licensing, joint ventures or strategic alliances.*

COMET is a competitive grants program which provides financial assistance and access to business advice in these areas:

- *management development including participation in approved management skills development courses;*
- *engagement of mentors;*
- *strategic and business planning, including an export strategy if appropriate;*
- *market research;*
- *market validity;*
- *IP strategy; and*
- *proven technology (including finalising working prototypes).*

COMET has been highly effective. The program has supported over 1000 small companies since it commenced in November 1999. Commercialisation outcomes include over $300 million raised in equity capital by COMET customers, over 600 strategic alliances, licences and agreements, and around 190 product / service launches.

COMET is a unique support program as it involves 'intermediaries' with expert skill sets to assist SMEs in taking an idea, product or service to market. Business Advisers take on a mentoring role, tailoring support to the firm's needs. Additionally, services (eg business plans) can also be purchased from providers in the market place. This program overcomes the impediment of 'not knowing who to get advice from' to go to the market.

Capital and risk investment

Capital and risk investment are key issues in the pathways to technological innovation. Firms seeking to take innovations through to commercialisation need risk capital to fund research, commercialisation and market entry.

The lack of capital for early stage ventures has often been cited as a constraint on commercialising innovation. The information below on the biotechnology, aquaculture and mining technology services sectors provides an insight into the issues faced by emerging industries and start-up firms, and the Australian VC market, and the sectoral initiatives being facilitated by the DITR to overcome barriers.

Australia's venture capital market

Venture capital is equity capital provided by specialised financial firms acting as intermediaries between primary sources of finance (such as pension funds or banks) and firms (formal venture capital). It is also provided by so-called "business angels" (usually wealthy individuals experienced in business and finance who invest directly in firms)[3].

Although Australia's venture capital market is a comparatively small (less than 1%) component of Australia's capital market, dominated by corporate financing sources such as the Australian Stock Exchange and bank lending, it is a major source of funding for new technology-based firms and plays a crucial role in promoting the radical innovations often carried out by these firms.

The level of technical and business risk associated with venture capital backed companies tends to be much higher than the levels of risk associated with debt financed or Stock Exchange financed companies. Technology-based firms are characterised by a limited operating history, no revenue and minimal physical assets, which means that they cannot meet the requirements for debt finance.

Technology-based start-up firms have traditionally tended to rely on the three "F"s, 'friends, family and fools' for capital up to about $250,000. After that they will require risk capital prepared to make longer term equity investments of up to $4 million and this where venture capital can have an impact.

Venture capital has been found to be responsible for an estimated 10% of United States industrial innovations in the past decade. Venture capital has also been found to contribute directly to multi-factor productivity growth through two main channels: it supports the introduction of new products, processes or services to the market that directly contribute to improved economic performances; and it develops an absorptive capability in firms enabling knowledge generated by private and public research institutions to be effectively accessed[4].

---

[3] OECD, 2003, *Science, Technology and Industry Scoreboard 2003*, pg A.7 Venture Capital.
[4] OECD, 2003, *The Economic Impact of Venture Capital*, released in September 2003

Venture backed companies contribute substantially to national economic growth through both direct investment and positive multiplier effects. These include high levels of research and development, payments to suppliers and supporters of VC backed companies, improved goods and services provided to customers, increases in the skill base through R&D employment and training. VC is considered a factor that substantially decreases the time necessary to introduce an innovation to market.

The Australian Government has established a range of venture capital funds to encourage the establishment of an early stage venture capital market. The current programs are described below. A feature of the programs is decisions are made by private sector investors to ensure a market focus to the investments.

The investment stage

Capital is needed by firms at different stages for different types of activity. Sometimes it can be sourced within the company, sometimes private sector investment is crucial, and government programs can assist when these two capital sources are not available.

