University Research: Technology Transfer and Commercialisation Practices

Commissioned Report No. 60

The Melbourne Consulting Group Pty Ltd
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Foreword

The Australian Research Council welcomes its commissioned report, *University Research: Technology Transfer and Commercialisation Practices*. As defined in the study, commercialisation is ‘the process of converting science and technology, new research or an invention, into a marketable product or industrial processes’. The study is concerned with raising awareness of the commercial advantage of research. It offers options for creating and sustaining cooperative links between universities and industry. It notes the need for increased science literacy among research users.

In recognition of the diversity of Australian universities and the diverse nature of activities in any individual university, Part 2 of the report presents a discussion of issues and approaches for universities and their commercial arms (technology transfer companies) to consider in commercialising their research. The discussion should also assist industry people, the end users of research.

The study has aptly pointed out that technology transfer and commercialisation of research is about people rather than procedures or university practices. It notes that, in general, the individuals involved need to devote time and effort in setting up useful relationships which may lead to the successful commercialisation of research. The study recognises that entrepreneurship in Australia is minimal and encourages its development for the future.

The Council has a special interest in research training within universities and the study addressed the question of how research commercialisation might affect postgraduate researchers. It found that, in general, the involvement of university researchers in the commercialisation of their research had a very positive impact on postgraduate student research training, particularly where students might have an opportunity of working in industry at a later stage.

The report represents an important contribution to the current discussion on research commercialisation. I commend the report to the Australian Vice-Chancellors’ Committee and individual universities and to those in industry who stand to benefit from the commercialisation of research. In the longer term, it will be the nation that benefits from increased levels of technology transfer and commercialisation of university research.

Vicki Sara
Chair
Australian Research Council

October 1999
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Glossary, Acronyms and Abbreviations

Glossary

CRC  
*Cooperative Research Centres Program* provides support for long-term collaborative ventures linking researchers and research users from universities, Commonwealth and State funded research organisation and business enterprises. It is a DISR funded program.

SRC  
*Special Research Centres* are established on the basis of research excellence and their potential to contribute to the economic, social and cultural development of Australia. The main objective of the centres is to pursue basic research. It is an ARC funded program.

Key Centres  
*Key Centres of Teaching and Research* are established to undertake applied, industry-related research and to promote postgraduate teaching. Key Centres aim to boost expertise in areas relevant to national development and to promote cooperation between the higher education sector and industry. It is an ARC funded program.

GIRD Grant  
*Grant for Industrial R&D*. Former Commonwealth grant system to support research of national economic importance. It was a DIST funded program.

Mechanisms A, B and C  
Former ARC funded schemes to support institutional research infrastructure.

Research Quantum  
The *Research Quantum* is allocated on a performance basis, and is directed to support research activities other than those directly linked to teaching and research training. Since 1995 the Research Quantum has been allocated on the basis of a composite research index that measures institutions’ research performance. It has three categories with differing weightings:

1. National Competitive Research Grants
2. Other Public Sector Research Funding
3. Industry and Other Funding

SPIRT Grant  
*Strategic Partnerships with Industry - Research and Training Scheme* encourages collaborative research between universities and industry organisations. It is an ARC funded program.

R&D START Program  
*R&D START (Strategic Assistance for Research and Development) Program*. Grants are made by the Industrial Research and Development Board (IR&DB) to companies to undertake research and development and related activities in Australia. Grants are competitive and conditions apply.
**Acronyms and Abbreviations**

<table>
<thead>
<tr>
<th>Acronym</th>
<th>Description</th>
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<tbody>
<tr>
<td>AFISC</td>
<td>Australian Food Industry Science Centre</td>
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<tr>
<td>AGPS</td>
<td>Australian Government Publishing Service</td>
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<td>AGSO</td>
<td>Australian Geological Survey Organisation</td>
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<td>ANSTO</td>
<td>Australian Nuclear Science and Technology Organisation</td>
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<td>ANGIS</td>
<td>Australian National Genomic Information Service</td>
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<tr>
<td>APA</td>
<td>Australian Postgraduate Awards Scheme, an ARC grant scheme</td>
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<tr>
<td>APA(I)</td>
<td>Australian Postgraduate Awards (Industry) Scheme, a former ARC grant scheme</td>
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<tr>
<td>APEC</td>
<td>Asia-Pacific Economic Cooperation</td>
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<tr>
<td>ARC</td>
<td>Australian Research Council</td>
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<tr>
<td>ATICCA</td>
<td>Australasian Tertiary Institutions Commercial Companies Association Inc.</td>
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<td>ATP</td>
<td>Australian Technology Park</td>
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<td>AVCC</td>
<td>Australian Vice-Chancellors’ Committee</td>
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<tr>
<td>BCG</td>
<td>Boston Consulting Group</td>
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<tr>
<td>BHERT</td>
<td>Business/Higher Education Round Table</td>
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<tr>
<td>BLO</td>
<td>Business Liaison Office</td>
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<tr>
<td>BOOT</td>
<td>Build, own, operate, transfer</td>
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<tr>
<td>CAE</td>
<td>College of Advanced Education</td>
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<tr>
<td>CEED</td>
<td>Cooperative Education for Enterprise Development</td>
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<tr>
<td>CMTE</td>
<td>CRC for Mining Technology and Equipment</td>
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<tr>
<td>CSIRO</td>
<td>Commonwealth Scientific and Industrial Research Organisation</td>
</tr>
<tr>
<td>CNRS</td>
<td>Centre National de la Recherche Scientifique, France</td>
</tr>
<tr>
<td>CSU</td>
<td>Charles Sturt University</td>
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<tr>
<td>'D' stage</td>
<td>Development stage</td>
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<tr>
<td>DEET</td>
<td>Commonwealth Department of Employment, Education and Training</td>
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<tr>
<td>DEETYA</td>
<td>Commonwealth Department of Employment, Education, Training and Youth Affairs</td>
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<td>DETYA</td>
<td>Commonwealth Department of Education, Training and Youth Affairs</td>
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<tr>
<td>Acronym</td>
<td>Description</td>
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<tr>
<td>DISR</td>
<td>Commonwealth Department of Industry, Science and Resources</td>
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<td>DIST</td>
<td>Commonwealth Department of Industry, Science and Tourism</td>
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<tr>
<td>DSTO</td>
<td>Defence Science and Technology Organisation</td>
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<tr>
<td>EFT</td>
<td>Equivalent full time</td>
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<tr>
<td>FASTS</td>
<td>Federation of Australian Scientific and Technological Societies</td>
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<td>HEC</td>
<td>Higher Education Council</td>
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<tr>
<td>HRDC</td>
<td>Horticultural Research and Development Corporation</td>
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<tr>
<td>IIF</td>
<td>Innovation Investment Fund (an IR&amp;DB managed early stage venture capital initiative)</td>
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<tr>
<td>IP</td>
<td>Intellectual property</td>
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<tr>
<td>IR&amp;DB</td>
<td>Industrial Research and Development Board</td>
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<tr>
<td>MIT</td>
<td>Massachusetts Institute of Technology, USA</td>
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<tr>
<td>NASA</td>
<td>National Aeronautics and Space Administration, USA</td>
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<tr>
<td>NBEET</td>
<td>National Board of Employment, Education and Training</td>
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<tr>
<td>NEFT</td>
<td>National Entrepreneurship Training Foundation, USA</td>
</tr>
<tr>
<td>OH&amp;S</td>
<td>Occupational health and safety</td>
</tr>
<tr>
<td>PCT</td>
<td>Patent Cooperation Treaty</td>
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<tr>
<td>QDPI</td>
<td>Queensland Department of Primary Industries</td>
</tr>
<tr>
<td>R&amp;D</td>
<td>Research and development</td>
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<tr>
<td>S&amp;T</td>
<td>Science and technology</td>
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<tr>
<td>SMEs</td>
<td>Small and medium sized enterprises</td>
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<tr>
<td>SPIN</td>
<td>Sponsored Programs Information Network, USA</td>
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<tr>
<td>TAFE</td>
<td>Technical and further education</td>
</tr>
<tr>
<td>TD</td>
<td>Technology development</td>
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<tr>
<td>TT&amp;C</td>
<td>Technology transfer and commercialisation</td>
</tr>
<tr>
<td>TUNRA</td>
<td>The University of Newcastle Research Associates Ltd.</td>
</tr>
<tr>
<td>UBC</td>
<td>University of British Columbia, Canada</td>
</tr>
<tr>
<td>UILOU</td>
<td>University/Industry Liaison Office, University of British Columbia, Canada</td>
</tr>
<tr>
<td>UQ</td>
<td>University of Queensland</td>
</tr>
<tr>
<td>VAT</td>
<td>Value added tax</td>
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<tr>
<td>VUT</td>
<td>Victoria University of Technology</td>
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<tr>
<td>WIPO</td>
<td>World Intellectual Property Organisation</td>
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Executive Summary

Aim and Objectives of the Report

The broad aim of this report is to promote economic growth through Australian universities, improving the extent to which they put their scientific research to productive commercial use. One of the priorities in this aim is to ensure that new technology is transferred to environments where it can be used most productively (technology transfer). A national objective is to keep in Australia the technology development stage and early stage manufacture (not just building prototypes).

An important strategic objective is to encourage the creation of new ventures to exploit research findings, and to provide measures to aid the creation, survival, progress and growth of these new ventures.

For universities, a strategic objective is to maximise financial returns and other benefits from the successful use of their intellectual capital.

Using the Scottish Enterprise employment targets as a model, the strategy underlying this study has the potential to create an additional 10 000 to 15 000 jobs in Australia over, say, the next five years. This job growth will be generated as follows:

- 10 000 additional jobs in existing companies (if all these jobs are generated from formal licensing agreements, the increase in university licensing income will amount to several million dollars); and

- 3 000 to 5 000 jobs in spin-off companies (a successful strategy will create an additional 300 spin-off companies, assuming at least modest growth in the economy).

The main output of this study was to be ‘an outline of a code of practice which the Australian Vice-Chancellors’ Committee (and individual universities) might find useful in the handling of intellectual property, technology transfer and commercialisation of research in Australian universities’ (Project Brief, Appendix 1). As the project developed, it emerged that the material collected and analysed for the study constituted a discussion of issues and approaches for technology transfer and research commercialisation practices, rather than an actual code of practice. The ARC agreed that such a discussion could be useful by providing options for individual universities to consider, depending on the unique research focus of each.
Related objectives include:

- to survey technology transfer and commercialisation (TT&C) policies and management arrangements, including intellectual property, in Australian universities;
- to assess the mechanisms for and effectiveness of TT&C at six selected universities: Victoria University of Technology, The University of Adelaide, The University of Sydney, The University of Queensland, The University of Newcastle and Charles Sturt University;
- to overview research user experience in TT&C relationships with universities; and
- to examine how the commercialisation of research affects or might affect research training.