Equity capital can take the form of pre-seed funding, seed funding, start-up funding or expansion funding. Pre-seed funding assists firms in demonstrating 'proof of concept' – that is whether the idea will work and if there is a potential market. Commonly, this is necessary once the research has been completed and there is a need to test whether it can be developed into a product. Seed-funding is necessary once a product is in development. This type of funding is usually needed to prototype, test, protect IP, and to prepare a business plan and other such steps in getting the product ready for market. This contrasts with start-up funding, which is used to take the developed product into pilot production. Additional capital is often necessary for further product development, additional staffing and initial product marketing. Capital is also sought for expansion. The firm's product or service is in the market and working capital is necessary to manufacture and sell it. The firm may also be ready to seek out new markets to meet growth funding targets.

Barriers to securing capital

Firms face a number of barriers in sourcing capital at different stages of their development or different stages of a product's development. Often cited barriers include:

- inexperience of Australian firms in pitching for private sector capital;
- other firm issues such as the existence of poor business plans or lack of management experience that deterred private investment. Sourcing first time capital can be difficult as VC firms are more likely to invest in companies that have successfully sourced capital previously;
- unproven product or untested market;
- long lead times before financial returns can be realised. This is especially the case in some industry sectors such as pharmaceuticals;
- there are few VC specialists in Australia and international VC specialists do not look to Australia for investments;
- a perception in Australia that there are funding gaps; and

- that the Australian VC market has not yet matured to the point where it is self-sustaining.

Is there a funding gap?

Departmental analysis in 2003 showed that there is a perceived funding gap for early stage commercialisation, by both investors and start-up firms, although there is no consensus on the exact range of the gap. The most common assertion is that there is a funding gap in the range of $250,000 - $1 million, and possibly extending to $2 million – which is often the range of funding needed at the research commercialisation (pre-seed) stage.

Government programs

The Government seeks to build the Australian VC market through a range of incentives.

> ***Innovation Investment Funds and PreSeed Funds***
>
> *The Innovation Investment Funds (IIF) and PreSeed Funds are 'co-investment' programs where the Government has established licensed funds with part government and part private sector investors. The investment decisions are made by the funds, within guidelines established for the programs. There are also tax incentive based programs to encourage investment in early stage ventures, including the Pool Development Funds (PDF) and the Venture Capital Limited Partnership Scheme (VCLP).*

These programs are described in more detail below.

- IFFs - are designed to promote the commercialisation of Australian R&D, through the provision of venture capital to small, high-tech companies at the seed, start up or early expansion stages of their development. Under the program, the Australian government licenses private sector fund managers who make investments in eligible investee companies, by utilising the $358m in capital provided by both the Government ($220.7m) and private sector investors ($137.35m).
- PreSeed Funds - The Pre-Seed Fund (PSF) program was introduced as part of *Backing Australia's Ability*, to help increase the commercialisation of Australian Government research. The PSF program has established four venture capital funds to invest in projects or companies from universities or Government agencies. The funds are managed by venture capitalists experienced in research commercialisation and the development of sustainable businesses. The Australian Government will provide $72.7 million of capital to the four Pre-Seed Funds, and when combined with capital from private sector investors, universities and public sector research agencies results in total funding of over $100 million.
- PDF – the program is designed to increase the supply of equity capital for growing Australian SMEs. PDFs are private sector investment companies established under the PDF Act, which raise capital from investors and use it to invest in Australian companies.

- VCLP - provides for the registration of limited partnerships as venture capital limited partnerships (VCLPs) and is designed to increase the supply of venture capital to Australian companies by providing tax incentives to non-resident investors in Australian VC.

Biotechnology

Early stage capital is particularly critical to the development of the biotechnology industry.

The 2003 Review of the Biotechnology Innovation Fund (BIF) found that there is a difficult VC environment for early stage biotechnology start-up firms in Australia. Biotechnology start-ups commonly involve longer lead times to successful commercialisation than start-ups in other sectors, and when VC funds are scarce, biotechnology start-ups face greater difficulties in attracting investment. The Review found that, in general, an early-stage funding gap exists and noted that the funds available for biotechnology start-ups are limited due to the high risks in this market; that venture capitalists are more willing to invest in start-ups that have been looked at by another 'critical eye' or have been independently assessed by public funding programs; and that venture capitalist involvement is facilitated if equity is 'clean' — that is, negotiations are with the owner of the technology or idea (not with multiple equity holders).