**From Research to Technological Innovation: The Process**

Research is only the first and usually the least expensive stage in innovation. Invention + commercialisation = innovation. Innovation is about change, even revolutionary change, and thus it includes risk. The technological innovation equation has more steps: R&D + technology development + commercialisation = technological innovation. It includes both process and product innovation. Process innovation derives mainly from technology transfer which itself derives from the use of accumulated know-how and the movement of people rather than from systems or procedures.

Technological innovation involves both technology risk and commercial risk. Entrepreneurship is about risk taking and, in this study, about the effective management of both types of risk, with the objective of creating wealth for those involved (institutions, companies and individuals).

For the purposes of this study, the word *industry* has been used to describe research users generally, whether private or public sector.

**TT&C Channels**

Technology transfer and commercialisation take place through a wide variety of channels:

- publications and the free interchange of ideas and information through seminars and other forms of informal communications;
- academic-industry linkages;
- education and training for company personnel;
- people transfer including the recruitment of former students, researchers and staff by companies and the secondment of staff both into and out of the science base;
- consulting, contract and collaborative research for industry and other research users;
- licensing or giving the right to use intellectual property through licensing deals or assignment to existing companies; and
- exploitation of intellectual property through the many and varied spin-off company routes that can be based on licensing deals, joint ventures and companies set up by the university, its staff or its graduate students.

Major Findings

Literature Review and Overseas Experience

The literature review, which included internet sites, revealed these highlights:

- The course of both invention and commercialisation is often random and is heavily influenced by messy and fortuitous developments (serendipity).
- Much of university innovation arises from new discoveries rather than as a response to a market need. Commercialisation success is about finding technical and commercial solutions to existing or often unforeseen market opportunities. More conventional linear models of product innovation are often not so relevant.
- Successful technological innovation involves both technology development and commercialisation. Both stages usually are many times more costly than the original research.
- Universities in the UK and USA are finding that generating new enterprises to develop research findings can be more effective than licensing intellectual property to existing companies. Whilst it can generate a greater multiplier on their investment, success requires access to a critical mass of management competence and specialist experience.
- A number of US universities are using their alumni to oversee start-up company business plans and act as mentors to start-up enterprises developed by their graduates.
A major divergence between US, and more recently UK tertiary institutions, and their Australian counterparts has been the lack in Australia of a culture of entrepreneurship. Failure in a new venture in the US is often seen as a condition for future success rather than as a social or commercial stigma.

Incubators and similar interventions can assist the success of entrepreneurs, but careful selection of entrants and a focus on products and processes with global market potential are critical.

People (rather than processes) are the key agents in transferring technology—generally through graduate employment and various arrangements under which researchers work with industry.

Relationships between universities and industry are more successful when both parties are aware of their own responsibilities and the expectations of the other party.

Views of Research Users

The users of research found the TT&C performance of universities very variable, both between universities and within them. The study found many examples of commercialisation relationships with which both the researchers and the research users were satisfied. However, the users of research were concerned that universities often failed to meet agreed deadlines and produce the research outcomes.

The most important success factor was shared understanding of the objectives and expectations of both the research user and the research provider. There was a learning curve for both parties, and longer term relationships tended to be more successful. University companies and liaison offices were not always seen by users to be helpful during the contract negotiation process. Research users wanted to be able to deal directly with individual researchers or their heads of department or centre.

Users involved with spin-off companies found there was a serious shortage of people with experience in managing the technological development stage—a thorough approach to this stage is essential if risks are to be reduced to an acceptable level. Delays inherent in university decision-making processes about new equity investments were a serious problem for venture capitalists.
University Experience

A number of university TT&C performance indicators were tested. Those showing the best relationship to qualitative performance assessments were:

- total funding and per cent of Total Research Income derived from Category 3 Industry and Other Funding (excluding funding from syndicated R&D, donations, bequests and foundations), which are university financial statistics from the then Department of Employment, Education and Training (DEET);

- success in collaborative research grants (SPIRT and R&D START);

- number and proportion of postgraduate awards such as Australian Postgraduate Awards (Industry) or otherwise funded by research users;

- patents filed and royalty income; and

- number of spin-off companies generated (with or without university equity).

DEET university financial statistics show the very wide range of commercialisation financial performance. The DEET Category 3 Industry and Other Funding (excluding funding from syndicated R&D and from donations, bequests and foundations) in the Research Quantum ranged for individual universities from $23 million down to $36 000 with a mean of $3.8 million. This funding as a percentage of Total Research income ranged from 33 per cent to 1 per cent, with a mean of 19 per cent.

Earnings from external commercial relationships were greatest for engineering, followed by biosciences and the physical sciences. Universities without engineering faculties appeared to have fewer opportunities for developing such relationships.

Universities are finding it difficult in developing consultancy and external earnings policies to strike a balance between protecting themselves against legal liabilities (even on small projects) and maintaining sufficient flexibility in their external relationships. Consultancies are important channels for technology transfer and as the first stage in building longer term relationships. Too much control and excessive internal levies on fees earned can be disincentives to researchers to build external commercial relationships.
Research Centres and Cooperative Research Centres

Creation of research centres, whether by the university alone or with an ARC Special Research Centre or Key Centre grant, has been important in creating a critical mass of research resources and infrastructure in a particular field. Their role in facilitating technology transfer and research commercialisation was clearly more variable than other areas within the university. It varied with the personal objectives of the head of centre and his researchers and with the need to generate external funding to survive. University case studies were undertaken for this study but are not included in the report. The studies showed examples of centres that had been highly successful in using their critical mass and infrastructure to develop intellectual property and build external relationships to add value to this intellectual property. There were other centres where the focus was on basic research, with little interest in TT&C.

On the other hand, the successful Cooperative Research Centres (CRCs), often as a result of the demanding review process, had developed a shared understanding (often with difficulty initially) of research user and provider expectations and priorities. Starting from this, they had been able to apply very successfully their improved access to research resources and infrastructure to develop collaborative research outcomes of major user relevance. This study has confirmed other evidence that the CRC program has been a critical agent in changing academic attitudes to TT&C by universities. For many research groups, however, the funding preference is still the more familiar ARC Large and Small Grant system. Obtaining CRC funding is seen to be expensive and complicated. Involvement with a CRC may be seen by more junior researchers to hinder rather than promote an academic career path.

Intellectual Property

All universities have intellectual property (IP) policies to cover staff and postgraduate students, but few have similar policies for undergraduates and visitors. Issues identified included possible coercion of students to sign IP rights assignment documents and how to provide them with independent legal advice. There were wide variations in practices on copyright ownership, particularly for software and eligible circuits.

A major issue which emerged from this study was whether the university or the licensee should bear the costs of final and overseas patent specifications.
Conditions for Commercialisation Success

Successful commercialisation of university research requires a champion. It also requires the infrastructure to be in place. It is too late to seek infrastructure funding after signing the contract. ARC infrastructure funding initiatives have been important.

A lot of hard work is involved in finding and developing the initial partner in the commercialisation of a new discovery. The researcher involved and the head of department or centre need support in this, but essentially they need to have the major role—often difficult when personal teaching, research and publication loads are high.

Universities are finding that success in maximising the value of IP, particularly through spin-off companies, requires access to a critical mass of specialist professional and management resources. Larger universities are able to carry the costs and the risks involved, but smaller universities may need to group together with a shared university company or other agency to achieve the critical mass of competencies required.

Research Training and Employment Readiness

The evidence from the university reviews in this study is that involvement of university researchers in the commercialisation of their research is generally very positive in its impact on postgraduate student research training. The positive impact is greatest where students have a high likelihood of later working in industry—and hence benefit from being employment ready—rather than following academic careers. The impact is less where the student is solely motivated by the opportunity to do basic research as the start of an academic career.

The advantages to research training from university TT&C involvement (including CRCs) include:

- finding real world problems needing more basic research solutions, but still addressing industry priorities;
- better student access to equipment and research infrastructure;
- working in a team, establishing networks, and better access to other researchers for advice and help with problems;
- having an associate supervisor (sometimes several) from outside the industry (for example, CSIRO; DSTO, AGSO, industry and other research users);
opportunities to work with industry people and on projects within industry, leading to a better understanding of research user cultures and needs and to employment opportunities;

learning opportunities on leadership, IP and commercially relevant topics; and

training in industrial health and safety, quality assurance including laboratory notebook recording, research costs and project costing, and project management disciplines (planning, regular reporting, milestones and timelines).

Not all of these will be equally important to all students.

The disadvantages of research supervisors being involved in external commercial relationship do not differ greatly from those of a supervisor having too many students to supervise for a range of reasons. The quality of supervision can be inadequate whether the research is pure or applied. Research users expressed concern that very often senior academics, often those with high international reputations, took on too many external contracts and used students to carry these out, but were unable to devote enough time for effective leadership of the individual projects. This is a matter for the university’s internal management and supervisor quality assurance processes, but can result from uncontrolled encouragement of external funds generation and distraction by tangential issues.

The other potentially adverse impact is that availability of additional funding for postgraduate students as a result of CRCs or other external relationships may result in loss of research quality and challenge in the PhD projects selected.

Additional Learning Opportunities

An important issue in most reviews of CRCs has been innovation in research training. Generally adequate attention is given to oral and written presentation skills. The additional needs have been for learning opportunities in project and technology management, in IP related subjects, in commercialisation practices and in leadership. Of the 15 postgraduate students interviewed in a recent CRC review, 14 indicated that they wanted to learn more about commercialisation practices. There is considerable scope for extending these CRC initiated practices across the postgraduate student body. This has been recognised in many universities in research student induction programs. The evidence is that these can be improved.
Drivers and Constraints

For academic staff, the primary motivator for pursuing commercialisation of research findings is monetary reward (both for their departments and for themselves) and access to finance, including that needed to support their research activities. Secondary motivators are the opportunity to take on new challenges and to identify new opportunities in basic research.

Constraints include the traditional negative attitudes towards anything ‘commercial’ (less prevalent today), lack of time because of increasingly busy schedules of academics, and the shortage of seed money and venture capital for the early stages of technology development.

Success Factors

In addition to the discussion of issues, the report identifies a number of key success factors that are shared by the most successful Australian universities. These factors are summarised below:

- The governing body and the Vice-Chancellor should demonstrate a commitment to technology transfer and commercialisation of research. There should be a strategic plan with regularly updated TT&C objectives and performance indicators. Senior people should provide encouragement and leadership in many aspects of the process.

- University ‘inventors’ need access to a critical mass of legal and contractual support services with adequate and success based operating budgets.

- The business liaison managers and the university technology companies should understand and accept the expectations of external clients. They need to develop manuals, standard contracts, competencies and ‘key customer’ databases and many other support services. Their role should be as consultants/coaches/mentors rather than as project managers.

- University educators should understand industry needs and ensure that a high proportion of honours year and postgraduate students have experience in working with industry.

- Universities need to strongly support entrepreneurship in staff, students and alumni and encourage and mentor spin-off ventures and all the actions that go with them.
A Discussion of Issues and Approaches for Technology Transfer and Commercialisation Practices

The major product of this study is a discussion of issues and approaches for technology transfer and commercialisation practices for university research. In recognition of the wide diversity of university research, the study presents a variety of issues and approaches which include:

- creating the right environment;
- marketing and building relationships;
- support structures;
- intellectual property;
- publications and conferences;
- education and training;
- consultancies;
- research contracts;
- licensing;
- spin-off and start-up companies; and
- technology parks and precincts.
Part 1

Collection and Analysis of Survey Data
1.1

Introduction

A key element of the transformation of the higher education sector in Asia-Pacific Economic Cooperation (APEC) member countries is recognised to be cooperation between higher education institutions and business enterprises.

(Turpin et al 1996, p. vii)

In industrialised countries such as Australia innovation is a key source of economic growth. Firms face the constant challenge of adapting technology and management to improve performance. Accordingly, it is essential to maintain a policy environment which encourages innovation, both in terms of research and development (R&D) and in the widespread take-up of new technology.

(Investing for Growth, Industry Policy Statement, 1997)

For this present study, the key initiatives in the $1 billion Investing for Growth strategy are:

- the expanded scope of the Industrial Research and Development Board (IR&DB) R&D START program;
- the extension of the Innovation Investment Fund program, designed to support early stage venture capital funding; and
- expanded technology diffusion initiatives.

Supporting initiatives have come from successive Ministers for Employment, Education and Training. The Australian Research Council project brief (Appendix 1) for this study stated:

In response to a reference from the then Minister for Employment, Education and Training, the Australian Research Council and the Higher Education Council delivered advice, entitled Maximising the Benefits: Joint ARCHEC Advice on Intellectual Property, in August 1995...In the joint advice the Australian Research Council and the Higher Education Council moved away from the critique of intellectual property law which had characterised past reports. Instead it focused on specific issues of concern to the higher education sector, including the perspectives of the inventor for developing options for maximising the benefits resulting from research...

The advice also identified further work which would explore the role of commercial arms or other bodies in maintaining a good dialogue between industry and the higher education research sector.

It is also relevant to note that the Government has, on several occasions, emphasised the importance of improving collaboration between industry
and universities and of developing more effective means of commercialising research and development.

Study Objectives

The main outcome of this study was to be ‘an outline of a code of practice which the Australian Vice-Chancellors’ Committee (and individual universities) might find useful in the handling of intellectual property, technology transfer and commercialisation of research in Australian universities’ (Project Brief Appendix 1). As the project developed, it emerged that the material collected and analysed for the study constituted a discussion of issues and approaches for technology transfer and research commercialisation practices, rather than an actual code of practice. The ARC agreed that such a discussion could be useful by providing options for individual universities to consider, depending on the unique research focus of each.

Related objectives include:

- to survey technology transfer and commercialisation (TT&C) policies and management arrangements, including intellectual property, in Australian universities;
- to assess the mechanisms for and effectiveness of TT&C at six selected universities: Victoria University of Technology, The University of Adelaide, The University of Sydney, The University of Queensland, The University of Newcastle and Charles Sturt University;
- to overview research user experience in TT&C relationships with Universities; and
- to examine how the commercialisation of research affects or might affect research training.

These initiatives clearly recognise the problem of the ‘innovation progression gap’ discussed in the NBEET paper Maximising the Benefits: Joint ARCHEC Advice on Intellectual Property (NBEET 1995). The ARC brief points to the importance that the government has placed on ‘improving collaboration between industry and the universities and of developing more effective means of commercialising research and development’.

The government policy statement identifies research commercialisation and technology diffusion and transfer as parallel but somewhat separate issues. Both are recognised in the brief: ‘The proposed project will assess technology transfer effectiveness and commercialisation performance’ (Project Brief Appendix 1).

The recent Australian literature reviewed in NBEET 1995 and elsewhere is heavily focused on the intellectual property aspects of the commercialisation of research, as is recognised in the brief. For many, indeed most, industry
situations, accumulated know-how and technology transfer can be more important than patents and more formal intellectual property issues.

This study develops issues and approaches for technology transfer and diffusion separately, but in parallel with those for commercialisation of other more specifically protected intellectual property. The latter is more product oriented and has a greater emphasis on the formal instruments of intellectual property such as patents, copyright, eligible circuits and registered designs.
1.2

Study Methodology

The consultancy work program is shown in Appendix 2. The key elements are:

- a survey of the literature on innovation, TT&C (see Chapter 1.4);
- a survey of all 37 universities to identify organisational issues and collection of comparative data (see Chapter 1.5);
- an overview survey of users of research in two categories (see Chapter 1.6):
  - twenty larger companies with involvements in many universities, and
  - nineteen companies identified as having relationships with universities involved in the reviews in the following dot point;
- reviews of research commercialisation organisational structures, practices and outcomes at six selected universities: the Universities of Adelaide, Newcastle, Queensland and Sydney, Charles Sturt University and the Victoria University of Technology (see Chapter 1.7); and
- five (originally six) case studies on selected topics identified in the earlier work. Details are not included in this report.

The literature review did not find any explicit statement of objectives for university research commercialisation in Australia. An early step was to develop such notional strategic objectives and validate them later in the consultation workshop.

The first stage of the project was a questionnaire mailed to all 37 Australian universities and a review of the Australian and overseas literature. This was followed by detailed reviews of six Australian universities selected to be representative of the wide diversity of institutions:

- The Universities of Adelaide and Queensland (selected for having university companies and a high success rate in research commercialisation);
- The University of Sydney (a large, long established university with a Business Liaison Office rather than a university company);
- Victoria University of Technology (a newer university that had developed from the college of advanced education system); and
- The University of Newcastle and Charles Sturt University, Bathurst and Wagga Wagga campuses (two different non-metropolitan institutions).
Two days were spent with each institution. The analysis and reports on each university were reviewed for accuracy and commercial sensitivity by the nominated university contact.

To inform the report, a number of mini-case studies of research commercialisation activities and projects at the six selected universities were undertaken. Details of the case studies are not included in the report.

The next stage involved 39 telephone interviews with research users. The final data collection stage involved five case studies on specific issues identified in the earlier university reviews. As noted above, details of these case studies are not included in the report.

The issues and approaches for technology transfer and commercialisation practices for university research were then drafted. These were reviewed with the universities and then further developed in a two-day consultation workshop with university people and research users from large and small organisations. A second draft was then sent to selected university commercialisation office managers for comment.
1.3

Definitions and Preliminaries

Industry and Research Users

The ARC brief and government policy statements refer to benefits to industry. For this report the word 'industry' includes industry as involving 'employment in useful work' as well as referring to a 'branch of trade or manufacture' (Oxford Dictionary). 'Industry' therefore includes all external users of research whether for profit or for the public good for example, climate, environmental or health issues.

Technology Transfer and Commercialisation

In defining these terms this report has drawn heavily on the analysis reported by Scottish Enterprise and the Royal Society of Edinburgh in their Science and Technology Commercialisation Enquiry Report for Scotland (Scottish Enterprise 1995) and their subsequent report Draft Science and Technology Commercialisation Strategy (Scottish Enterprise 1996). These studies are discussed in more detail in Chapter 1.4 of this report.

Economic and Policy Context

Industrial competitiveness and the creation of new industries to support a high-income economy are dependent upon the application and exploitation of science, technology, information and know-how. As the major funders of the science base, governments around the world, including...[Australia], are looking for it to contribute more to the wellbeing of society in part through its role in economic development.

(Scottish Enterprise 1996, p. 2)

Australia has a strong science and technology (S&T) resource in its universities and research institutions that is an important source of future competitive advantage. However, its application and commercialisation have been relatively limited until recently.
Commercialisation: a Definition

The Scottish Enterprise report defines the term well:

Commercialisation is the process of converting S&T, new research or an invention, into a marketable product or industrial processes. This can be done either by existing companies or through the creation of new companies. Successful commercialisation results in:

- **Product Innovation.** This takes place through companies and other enterprises selling new products and services, including new process technology. It involves not only the research, but also product design, prototyping, manufacturing and marketing.

- **Process Innovation.** Many new processes may be converted into products and sold on the open market (i.e. product innovation); others are developed by, and then incorporated into, companies’ production processes.

Both product and process innovation are important. New processes can form the basis of new companies and be an important source of competitive advantage for existing companies. However, product innovation offers greater potential for the creation of new industries and long-term economic development. In Australia with the dominance of commodity exports, especially agriculture and mining, and the importance of adding value to their output, process innovation may be equally important.

The outputs from the science base which can be commercialised are formal knowledge (know-how), tacit relevant information, intellectual property such as that protected by copyrights (including software), eligible layouts, patents, research methods and research equipment. The last mentioned—equipment (and software) designed and built to undertake research—is an inadequately recognised source of potential commercialisation.

*(Scottish Enterprise 1996, p. 2)*

Technology Transfer and Accumulated Know-how

For academic researchers working with industry, the confidentiality requirements in relation to unpatented but accumulated proprietary industrial know-how may be more complex than those related to patents. Patents clearly define the claims that are subject to intellectual property constraints and potential benefits. To avoid premature disclosure to a competitor, know-how is often not patented. Risks of such disclosure are an important constraint to the involvement of research students and staff in industry research situations. These issues have been particularly critical, for example, in Cooperative Research Centres (CRCs) with participants from highly competitive process industries such as polymers, food additives and mining.
Commercialisation Routes

The Scottish Enterprise study identified a variety of routes (Table 1) by which the commercial sector can obtain access to and benefits from these assets, including:

- publications and the free interchange of ideas and information through seminars and other forms of informal communications, the traditional but no less relevant academic performance measures;
- academic-industry linkages;
- education and training for company personnel;
- people transfer, including the recruitment of former students, researchers and staff by companies and the secondment of staff both into and out of the science base;
- consulting, contract and collaborative research for industry;
- licensing or giving the right to use intellectual property through licensing deals (where the university retains ownership of the intellectual property) or assignment (where it will cease to own the intellectual property but may negotiate to be able to continue to use the intellectual property in its own future research) to existing companies; and
- exploitation of intellectual property through the many and varied spin-out (spin-off company) routes—for example, spin-outs based on licensing deals, joint ventures and companies set up by staff or graduate students.