The Review of BIF also indicated that Australian venture capitalists are using a significant amount of their available funds to provide additional support to existing investments. That is, once a company has attracted some VC funds, it is more likely to attract additional VC funds. In 2003-04, 59 VC investments in biotech were made, with those 59 investments going to 50 companies. In 2002-03, 51 investments went to 41 biotech companies.

Adding to this, Professor Michael Vitale's *Commercialising Australian Biotechnology* discussed the issue of whether there is sufficient VC investment in biotech. He noted that venture capitalists argue that there is a lack of good projects while biotechs argue that VC investments are too small. Vitale concludes that the overall investment level is too small (and given in small amounts), that Australian venture capitalists are too conservative, and the answer is to keep the technologies gestating in the public institutions longer. However, capital for high-risk technology based ventures is difficult to attract without the right mix of technical, managerial, marketing and financial expertise, and these are areas not generally enhanced by keeping projects in research facilities for longer. Instead, fledgling biotechnology companies should be encouraged to develop their business skills and access mentoring advice.

For venture backed biotechs (meaning any that source private equity) that reach the IPO stage of development, the story is largely positive. Victor Bivell (Private Equity Media) has recently produced numbers for Australian Venture backed IPOs for the period 1992-93 to 2003-04. This study classified IPOs across 17 industry sectors and groups biotechs with health services companies. The Health/Bioscience grouping is the leading industry by IPO with 20 venture backed IPOs (20% of the total), largest number still listed (17 companies which is 26.6% of the total), and a market

capitalisation of $5.89 billion. A quick review of the 17 companies suggests that at least 8 are core biotechs with a further 5 in the related medical device category.

However, of the top market capitalisation companies in this grouping, 4 of the 5 are in healthcare. There is good potential to add private venture funding in the future with new VC funds being developed to invest in Australian biotechnology including: the Starfish Technology Fund (with a focus on high tech sectors including biotechnology) which closed to investors in Quarter 4 2004 after exceeding its target of $100 million by raising $123 million; and the $100 million Life Sciences Venture Fund will invest in the agriculture and food biotechnology sectors.

It is important to note that there are around 69 listed biotech companies (excluding medical devices), and around 300 unlisted. These companies have come to market, or pursue business development, by a variety of funding mechanisms that include individual investors, business angels and Government programs. Australian Government programs relevant to biotechnology industry development include:

- Innovation Investment Funds – provide funding on a matching basis of up to 2:1 with the private sector;
- Pre-Seed Funds – the program assists with the commercialisation of research from universities and public sector research agencies. The Australian Government has licensed four Pre-Seed Funds, whose managers provide VC and operational advice on the commercialisation of projects or companies spinning out of those research organisations; and
- current Government Grant programs – including P3 and Commercial Ready.

Mining Technology Services (MTS)

Often access to capital restraints can be overcome by raising the profile of investment opportunities in certain industry sectors. This is the case with the MTS sector. To this end, the DITR and the MTS sector are working together to raise the profile of the MTS sector with the financial community and to assist the sector to become more knowledgeable about investor options. This includes the preparation of fact sheets and seminars to outline the benefits of investment in the MTS sector, industry associations disseminating information outlining the range of equity available in Australia through a compendium of Australia's equity providers and overseas options.

Business and scientific regulatory issues

The Australian Government recognises the need to minimise red tape and regulations, particularly those impeding the growth of SMEs. Some regulations can enhance industry innovation. For example, the DITR, through the Australian Building Codes Board, is helping develop performance-based regulations for the building and construction industry that facilitate innovation.

Action Agendas also provide the DITR with information on the impact of regulations and standards on businesses – and help develop strategies to address these. For example, in 2004 the Government passed new regulations for chemicals of low hazardous concern that has slashed red tape in line with the Chemicals and Plastics Industry Action Agenda recommendation.

Harmonisation of state and territory regulations, and multi-jurisdiction approval processes are a major issue for many industries. Through its Action Agenda, the aquaculture industry has succeeded in getting four agencies at three levels of government to agree on a single approval process for aquaculture developments in the Great Barrier Reef Marine Park.