These various TT&C channels are summarised in Table 1 below:

Table 1: Commercialisation Routes

<table>
<thead>
<tr>
<th>Education/Training</th>
<th>Single Company</th>
</tr>
</thead>
<tbody>
<tr>
<td>Collaborative Research</td>
<td>Industrial Consortia (e.g. AMIRA)</td>
</tr>
<tr>
<td>Contract Research</td>
<td>Cooperative Research Centres</td>
</tr>
<tr>
<td>Industrial Consultancy</td>
<td></td>
</tr>
<tr>
<td>Licensing</td>
<td></td>
</tr>
<tr>
<td>Spin-off Companies</td>
<td>Established Company</td>
</tr>
<tr>
<td>Joint Ventures</td>
<td>New Company</td>
</tr>
<tr>
<td></td>
<td>University Owned Company</td>
</tr>
<tr>
<td></td>
<td>Owned by Postgraduates</td>
</tr>
<tr>
<td></td>
<td>Other</td>
</tr>
</tbody>
</table>

Source: Scottish Enterprise 1996
The effectiveness of each route will of course vary by science or 
technology, industry, nature of innovation (product or process) and 
academic resource being exploited (for example, know-how, licence, 
copyright, information, data, materials and equipment).

Successful commercialisation does not occur when knowledge and 
technology are transferred into the commercial sector at the completion of a 
licensing deal, but rather when S&T has been converted into a marketable 
product or an industrial process. The strategy must be concerned with all the 
transfer routes and all stages of the process from research through to the 
marketing and manufacture of products (adapted from the Scottish 
Enterprise 1996, p. 3).

**Economic Context**

The Scottish Enterprise strategy identified a number of key issues that are 
equally relevant for Australia:

- **We live in an increasingly competitive, changing and global economy.**

- **The Science Base.** A strong science base is a necessary but not sufficient condition for 
commercialisation and economic development. Research funding is becoming more 
dependent upon links with industry and potential users of research. Such links offer 
opportunities to commercialise research and generate income to undertake further 
research.

- **Economic Impact.** The income generating commercial activities of universities and 
other research institutions through, for example, consultancy, contract research, 
collaborative research and the sale of intellectual property promote the growth of the 
science base and the... [Australian] economy. While income generated from overseas 
based customers represents export earnings, there is a much larger potential economic 
impact from the commercialisation of research by companies located in ... [Australia]. 
This is particularly true when commercialisation results in product innovation.

- **Global v Local Perspective.** Both companies and the science base must operate in a 
global market. Companies will source S&T from the best available sources both 
within and outside Australia. The science base must also generate research income 
and sell its intellectual property outside Australia. Nevertheless within a global 
perspective, the local environment still matters. The tacit nature of much know-how 
means S&T does not always readily transfer over long distances. (Mansfield (1995, 
1996) of the University of Pennsylvania also points to the benefits of relationships 
with local industry). Establishing contacts and working relationships is generally 
easier with local rather than more distant partners. A key objective must be to keep in 
... [Australia] as much as possible of the development stage and subsequent 
manufacture, not just the building of prototypes.

- **Innovation and Diffusion.** For the majority of companies, especially low-tech small 
and medium sized companies, the key requirement is the adoption and adaptation of 
existing S&T. Much of this is acquired from equipment and other suppliers. 
Universities will need to identify and work with such intermediaries, particularly those 
servicing low-tech local industry. The ability to use existing technology effectively is 
enhanced by internal company R&D. Effective diffusion of technology is not 
dependent upon leading edge S&T in the science base but government support for 
technology diffusion can be harvested by universities to reinforce commercialisation 
outcomes.
• **Technology Push v Demand Pull.** Commercialisation does not arise simply from advances in S&T (technology push) or from serving current markets (demand pull). Product push is also important in health industry developments. Rather it is a consequence of a complex interplay between S&T opening up new opportunities with the development of products that satisfy a perceived potential demand and societal need, meeting or creating demand. At the outset, it is frequently not possible to identify and measure demand for new products. Nevertheless, success is more likely if research is driven by the desire to meet a perceived societal need and potential demand.

*(Scottish Enterprise 1996, pp.3-4)*

To these need to be added:

**The Business Cycle.** The normal business cycle for most companies ranges through a cycle usually of about seventeen years involving sequential periods of respectively idea generation and commercial innovation, selection and culling to remove less attractive innovations and cost-cutting. This tends to be followed by cash generation and availability once again to seek out new commercial innovations. The susceptibility of a company to invest in new technology will vary significantly across this cycle.

### Particular Characteristics of University Research Commercialisation

Research in industry primarily derives from a perceived market need. The process of commercialisation of research in universities is more complex (Yong Lee & Gaertner 1994). Most often it will start from more basic research. The challenge is then to identify a market opportunity.

From the university researchers' point of view, the sequence is more likely to be:

• establishing the research infrastructure;
• doing the basic research;
• seeing an opportunity to apply it;
• developing the solution for that opportunity; and
• selling the new concept to an external commercial partner.

Wise researchers will be involved with and establish their credibility with one or more potential commercial partners quite early in this process.

There was a clear message from the individual university reviews that in most situations individual academic researchers, with support where available, had to work hard to identify and build relationships with potential commercial partners.
Commercialisation of Research

The earlier focus has been on more formal intellectual property issues, as reported in the Business/Higher Education Round Table report *Partners in Intellectual Property* produced by a task force chaired by Professor Coghlan, and his earlier report to Minister Howe in 1991 on the commercial development of medical research. This project brief focuses on the Cambridge model, with its emphasis on the perspective of the inventor. In the early years of ANUTECH Pty Ltd a study was made of the different European models for research commercialisation in use at institutions, including Cambridge and Sheffield Universities and polytechnics in the United Kingdom, Uppsala University in Sweden and Louvain in Belgium. It was clear from that study that the different models had developed primarily in response to the differing terms and conditions of employment and legal/political constraints involved. These latter constraints were particularly evident in discussions in 1996 with the Tallinn Technical University in Estonia.

The brief draws attention to the need to ‘explore the role of commercial arms in maintaining a good dialogue between industry and the higher education research sector’. It lists a number of key issues that are all relevant across the whole domain in which commercialisation of research takes place.
1.4

Literature Survey

Commercialisation of research is only one element, albeit an important one, in the whole process of technological innovation. The literature on innovation is immense. The focus in this survey is to identify the key sources, which are listed in the Bibliography, and extract from these what appear to be the key issues for TT&C in Australia.

The Outcomes of Research and Innovation

Mansfield (1995, 1996) in his many papers and other US writers (Smith & Barfield 1996) have documented well the high rates of return from investment in innovation. A recent reworking of ABS statistics (Barraclough 1998) has shown the impact of innovation in Australia on exports per employee and sales per employee (Figure 1).

Figure 1: The Effect of Innovation on Sales and Exports Per Employee

![Bar chart showing the effect of innovation on sales and exports per employee]

The Process of Innovation and Research Commercialisation

Models that depict innovation as a smooth, well-behaved linear process badly misspecify the nature and direction of the causal factors at work. Innovation is complex, uncertain, somewhat disorderly and subject to changes of many sorts... The systems used... are among the most complex known (both technically and socially), and the requirements for successful innovation vary greatly from case to case.

(Kline & Rosenberg 1986, p. 275)

Similarly, 'classification schemes that describe the innovation process as a straight-line progression fail to capture its essential messiness and serendipitous nature' (Smith and Barfield 1996, p. 1).

Before considering the specific issues which arise when universities are involved, it is important to be clear about the nature of the process by which technical innovation takes place. The current OECD study on The Innovative Company (ADL 1998), to which Australia through the Department of Industry Science and Resources (DISR) is a contributor, shows how innovation process models have evolved over time:

- first generation: technology push;
- second generation: market pull;
- third generation: coupling models; the balance and coupling between technology supply and market demand;
- fourth generation: the rugby team, based on Japanese influenced models; and finally
- fifth generation: the distributed innovation system, emphasising systems integration, networking, collaboration.

Their progress report contains a full bibliography of the relevant literature.

Similarly, more recent US analysts studying research commercialisation outcomes (Yong Lee and Gaertner 1994) show that earlier models (Kline and Rosenberg 1986) starting from an identified market need (market pull) are not so relevant for research commercialisation where the starting point is more likely to be an invention or a discovery arising out of basic research than the identification of a market need. The Yong Lee & Gaertner model is shown in Figure 2.
National Strategies and Practices

There are interesting comparisons and differences in the US and British and European experience.

US Experience

In 1980, perceived structural barriers to commercialisation of research by public funded institutions were removed by the Bayh-Dole Act and the Stevenson-Wyder Technology Innovation Act. These allowed such institutions to licence and grant exclusive rights for their IP. This however was not enough: by 1994, US industry was not running with the ‘technology ball’. The flaw in the model was the lack of technology development or technology development research, ‘academic research translated into technological innovations’ (Kline & Rosenberg 1986). Wall Street had a short-term focus and US industry was historically risk averse. Technology development and funding for it were needed to reduce the risk of investing in new technology (Figure 3).
The need for funding for technology development was well illustrated in the University of Iowa experiment (Yong Lee & Gaertner 1994). The University had a strong reputation for basic research, but not at that time for commercialisation. The project started from the assumption that basic research can be converted into commercially useable technologies provided that organisational capability was expanded to permit carrying out of technology development research. Funding, primarily from public sources, of US$2.3 to 3.7 million per annum was made available over five years for 72 carefully selected projects at an average funding per project of US$240 000. External commercial people were heavily involved in the project selection process. The outcomes were:

- all projects except one were completed within the two years;
- 40 new licensable technologies were generated; and
- of 34 patents, nine were licensed and five were under negotiation.

The lessons from the Iowa experiment were:

- external financial support is essential for technology development research;
- external involvement in project selection is important;
- technology development research needs to complement basic research;
- technology development research by universities is cost effective;
- technology development involves much problem solving requiring more basic science;
• academic researchers can have both basic and applied research competencies; and
• academic scientists build cost effectively on their own discoveries.

A further relevant observation came from the Massachusetts Institute of Technology (MIT):

Entrepreneurship at MIT has been very successful because of three main factors: the presence of MIT and its associated expertise, a large venture capital community, and the availability of experienced start-up executives. Because this community is available to us, we can put together a case team to evaluate business plans which would be difficult, if not impossible, to duplicate elsewhere.

*(Dunn 1998)*

**UK Initiatives**

Two UK initiatives merit attention. The most important is the industry innovation strategy (Scottish Enterprise 1996) developed by Scottish Enterprise following a detailed enquiry into commercialisation by Scottish Enterprise in conjunction with the Royal Society of Edinburgh (Scottish Enterprise 1995). Professor Trevor Cole (Cole 1998) at the Warren Institute of the University of Sydney has pointed out that Australia and Scotland have inherited the same university culture—one which is very different from that in the USA. Scottish initiatives may therefore be the more relevant for Australia. The origins of the Scottish enquiry are similar to those for this present ARC study:

As the major funders of the science base, governments around the world, including the UK, are looking for it to contribute more to the well being of society in part through its role in economic development...Scotland has strong S&T in its universities and research institutions which could be an important source of future competitive advantage. However its application and commercialisation in Scotland is relatively limited. Given that S&T is one of our major assets, urgent action is required to exploit the opportunities.

*(Scottish Enterprise 1996, p. 2)*

The Scottish Enterprise strategy is based on a number of strategic directions, six of which are relevant to the present study and are developed in Part 2:

• creating the right academic environment;
• developing effective institutional commercialisation support structures and infrastructure;
• developing and expanding relationships with existing companies;
• facilitating and increasing the number of new research derived spin-off companies;
• strengthening the corporate base; and
• improving the financing of commercialisation.

*(Scottish Enterprise 1996, p. 7)*
The first four of these are at the core of this study. The fifth is the subject of the OECD *The Innovative Company* study referred to earlier (ADL 1998). The sixth of these identified the key constraint to developing new ventures in Australia, that is, the shortage of seed funds to fund the technology development gap (the ‘D’ stage and patent costs) identified in the previous pages. This investment is required by the researcher or technology developer to reduce the investment risk to the early stage venture capitalist. In the words of the Swedish definition of the end point for public funding of industrial research, reducing the investment risk ‘to that point at which an experienced venture capitalist can make a reasonable decision whether to invest’.

The Scottish Enterprise Annual Report for 1997–98 (Scottish Enterprise 1998) shows how these strategic directions have led to a number of successful initiatives:

- the *Technology Ventures Initiative* that aims to connect Scottish inventiveness and academic excellence with commercial success;
- the *Business Birth Rate Strategy* that in 1997-98 'helped a further 5 300 Scottish businesses open their doors, providing employment for over 13 500 people';
- *Global Companies Enquiry* that has placed the focus on the internationalisation of Scottish businesses; and
- developing local clusters of mutually supportive industries and institutions.

The other interesting UK initiative was the Graduate Enterprise Program monitored by Cranfield University (Brown 1990). A package of programs was used to select 214 young entrepreneurs and facilitate and monitor their start-up businesses, while also involving external capital, management skills and family support. The results were accelerated timing of good potential-business start-ups with each surviving business generating on average 4.3 full-time and 2.8 part-time jobs. The lessons were that such interventions can be effective in helping people who are already keen to set up their own enterprises.

**Diffusion and Transfer of Technology**

The objective is the adoption of commercially viable new technology. Technology diffusion and transfer is just the mechanism. Technology transfer is essentially about people rather than procedures or institutional practices. Turpin comments that ‘...transfers between academic research and private enterprise commercialisation of research are led by the movement of people and the establishment of broad ranging personal networks’ (Turpin et al 1996, p. 38).

The experience of the CRC program suggests that technology transfer is most effective when:
postgraduate research students have opportunities to work in industry, a major consideration in APA(I) awards;

industry recruits people to do a postgraduate research degree who then come back to work in the company;

academic researchers are seconded to work alongside industry researchers; and

research users are involved in the development of industry research priorities and in the process of initial assessment, cost/benefit analysis, monitoring, review and reporting progress of any resulting research projects, that is, when it has an industry rather than a university champion.

There are similarities with experience in extension performance in agriculture. Extension models based on traditional information diffusion theory involve 'labeling farmers according to their order in the adoption spectrum, the earliest being innovators, followed by early adopters, early majority, late majority and finally the laggards' (Campbell 1994, p. 195). These models are the basis for 'transfer of technology' strategies that 'have been remarkably successful in increasing agricultural production'. They essentially involve linear communication from researcher to extension agent to farmer. However, Campbell quotes Rogers' earlier analysis (Rogers 1983) of technology diffusion characteristics to show that linear communication is unlikely to result in widespread adoption 'where the innovation is complex, where costs and returns can be hard to identify or apportion, where there is no immediate return, or where the innovation challenges community norms' (Campbell 1994, p. 196). He comments that these conditions are quite common in developing more sustainable farming systems. He points to Chambers and Higgins (1987) proposed new participatory model 'Farmer First, Farmer Last'.

This model needs to be considered for diffusion and transfer of technology, particularly—but not solely—to public sector research users where the issues are complex and the benefits tend to be long term or not immediately obvious, as for environmental and sustainability issues.

The Awareness Barrier

The other important barrier to new technology adoption is lack of awareness of need for, or relevance of, the new technology to the potential user—for example, treatments for an insect pest that has not yet arrived (Yencken 1997) or new package test protocols. The issue is how to create this awareness of potential benefit. Channels can include professional continuing education and laboratory visits for industrial managers.
Overseas Best Practice in Research Commercialisation

A University of Glamorgan report (University of Glamorgan 1998) contains a wide-ranging review of research commercialisation and academic entrepreneurship, including many case studies.

The best documented examples of North American practice come from the Universities of British Columbia (University of British Columbia 1998) and of Chicago (University of Chicago 1998). These are referred to in more detail in Part 2 of the report. Of particular interest is the statement by the University of British Columbia–University Industry Liaison Office:

Until recently, the standard practice throughout North America has been to license technology to existing companies, especially to companies who are in a business related to that to which the technology should apply…is it better to license a technology to an existing company or to a spin-off?… Alas there are no easy answers…In fact one of the main reasons for trying the spin-off company route was the difficulty that the UILO experienced in finding licensees amongst existing companies.

(University of British Columbia 1998, p. 1)

The Chicago University Website [www.arch.uchicago.edu/Virtual_Co](http://www.arch.uchicago.edu/Virtual_Co) sets out an interesting concept of ‘a virtual company’ to provide the framework for the development of spin-off and new start-up companies. Other useful sources include the Chalmers Innovation Centre at [www.mot.chalmers.se/inst/innov/CIC](http://www.mot.chalmers.se/inst/innov/CIC).

Useful references on R&D consortia management can be found in Corey (1997) and an Australian view on innovation processes in Marceau (1997).

The Australian Environment

Mann (1996) contains a useful survey of the Australian and overseas literature. The growing trend towards collaboration between universities and industry is worldwide, not just an Australian phenomenon. ‘The benefits of collaboration, as well as the challenges, may be somewhat different for industry and partners…Many collaborations do not fulfil expectations and some have been major disappointments’ (Mann 1996, p. 3).

There is a consistency in the literature in identifying a limited number of more general issues.

*External/internal* issues include:

- traditional and pre-existing research cultures;
- industrial relations, employment, intellectual property and promotion policies;
• impacts on research training and publication approval practices, for example, the need for confidentiality and/or delayed publication in commercial applications; and

• impact of government research funding policies and competitive tendering practices.

Other precedents include what has worked, what has not worked and the reasons why, in similar environments overseas.

Mann (1996) identified the following key success factors:

• developing and maintaining well-defined and acceptable objectives and procedures;

• ensuring partners are well organised and accountable for their research and development contributions;

• emphasising the transfer of implementable knowledge to industry;

• having experience with linkages and establishment of long-term relationships; and

• building realistic expectations and mutually accepted practices.

He also stresses industry’s expectation of ‘good planning’ that ensures that both parties are aware of their responsibilities and of the expectations of the other party. At the same time, he notes that such good planning was the success factor in his survey ranked least important by university respondents.

Use of Alumni

Cornell University (1998) and the Massachusetts Institute of Technology (ilp.mit.edu/ilp/non_member/aboutus_main and www.mit.edu/entforum/www/Business_Plan/bplans) have developed interesting involvements of their alumni in their research commercialisation support processes. Alumni chapters are active in helping to develop external relationships with potential research users, in overviewing and counselling on business plans and in mentoring graduates involved in new start-ups.

Future Monitoring of Best Practice

The new journal ‘R&D Enterprise Asia Pacific’ (published by Calibre Communications, Sydney) includes in its vol. 1, no. 1, 1998 reviews of commercialisation best practice from the Southern Technology Council in the US on ‘Making the most of university start-ups’, ‘Working with external patent counsel’ and ‘Rewarding successful commercialisation in universities’. These will continue in future issues.
Experience both in Australia and overseas suggests that some greater consideration is needed of behavioural and value related issues, including both attitudes of academic researchers and industrial relations practices and recognition of commercial as well as academic or administrative performance.

People involved in research commercialisation within the university system have to be involved in two markets: they have to be able to work with the research providers—this is usually the more difficult market—as well as with external commercial interests. The success, for example, of executives working in a university’s commercial arm is generally closely related to their ability to communicate with, and gain the respect of, researchers. This usually derives from a respected earlier research record rather than from purely commercial or entrepreneurial skills.

The Role of Technology Parks or Precincts

A case study, including a survey of the literature, on issues affecting the roles of technology parks or precincts in TT&C of university research was undertaken to inform the report. A summary of key conclusions appears in Part 2 of the report, Chapter 2.12.

The Changing Nature of Work

The trend in most developed countries is towards a higher proportion of casual as opposed to full-time jobs (Bridges 1998). Australia now, with over 24 per cent of jobs classified as casual, has the second highest proportion of casual jobs in the OECD.

At the same time, in Australia many of the paradigms that have historically applied to university funding and employment are no longer valid or have less relevance. Past assumptions that are no longer valid include:

- adequate public funding;
- competitively adequate academic staff remuneration;
- ‘I will get a degree and then a job with a large company’; and
- a good PhD leads to a full-time academic career.
A Royal Society of Arts report, quoted in *The Australian* newspaper, commented:

...the traditional male working model of a ‘40/40 job’, which assumes that most men work 40 hours for forty years...ignores the growth in short term contracts and the predominance of casualised employment among newly created jobs...There are few fixed boundaries between sectors and businesses, private and public sectors...Even where people work for one organisation for a long period, the relationship with the employer has changed; often it looks more like what used to be seen as self-employment, the individual moves from project to project as demands evolve

(Bridges 1998, p. 54)

Australian universities are not immune from these trends. In the reviews, there were frequent instances of academic researchers moving or wanting to move into less than full-time academic teaching and research to allow greater involvement in projects with industry or in their own start-up companies. The era of the part time academic is approaching’, said one professor of engineering.