In addition, the DITR through, for example, the National Measurement Institute (NMI) and IP Australia, seeks to provide services to businesses to assist them in meeting regulatory requirements – particularly in relation to international regulations and standards.

National measurement system

World class measurement standards enhance innovation, increase industry competitiveness, and facilitate trade. The NMI within the DITR is responsible for establishing and maintaining Australia's units and standards of measurement and it coordinates Australia's national measurement system.

NMI provides services to industry and research organisations in physical, chemical and biological measurement. It also provides training in measurement science – a key skill in many industries. Underpinning these services are NMIs active programs of basic and applied research needed to maintain and realise those standards with the high degree of accuracy require to support Australian research and technology.

NMI works closely with companies to help solve measurement related problems. The following is a case study that demonstrates a collaboration that is serving to assist researchers and companies with measurement standards thereby strengthening the path to commercialisation and skills.

Researchers at NMI, Macquarie University and the biotechnology company BTF Pty Ltd have collaborated to develop novel fluorescent reference strains that can be quickly and easily distinguished from genuine bacterial contamination. This improved the quality of, and confidence in, microbial testing. To ensure accurate, quantitative DNA measurement, the research collaboration is developing DNA reference materials that contain accurate and precise copy numbers of target DNA with a known measurement uncertainty. This approach can be used to produce reference materials for specific applications or for quality-control in routine analysis.

NMI provides services to a wide range of innovative companies across many industries.

Regulation environment and biotechnology

Biotechnology is a term covering a number of different technologies, which can lead to a myriad of end products – different biotechnologies are used in mining, drug discovery, drug development, land remediation, water treatment, agriculture etcetera. Consequently there is no single regulatory path for biotechnology. The technology and the end product will determine which regulatory regime any biotechnology business will need to comply with.

There are a range of regulatory requirements that impact on the biotechnology, at a local, state and federal level, and internationally. For biotechnology enterprises involved in gene technology, there are regulations that are necessary to protect human health. For biotechnology businesses in the agricultural sector, there are regulatory requirements such as food standards that are necessary to ensure safe food.

For biotechnology firms to be internationally competitive there are also a number of international standards and practises that need to be complied with. These include the need to undertake clinical work to satisfactory Good Manufacturing Practice (GMP) and Good Laboratory Practice (GLP).

Environment Industries

The impact of regulations and standards can be positive for the development of emerging industry sectors. For example, the Water Efficiency and Labelling Standards (WELS) scheme involves the introduction of national mandatory water efficiency labelling and minimum performance standards for domestic water-using devices, and is expected to drive increased investment in water efficient technologies and related services. The scheme was passed by the Senate at the end of January 2005 and it is expected to begin operating by May 2005 in all States and Territories.

The environment industry through its Action Agenda, has, however, identified inappropriate public procurement practices as an obstacle to the uptake of the industry's innovative technologies. As a result, the Australian Department of the Environment and Heritage has developed an environment purchasing guide and checklist to give practical effect to the Commonwealth Procurement Guidelines that require Australian Government purchases to consider relevant environmental issues as part of overall value for money.

Research and market linkages

Linkages or collaborations between researchers and companies play an important role in creating commercial avenues for innovative ideas and technologies. Collaborations help to create the necessary critical mass of expertise, infrastructure and resources, and provide more pathways to the market place.

The increasing speed of technological change, the resources required to be leading-edge, shortened product development cycles and specialisation of knowledge, mean that the linkages between the research sector and firm's are increasing in importance. Performance of Australia's innovation system depends of the intensity and effectiveness of the interaction between knowledge generators and knowledge users.

Linkages range from informal interactions and partnerships between individuals to more formal strategic collaborations between organisations. Some of the gains from such linkages include increased scale and scope of activities, shared costs and risk, improved learning capacity, and the speed to capitalise on emerging opportunities[5].

Mapping Australian Science and Innovation: Main Report[6] includes further about linkages and collaborations across the innovation system, the extent of the linkages, and the barriers faced by the system actors in forming such linkages. Barriers include cultural differences, different understandings of IP arrangements for commercialisation of R&D, and limited capacity for SMEs to connect with the research base.