The best practice issue is to remove disincentives (such as impacts on superannuation and career opportunities) to such greater involvement in research commercialisation and new ventures outside the university.

**Statistics and Performance Indicators**

Two tables of research and research commercialisation performance indicators (Appendix 3) have been extracted from university financial statistics from the then Department of Employment, Education and Training (DEET) showing:

- research funding as a percentage of total funding (Appendix 3, Table 1) ranging from 0 per cent to 25 per cent; and
- data calculated from 1994 and 1995 Research Quantum calculations on *Category 3 Industry and Other Funding* (excluding income from syndicated R&D and from donations, bequests and foundations) in dollars and as a percentage of Total Research Funding (Appendix 3, Table 2).

The *Category 3 Industry and Other Funding* (excluding funding from syndicated R&D and from donations, bequests and foundations) ranged for individual universities from $23 million down to $36 000, with a mean of $3.8 million. The percentage of Total Research Income ranged from 33 per cent to 1 per cent with a mean of 19 per cent.

The data show the wide range of Australian university performance.
1.5

Preliminary University Survey Findings

After formal clearance with the Australian Vice-Chancellors' Committee, a questionnaire (Appendix 4) was sent to 37 universities. The questionnaire avoided asking for data already available from existing sources.

In all, 29 responses (a 78 per cent response rate) and one refusal to participate were received. Generally, respondents showed considerable interest in the project and, with a few exceptions, a desire to be involved.

The analysis has been limited to identifying major trends and other issues relevant to the selection of institutions for the more detailed reviews. The detailed findings are presented in Appendix 5. No university indicated any previous studies of commercialisation of university research.

University Retention of Consultancy Earnings (Survey Question 1)

Consultancy earnings retention policies were included in the survey because of the role of consultancies in building external relationships. High levels of earnings retention by universities may act to inhibit the development of these relationships. One of the surprises in the survey was the very wide range of the reported percentage of consultancy earnings retained by the university ranging from zero to 80 per cent as shown below:

<table>
<thead>
<tr>
<th>Per cent retention of consultancy earnings by universities</th>
<th>Number of responses</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nil</td>
<td>4</td>
</tr>
<tr>
<td>10 per cent</td>
<td>8</td>
</tr>
<tr>
<td>15 per cent</td>
<td>3</td>
</tr>
<tr>
<td>25 per cent</td>
<td>1</td>
</tr>
<tr>
<td>30 per cent</td>
<td>3</td>
</tr>
</tbody>
</table>

Source: MCG Preliminary University Survey

These responses may have resulted from the wording of the question. The issue was discussed further in the detailed university reviews (refer to Chapter 1.7).
Postgraduate Student Awards
(Survey Question 2)

Numbers of postgraduate students by type of award are set out in Appendix 5, Table 1. Particularly interesting is the very wide variation in the percentage of APA(I) awards to total PhD students and the ratio of APA(I) to APA awards. This may be an indicator of the effort put into, and the effectiveness of, collaboration with industry.

Intellectual Property Policies
(Survey Question 3)

All institutions surveyed had in place intellectual property policies for staff, as did most for postgraduate students. These were less universally available for undergraduate students and visitors. While in almost all institutions these policies had been negotiated with postgraduate student associations, in many instances this had not happened with undergraduate student associations. The complex legal issues in IP ownership are discussed in detail by Monotti (1997).

Management of Commercialisation Activities
(Survey Question 4)

Table 2 in Appendix 5 shows how arrangements for management of these activities vary between respondent institutions. Twelve universities (39 per cent of responses) used incorporated entities to handle research commercialisation. All of these handled patents and IP licensing, sometimes in conjunction with the university administration. However, their involvement with university consultancies and to a lesser extent contract research was more variable.

Heads of departments had the key roles in relation to consultancies in ten universities and in relation to contract research in six responses. Only four responses in relation to consultancies and only two in relation to contract research reported the 'university role limited to ensuring that terms and conditions of employment (external earnings and time limits) are satisfied'.
Potential for External Earnings
(Survey Question 6)

Table 3 in Appendix 5 shows how respondent institutions assessed the earnings potential by type of activity and by discipline area. Question 7 on expenditure in supporting external earnings was not analysed. The form of the question made this analysis of little comparative value.

As expected, engineering, followed by the biosciences and the physical sciences, was reported as having the greatest earning potential. The high figures in the 'Other' category came from respondents who included agricultural science in this category. The low earnings potential in economics and the social sciences was interesting, given the recent high success rates by these disciplines in SPIRT collaborative grant applications.

Commercialisation Successes and Failures
(Survey Questions 8 and 9)

Tables 4 and 5 in Appendix 5 summarise responses. The main points of interest were as follows:

- Only a few institutions identified the maximum of five success stories.
- A wide range of disciplines were involved in the success stories.
- Very limited data were supplied on potential benefits to the research user, which is important information when negotiating licensing agreements. However, the data supplied showed the high multipliers potentially resulting from investment in university research and IP.
- The general view was that most failures derived from external issues such as lack of funds, market or commercial failure rather than from university related issues.
- The cost to the university from some of the failures was high.

These issues were explored further in the detailed university reviews.

Training for University Staff and Students
(Survey Question 10)

Almost all institutions reported staff and student training opportunities on IP issues. Only a few appeared to be addressing the broader issues of leadership, project management, working in groups, research commercialisation, technology marketing processes or new venture creation.
Technology Parks
(Survey Questions 11, 12 and 13)

Five respondents were involved with four technology parks or precincts and a further two had plans for these. Table 6 in Appendix 5 summarises respondents’ attitudes.
1.6

University Research User Overview

Two groups of research users were interviewed by telephone. The first group consisted of senior executives in large companies who had managed relationships over the years with several universities. The second group consisted of people in companies and other agencies who had been identified as being users of specific university departments and centres in the six university reviews. Appendix 6 includes the checklist for these interviews and the list of companies and agencies whose executives were interviewed. The analysis of the interviews appears in Appendix 7. In all, 39 interviews were completed, 20 in the general category and 19 in relation to specific university relationships.

No quantitative conclusion can be drawn from such a small and relatively unstructured sample. There was, however, a consistency in the responses.

Overall Performance

The main conclusion is that university performance in relation to research commercialisation and research contract relationships with research users has been highly variable, both between universities and within the one university. At the same time there were many highly successful relationships. Others never got started because negotiations were abandoned by the industry partner due to excessive complexity in negotiations at various levels within the university. For others, whether due to teaching loads or taking on too many other commitments, the senior academic researcher involved was unable to provide the commitment and effective leadership to the project to achieve agreed timelines and user output expectations.

Initial Contact and Contract Negotiation

The source of the initial contact initiative was equally divided between the research user and the research provider, with a somewhat higher proportion of research user initiatives in the university specific interviews. There were frequent references to pre-existing relationships. The larger companies looking for process rather than product innovation assistance generally found it easier to deal with people they knew and had successfully worked with in the past. Importantly, in two situations the relationship developed from a research user initiative after the user had attended a conference or seminar at which the research provider had presented.
Responses suggest that most people who approached universities without having a specific contact person had difficulty obtaining the expertise that they were seeking. Universities generally were seen to have no up-to-date knowledge in one central place about their researchers' competencies. This issue is addressed in Part 2 of the report, Chapter 2.3.

The negotiation stage was clearly the area where there was the greatest scope for improvement. The most common criticism was about complexity, to-and-fro negotiations and delays when a number of levels within the university system became involved. The most successful negotiations from the users' point of view were those made directly with the senior researcher, who had support where required, but handled intra-university issues without face-to-face involvement of the user. There were generally mixed views on the performance of business liaison offices and university companies. They were often seen as interfering to get part of the action. There was resentment at levies, other than for genuine overheads, to be used for other university purposes.

Most of the negotiation centred on IP issues, but there appeared to be recognition and acceptance of university IP ownership policies and of the competence of university IP professional support people. There was no high level of concern about publication conflicts.

**Spin-off and Start-up Companies**

While research contract negotiation experience varied, almost all respondents involved in the formation of start-ups and other companies where there would be ongoing university equity were critical of the complexities and delays in getting decisions. This was of greatest concern when the final approval had to come from a governing body that met only rarely. Universities need to simplify such decisions with proper delegations of authority to appropriate senior officers.

The second problem in this area was the perceived lack of management experience and competence in new venture creation, management and mentoring. While the better university companies and liaison offices are seen to have appropriate skills and experience in negotiating and supporting relationships involving consultancies, research contracts and IP licensing, they are seen to have much less competence and experience in facilitating new venture creation and survival. For the smaller institutions, where a critical mass of such skills is unlikely to be achievable, there will be a need to build relationships with local 'business angels' and venture capitalists to obtain the necessary support for such new venture creation.

The third problem is the shortage in Australia of people with proven competence and experience in the management of the technology development stage. This shortage will become more critical as more new technology innovation based ventures are born. Initiatives within the CRC
program to improve the technology management skills of their middle managers will be very important here.

Key Success Factors

The eight key success factors for university–industry commercial relationships developed by Mann (1996) and discussed earlier in Chapter 1.4 were used to focus discussion. Generally there was support for these, but considerable variation in their ranking.

‘Good researchers’ ranked first for the biosciences and computer science research users. For many users, particularly those seeking process innovation solutions to their problems, locally available expertise was important. In the high growth areas, such as pharmaceuticals, medical technology and information technology, Australian researchers had to identify niche markets in a highly competitive market and establish their world class credibility.

Most respondents put ‘understanding the partner’s needs’ as first or close to first. This was associated with the available level of commitment of the senior researcher in providing leadership. ‘Good personal contacts’ came out strongly. This was associated with recognition of the time that it took to build relationships and hence the benefits of repeat business—provided the first experience was good.

There were limited though important comments on the competence needed by the research user in working with an academic researcher. The key need is science literacy. This showed up as a key success factor in developing critical marine biology inputs into a community outreach program on tideland conservation. The indication was that the key lay in the relevant science literacy of the immediate local government contact.
1.7

Reviews of Selected Universities

The reviews of the six selected universities in April–May 1998 are set out in this chapter. The institutions were selected to cover a wide range of institutions:

- in metropolitan and non-metropolitan areas;
- with developing or established research profiles;
- with or without a university technology marketing company; and
- with or without a technology park.

The Universities selected are shown in Table 3 below:

Table 3: Universities Selected for Review

<table>
<thead>
<tr>
<th>University</th>
<th>Research profile</th>
<th>Technology company</th>
<th>Technology park/precinct</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Victoria University of Technology</td>
<td>Developing</td>
<td>No, but have had one in the past</td>
<td>Being considered at present</td>
</tr>
<tr>
<td>2. University of Adelaide</td>
<td>Established</td>
<td>Yes, Luminis Pty Ltd</td>
<td>Yes, Commerce and Research Precinct</td>
</tr>
<tr>
<td>3. University of Sydney</td>
<td>Established</td>
<td>No</td>
<td>Yes, Australian Technology Park</td>
</tr>
<tr>
<td>4. University of Queensland</td>
<td>Established</td>
<td>Yes, UniQuest Pty Ltd</td>
<td>No</td>
</tr>
<tr>
<td>5. University of Newcastle</td>
<td>Established, non-metropolitan</td>
<td>Yes, TUNRA Pty Ltd</td>
<td>No</td>
</tr>
<tr>
<td>6. Charles Sturt University</td>
<td>Developing, non-metropolitan</td>
<td>No</td>
<td>No</td>
</tr>
</tbody>
</table>

The checklist of questions used for the individual institution reviews is set out in Appendix 8.
1.7

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<td>Yes, Commerce and Research Precinct</td>
</tr>
<tr>
<td>3. University of Sydney</td>
<td>Established</td>
<td>No</td>
<td>Yes, Australian Technology Park</td>
</tr>
<tr>
<td>4. University of Queensland</td>
<td>Established</td>
<td>Yes, UniQuest Pty Ltd</td>
<td>No</td>
</tr>
<tr>
<td>5. University of Newcastle</td>
<td>Established, non-metropolitan</td>
<td>Yes, TUNRA Pty Ltd</td>
<td>No</td>
</tr>
<tr>
<td>6. Charles Sturt University</td>
<td>Developing, non-metropolitan</td>
<td>No</td>
<td>No</td>
</tr>
</tbody>
</table>

The checklist of questions used for the individual institution reviews is set out in Appendix 8.
The review was undertaken in two parts:

- a general overview addressing key issues included in this report; and
- mini-case studies of TT&C activities of specific, selected university schools, centres and spin-off companies. Details are not included in this report.

The specific centres and schools to be included were selected in consultation with the Deputy Vice-Chancellor (Research) or other appropriate senior manager nominated as the contact person by that university.

Drafts of these reviews were supplied to the nominated contact in each university to allow for correction of errors and adjustment of any commercially sensitive material. These adjustments have been made and in no way weaken the study's findings.

**Performance Measures**

Possible performance measures, which have been used wherever possible as somewhat crude measures, to assess the commercialisation performance of the selected universities include:

- total and percentage of DEET *Category 3 Industry and Other Funding* in the Research Quantum;
- success in the attraction of collaborative research grants, both SPIRIT and R&D START;
- proportion of APA(I) and research user funded postgraduate students;
- university supported consultancies;
- number of patents, particularly number of patents with an outside partner carrying the patenting cost;
- royalty and licensing income streams; and
- spin-off companies.

The mini-case studies of research commercialisation activities were also assessed against the Mann et al. (1994) success factors:

- good planning;
- personal contact;
- understanding the partner's needs;
- integration of expertise;
- financial support;
- equipment and infrastructure; and
- attracting work/flexibility.
Victoria University of Technology

The review of TT&C practices at Victoria University of Technology (VUT) took place over the period from 22 April to 5 May 1998. The review involved discussions with VUT staff and telephone interviews with external research users. A list of University people interviewed is shown at the end of this review and a list of research users interviewed is included in Appendix 6.

The review involved two types of discussion:

- university structure and policies; and
- small case studies of a selection of centres and research groups in departments (details are not included in this report).

Organisational Structure and Research Strategy

VUT was created from a merger of the Footscray Institute of Technology and the Western Institute, both of which were part of the earlier college of advanced education (CAE) group of institutions. These institutions were strongly focused on teaching with a low research profile. It was, however, interesting to find research commercialisation successes coming from groups originating in these former CAEs.

The new VUT quickly adopted a strategy to build its research profile in two ways: by encouraging existing staff to gain doctoral qualifications, and by establishing and funding a number of centres with research and technology transfer responsibilities and limited or no undergraduate teaching responsibilities. The University Research Management Plan well illustrates this. Interestingly, the selection of research foci in this planning process was very much an internal bottom-up process and appears to have taken little cognisance of external potential research user needs and priorities. However, as will be shown later, these have been important considerations in the ongoing development of these selected research foci.

VUT now has six University research centres, but at the same time other research areas have grown and overtaken some of the originally selected foci. Key aspects identified for the centres were as follows:
• The centres are all attached to a faculty.
• The University and the host faculty have agreed to support each centre for five years on the understanding that the centres will be self-funding in relation to the salaries of key staff after that time. Except in the case of one centre, this is unlikely to be achieved fully. New arrangements have been made to give the centres a greater share of the Research Quantum in proportion to their generation of contributions to these funds.
• Each centre has a four-person advisory panel with two members from outside the University.
• This year the University will start to review progressively the centres as they reach the end of their five-year term.
• The more successful centres have attracted large collaborative grants, both SPIRT and R&D START grants. While the early centres had their infrastructure funded under a previous ARC program, Mechanism B, these collaborative grants have been essential more recently to fund research infrastructure. It is difficult to attract collaborative or contract research without the evidence of such infrastructure.

A number of issues relate to this centre oriented structure:
• The centres tend to be more externally focused groups and some are successful as the marketing arm of their faculty. They can form multidisciplinary groups, take on larger projects and take projects into the commercialisation stage, but there must be a clear leader.
• What are the relative benefits of loose research alliances by comparison with more formal centre structures? What is the best strategy to retain the freedom of individual academics to make individual choices on their research directions? The recent merger of engineering and science at VUT appears to have generated some resistance at being forced into larger teams.
• How to retain and develop close relations and synergy with the host faculty, particularly in its undergraduate teaching role? This is clearly a problem with some but not all centres.

University Technology Marketing Company

VUT has an incorporated entity registered but it is no longer active. Its activities were suspended because it could not generate sufficient income to cover the costs of a full-time chief executive. This initial generation of critical mass and hence profitability is clearly a problem for institutions with small but developing research profiles.
Technology Transfer and Research Commercialisation Strategies

The core strategy is to encourage centres and groups within faculties to do their own marketing and look for external TT&C opportunities. The Office for Research is the primary channel through which external contracts and patent applications are handled. The office at this time does not have a designated contracts officer. The roles of the Office for Research are to advise and to provide the channel to university sources of contracts legal advice.

Provisional patents come first to the Director, Office for Research, and to the Dean concerned, then finally to the Deputy Vice-Chancellor with responsibility for research. The Dean will sometimes underwrite the patenting costs. More usually, University funds will be sought from the Deputy Vice-Chancellor.

An important role of the Office for Research is its support of SPIRT and START grant proposals, including assistance in finding outside partners.

In 1995 VUT received a high proportion of the Research Quantum, 34 per cent, under Category 3 Industry and Other Funding. The proportion was one of the highest percentages for a smaller, newer institution. This is a strong indication that these strategies are working.

Performance Measures

VUT performance against the selected performance measures is shown in Table 4 below.
Table 4: Performance Measures for Victoria University of Technology

<table>
<thead>
<tr>
<th>Performance measure</th>
<th>Year</th>
<th>VUT Performance</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Total Category 3 Industry and Other Funding (excluding funding from syndicated R&amp;D and from donations, bequests and foundations)</td>
<td>1994</td>
<td>$ 980,963</td>
</tr>
<tr>
<td></td>
<td>1995</td>
<td>$1,225,822</td>
</tr>
<tr>
<td>2. Per cent (excluding funding from syndication, donations, etc) of Total Research Income</td>
<td>1994</td>
<td>28 per cent</td>
</tr>
<tr>
<td></td>
<td>1995</td>
<td>34 per cent</td>
</tr>
<tr>
<td>3. Collaborative research grants:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- SPIRT</td>
<td>1996</td>
<td>Applications 3, funded 2. New funding $75K</td>
</tr>
<tr>
<td></td>
<td>1997</td>
<td>Applications 6, funded 1. New funding $76K</td>
</tr>
<tr>
<td></td>
<td>1998</td>
<td>Applications 7, funded 1.</td>
</tr>
<tr>
<td>- R&amp;D START</td>
<td>1997</td>
<td>CRESS $1.6 million grant</td>
</tr>
<tr>
<td>4. Externally funded postgraduate students:</td>
<td>1997</td>
<td></td>
</tr>
<tr>
<td>- APA</td>
<td>Masters</td>
<td>4 36</td>
</tr>
<tr>
<td>- APA(I)</td>
<td>PhD</td>
<td>1 12</td>
</tr>
<tr>
<td>- CRC</td>
<td>0 1</td>
<td></td>
</tr>
<tr>
<td>- other university</td>
<td>2 39</td>
<td></td>
</tr>
<tr>
<td>- own university funding</td>
<td>0 30</td>
<td></td>
</tr>
<tr>
<td>- industry/community supported</td>
<td>13 56</td>
<td></td>
</tr>
<tr>
<td>5. University supported consultancies</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1995</td>
<td>Arts</td>
<td>$13,500</td>
</tr>
<tr>
<td>1997</td>
<td>Business</td>
<td>254,241</td>
</tr>
<tr>
<td></td>
<td>Engineering</td>
<td>128,125</td>
</tr>
<tr>
<td></td>
<td>Human</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Development</td>
<td>68,792</td>
</tr>
<tr>
<td></td>
<td>Science</td>
<td>94,826</td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>$559,484</td>
</tr>
<tr>
<td>6. Patents</td>
<td>Current</td>
<td>4 final specifications</td>
</tr>
<tr>
<td></td>
<td></td>
<td>3 provisional specifications</td>
</tr>
<tr>
<td>7. Royalties and license fees</td>
<td>None identified</td>
<td></td>
</tr>
<tr>
<td>8. Spin-off companies</td>
<td></td>
<td>1 proposed for optical fibre gratings</td>
</tr>
</tbody>
</table>
Relations with External Research Users

Development of relations with external research users is largely left to individual centres and departments.

VUT has participated in local community field days, but, except for the earlier success with Olex Cables arising from a field day, there appears to have been little direct benefit in terms of technology transfer as opposed to local community support from such participation.