There has been significant attention paid to interaction between the research community and the private sector – most recently in The Business Council of Australia / Vice Chancellors Committee on "Building Effective Systems of the Commercialisation of University Research".

The Government has long recognised the need to improve collaborations between the research sector to increase commercialisation activity and to improve the innovation system as a whole. For example, the CRC program was established in 1990 to do just that. The commercialisation focus of the program was strengthened in 2003 and the program objective is now as follows:

> *To enhance Australia's industrial, commercial and economic growth through the development of sustained, user-driven, cooperative public-private research centres that achieve high levels of outcomes in adoption and commercialisation.*

Below are specific examples of DITR and industry sector initiatives designed to improve linkages between industry and the research sector. The DITR contends that companies are best placed to make their own commercial arrangements – government can only encourage through programs such as the CRC program.

---

[5] OECD., Collaboration and networking can lead to benefits., 2001., page 324-325.
[6] Mapping Australian Science and Innovation: Main Report., Op Cit, page 251-285.

Aerospace and industry/research linkages

The Aerospace Action Agenda, finalised and launched in March 2004, found the CRC for Advanced Composite to be a fundamental building block to the industry's overall strategy to capture future global opportunities in major aircraft projects. The core participants of the CRC for Advanced Composite Structures are:

- Hawker de Havilland Aerospace;
- Royal Melbourne Institute of Technology;
- University of Sydney;
- University of New South Wales;
- Monash University;
- Defence Science and Technology Organisation;
- CSIRO; and
- Composites Institute of Australia.

The primary aim of the CRC is to provide a focus for the development of advanced technologies which foster the growth of an efficient, globally competitive Australian composite industry. This is achieved, for example, by conducting R&D into the design, manufacture, testing, and durability of advanced composite structures. The CRC has structured its research into three major programs: Aerospace Composites, Maritime Composites, and General Composites.

Aside from the research program, the CRC also provides assistance to organisations which are not directly involved in the Centre on a contract basis. Services provided include:

- R&D project management;
- analysis of composite structures;
- development of working prototypes;
- evaluation of composite products;
- building of technology demonstrators;
- facilitating technology transfer;
- developing international partnerships; and
- running training seminars.

Biotechnology

Most Australian biotechnology firms have emerged from Australian research institutions. Despite the immaturity of Australian biotechnology, many of these companies retain linkages with the organisation from which they have spun-out whilst developing alliances with research institutions and firms overseas to support their business development and market entry. They understand that biotechnology is a global business, and will move to locations where they can conduct their business most cost effectively.

Professor Michael Vitale's *Commercialising Australian Biotechnology* (2004) recommended a number of ways to encourage university based biotechnology research toward a commercial path. He suggested a "carrot and stick" approach by offering contestable funding for the improvement of commercialisation activities, and reducing research funding to institutions that do not develop effective approaches to commercialisation. However, his approach presumed that all universities consistently adopt inadequate commercialisation strategies, and failed to recognise the Government's *National Principles of Intellectual Property Management for Publicly Funded Research* to achieve 'best practice' in IP management, that universities are required to report on their IP and commercialisation activities, and that the method of commercialisation of publicly-funded R&D is a matter for the individual research institution to decide.

Vitale suggested that universities do not provide adequate attention or resources to the decision making process leading to invention disclosure and to decisions as to sale, license or start-up company formation. DITR research (responses from a survey of 18 University Commercialisation Offices) suggests that universities do consider these issues and possess varying IP management policies. It revealed that judgements are based on pragmatic decisions determined by the level, extent, nature and preference of the interest by external parties. Mechanisms for commercialising IP are considered on a case by case basis. The DITR survey revealed potential for a significant improvement in the IP management practices of some universities, including resource constraints.

Commercialising research requires the right mix of technical, managerial, marketing and financial expertise which is not usually available in public research institutions. Also, there is a range of collaborative support measures available within universities. Most biotechnology companies are aware of global business imperatives and specifically target major international markets (eg biopharmaceuticals companies target the US drug market). This is reflected by the strong industry partnerships Australian biotech companies are developing with overseas collaborators. In fact, Australia's listed biotechs entered into 84 partnerships in 2004, 69% of which (58 of 84) were with international organisations. The US is still the most favoured destination, comprising 40% of all partnerships (34 of 84), and partnerships with Japan and China are becoming an increasing focus. Partnerships between an Australian and US organisation exceeded those between two Australian organisations. Most partnerships are with another biotech, research organisation, or pharmaceutical company.

Business to business linkages

Some technologies are more likely to be developed in publicly funded research institutions and then commercialised by the private sector – pharmaceuticals and biotechnologies. For these sectors, effective linkages between the two sectors are important.

However there are many technology areas where technologies are developed within the private sector and linkages with the public research base are immaterial. This is certainly the case with most information technology and communications technologies in Australia. In these cases, effective private sector links with each other and with key sources of advice are essential. This is born out by the ABS Innovation in Business survey which identified that the proportion of businesses collaborating with universities, government and research institutions was 6.5% compared with collaboration with suppliers, clients, competitors and consultants at 25.1%. Location remains an issue for collaborative activity with most businesses collaborating with partners within 100 kilometres of their business.

Appendix A

Commercialisation Issues Identified in Action Agendas: Based on Recommendations

	Venture Capital	IP management	Management Capabilities	Skills/Education issues	Industry R&D	Collaboration with Public Sector Research org (including CRCs) to source innovations	"Commercialisation" Initiatives as a whole
Aerospace				✓	✓	✓	
Aquaculture	✓			✓	✓	✓	✓
Biotechnology	✓	✓	✓	✓	✓	✓	✓
Building and Construction					✓	✓	
Chemicals and Plastics				✓	✓	✓	
Digital Broadcasting					✓	✓	✓
Electronics	✓		✓		✓	✓	✓
Environment Industry	✓				✓	✓	✓
Facilities Management (under development)				✓	✓	✓	✓
National Food Industry Strategy	✓	✓	✓	✓	✓	✓	✓
Forest and Wood Products	✓		✓	✓	✓	✓	✓
Freight Transport Logistics			✓	✓	✓	✓	
Furnishing Industry			✓	✓	✓	✓	✓
Heavy Engineering and Infrastructure			✓		✓	✓	✓
Light Metals				✓	✓	✓	✓
Marine Industries				✓	✓	✓	
Minerals Exploration (being implemented)				✓	✓	✓	
Mining Technology Services	✓	✓		✓	✓	✓	✓
Pharmaceutical Industry	✓	✓	✓	✓	✓	✓	✓
Renewable Energy	✓		✓	✓	✓	✓	✓
Science Industry	✓	✓		✓	✓	✓	✓
Spatial Information	✓	✓		✓	✓	✓	✓
Textiles Clothing and Footwear			✓	✓	✓	✓	✓

Acronyms

ASCC	Australian Stem Cell Centre
BAA	Backing Australia's Ability
BERD	Business Expenditure on Research and Development
BIF	Biotechnology Innovation Fund
CRC	Cooperative Research Centre
CSIRO	Commonwealth, Science and Industrial Research Organisation
DITR	Department of Industry, Tourism and Resources
GMP	Good Manufacturing Practice
GLP	Good Laboratory Practice
IIF	Innovation Investment Fund
IP	Intellectual Property
IPO	Initial Public Offering
IPRs	Intellectual Property Rights
MFP	Multi-factor productivity
MSD	Merck Sharp & Dohme (Australia)
MTS	Mining Technology Services
NMI	National Measurement Institute
P3	Pharmaceutical Partnerships Program
PDF	Pooled Development Funds
PSF	Pre-Seed Fund
R&D	Research and Development
REDI	Renewable Energy Development Initiative
SMEs	Small and Medium Sized Enterprises
TRIPS	Trade Related Aspects of Intellectual Property Agreement
US	United States
VC	Venture Capital
VCLP	Venture Capital Limited Partnership Scheme
WELS	Water Efficiency and Labelling Standards
WIPO	World Intellectual Property Organisation
WTO	World Trade Organisation