There does not appear to be an easily accessible and complete database of VUT research and technology competencies. The Office for Research wishes to establish such a database but only if there is a clear agreement for joint output with the Media and Communication Group, the University Foundation and the Alumni Office to avoid duplication of effort.

Consultancies

VUT policy on consultancies makes a proper and clear distinction between University supported consultancies and those where a staff member acts as a private agent. There is clearly concern that not all private agent consultancies comply with rules about use of University letterhead and could therefore possibly put the University at risk in terms of professional and other liabilities. However, the administrative effort to achieve total knowledge about and control of private agent consultancies may be greater than the risk involved. An analogy is food pilfering from restaurants: good systems will control the level of pilfering but you cannot afford a system that would totally prevent it. The VUT documentation shows awareness of the risk and what should be effective communication to staff.

Key policy issues are:

- staff may expend up to 20 per cent of their time, up to a limit of 13 days in each quarter, on formally approved consulting and other outside earning activity; and
- net proceeds, after direct costs have been reimbursed, are distributed as follows:

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Staff member</td>
<td>75 per cent</td>
</tr>
<tr>
<td>Department or centre</td>
<td>15 per cent</td>
</tr>
<tr>
<td>Central University fund</td>
<td>10 per cent</td>
</tr>
</tbody>
</table>
Retainers

No situations were identified where staff received retainers (as opposed to fees for specific consultancies) from outside research users.

Management of Intellectual Property

The VUT intellectual property policy document sets out IP management responsibilities starting from the Office for Research through the Deputy Vice-Chancellor (Research) as Intellectual Property Officer with an Intellectual Property Committee responsible for 'formulating and overseeing policies and practices'.

In the review it was clear that initiatives, particularly patents, are made at the senior researcher level. However, in most cases the decision to prepare final patent specifications took place at the Deputy Vice-Chancellor level because of the need to seek university funding for the patenting costs involved. None of the patent applications to date appeared to have a commercial partner who might take responsibility for the expensive stage of final specification and overseas patent filings. Experience elsewhere suggests that, as the patent IP portfolio grows, care needs to be taken to avoid a large investment by VUT in patents with no commercial partner and little likelihood of a commercial return.

Patents

VUT has a clear patent policy as part of staff employment conditions. The present IP policy document makes no reference to any sharing of income arising from intellectual property with the original inventor staff member.

Students basically retain ownership of intellectual property that they generate, except where research funding conditions require them to enter into agreements for a specific project. Under the latter conditions, publication of a thesis can be delayed for a maximum of 18 months. In other situations, VUT will negotiate with the student for a share in the intellectual property rights in exchange for funding of patent and other development costs.

VUT does not appear to have any policy with regard to visiting academic staff. In this situation, IP ownership will probably rest with the normal employer of the person concerned unless there is a specific agreement between the parties concerned.
Scope for Best Practice Improvement

Key elements of best practice that may merit attention are:

- strengthening the IP Committee with council members or other outside people with appropriate commercial experience in this area;
- clarifying and strengthening the responsibilities of the Office for Research, or re-establishing an incorporated entity for technology marketing, including management of patents and the associated licensing; and
- establishing a policy that, unless there are very strong reasons to the contrary, the University will not file final Australian specifications or file overseas unless it has a commercial partner who will be responsible for the associated costs.

In the absence of an active university company with outside independent board members, the management of research TT&C appears to rest solely within the University administration. The only external inputs into decision making may come from the external members of centre advisory panels.

A best practice issue is the involvement of independent outside people with appropriate industrial/commercial experience. In the specific VUT context, possible initiatives might be:

- to include research commercialisation, IP and technology transfer in the formal remits to centre and any other advisory panels for particular attention by their external members; and
- to establish what might be called a research TT&C advisory panel, essentially to advise and support the Deputy Vice-Chancellor (Research) as the intellectual property officer of the University.

This panel might operate in a similar mode to the board of a University company, meeting perhaps three or four times a year, and might have as members:

- an independent, outside University council member as chair;
- the Deputy Vice-Chancellor (Research) and the Director, Office for Research;
- a Dean and a centre director or department head (perhaps on a two-year rotation); and
- two or three external members of centre advisory panels, with appropriate industrial/commercial experience.
Copyright and Eligible Layouts

The present VUT IP policy document defines copyright ownership for written publications but makes no mention of copyright in relation to software or eligible layouts. In default of specific agreements with individual staff members, the staff member therefore probably retains copyright ownership of software and eligible circuits. The relevance of this is the recent agreement on the use of fire engineering software by VUT with the Fire Code Reform Centre. There could be similar issues in relation to software and eligible circuits developed in other areas of the University.

Accumulated Know-how

Staff members involved in the discussions clearly understood the benefits of non-disclosure of accumulated know-how, as an alternative to patenting, in the protection of intellectual property. At the same time such non-disclosure may be a restriction on the postgraduate student intake, academic career paths and ARC grant access.

Students

VUT needs to consider carefully copyright ownership issues in relation to software and eligible circuits developed by students.

Visitors

There is an awareness of IP ownership issues with visitors at the administration level, but less so at the departmental level. This could pose risks where there are no specific agreements with visiting researchers.
Performance against Best Practice Criteria

Table 5: Performance against Best Practice Criteria: Victoria University of Technology

<table>
<thead>
<tr>
<th>Criterion</th>
<th>Performance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Technical soundness</td>
<td>Policies and their implementation accord well with perceived best practice.</td>
</tr>
<tr>
<td>Administrative practicality and cost</td>
<td>Effective use of limited Office for Research resources, but these may be inadequate in the longer term. A contracts person will be needed. A university company may not be able to trade profitably without enterprises generating early cash flow.</td>
</tr>
<tr>
<td>Acceptability</td>
<td>Generally well accepted by researchers.</td>
</tr>
<tr>
<td>Research user involvement</td>
<td>In the centres, this appears very good. In some areas, such as packaging engineering, more use could be made of continuing education to bring industry up to speed with research.</td>
</tr>
<tr>
<td>Originality and general utility</td>
<td>A number of commercialisation successes, mostly originating in good external relationships out of earlier CAE level activities. Lack of critical mass is inhibiting in other areas.</td>
</tr>
</tbody>
</table>
# Interviews and Contacts at Victoria University of Technology

<table>
<thead>
<tr>
<th>Name</th>
<th>Position/Department</th>
</tr>
</thead>
<tbody>
<tr>
<td>Professor Paul Clarke</td>
<td>Deputy Vice-Chancellor (Research)</td>
</tr>
<tr>
<td>Dr John Allen</td>
<td>Director, Research Office</td>
</tr>
<tr>
<td>Associate Professor Vaughan Beck</td>
<td>Centre for Environmental Safety and Risk Engineering</td>
</tr>
<tr>
<td>Professor Mike Faulkner</td>
<td>Mobile Communications and Signal Processing Group in the Faculty of Engineering and Science</td>
</tr>
<tr>
<td>Professor John Carlson and Dr Russell Best</td>
<td>Centre for Rehabilitation, Exercise and Sport Science</td>
</tr>
<tr>
<td>Associate Professor Graham Thorpe</td>
<td>Grain Cooling Research in the Faculty of Engineering and Science</td>
</tr>
<tr>
<td>Associate Professor Michael Sek and Vincent Rouillard</td>
<td>Mechanical Engineering Research and Consultancy Centre, in the Department of Mechanical Engineering</td>
</tr>
<tr>
<td>Professor Graham Trout, Dr Nagendra Shah and postgraduate students Rajiv Dave, Ramakanth Ravula and Amal Shihata</td>
<td>School of Life Sciences and Technology, including Centre for Bioprocessing and Food Technology</td>
</tr>
<tr>
<td>Professor David Booth</td>
<td>Applied Physics and Optical Technology Research Laboratory</td>
</tr>
<tr>
<td>Bruce Esler</td>
<td>Trade Data, Centre for Strategic Economic Studies</td>
</tr>
<tr>
<td>Suku Bhaskaran</td>
<td>Australian Food Marketing Centre in the Faculty of Business</td>
</tr>
</tbody>
</table>
The University of Adelaide

The review of TT&C practices at The University of Adelaide (Adelaide) took place on 4 and 5 May 1998. The review involved discussions with university staff and telephone interviews with external research users. A list of university people interviewed is given at the end of this review. A list of research users is included in Appendix 6.

The review involved two types of discussion:

- university structure and policies; and
- small case studies of a selection of centres and research groups in departments (details are not included in this report).

Organisational Structure and Research Strategy

The Deputy Vice-Chancellor (Research) has responsibility for the Research Branch, the Graduate Studies and Scholarship Branch and industry liaison (Thebarton campus). He is also on the board of the University technology company, Luminis Pty Ltd (Luminis).

The University has a well-developed mix of centres, including some formal University centres and others less formally structured. They vary in their scope from facilitation of purely research activity to providing the focus for the development of external research and technology transfer relationships. The research centres report to a division or faculty and have advisory boards that include external representatives. These boards need to include significant research users if they are to be effective.

There is a Research Management Plan for the University and there are supporting plans in each division of the University.

The University is heavily involved in the CRC program. It participates in 13 centres. This is probably the highest number for any university. One may ask whether this is too many, but as the centres are independent, with separate management and boards, involvement with such a large number of centres should not be a problem.

The Research Branch and the Graduate Studies Branch assist graduates to secure scholarship and grants for their postgraduate work.
University Technology Company: Luminis Pty Ltd

Luminis was established in 1984 to link intellectual property with venture capital but after a stumble in the 1987 downturn it changed its role to become a service company. Its role today is to develop and commercialise the intellectual property of the University of Adelaide. It is University policy that all consultancies, patent and other intellectual property management and licensing should be managed by Luminis.

This strict policy is to protect both the academic staff and the University while Luminis also provides business advice and administration. Income is split, with 80 per cent to the researcher, 10 per cent to the department and 10 per cent to Luminis.

Luminis Pty Ltd has two shares owned by the Luminis Investment Trust. All trust earnings go to the University. Luminis has an independent board that includes two representatives of the University. The University subsidises Luminis by about $0.5 million per annum by paying staff salaries. The levy from the consultancies does not cover the related costs, whilst the IP and investments have generated income for Luminis and thus in effect the University.

Luminis markets itself to both the University researchers and the outside market. It conducts seminars and uses printed matter to publicise its activities, to encourage staff to undertake outside work and to explain the benefits of its services.

Thebarton Commerce and Research Precinct

The precinct is owned 100 per cent by the University. It is four kilometres from the Adelaide central business district and is a dedicated research and development park set up to provide a base for a variety of industrial and commercial projects. It has 20,000 square metres of building space on five acres of land and over 400 people work there.

The tenants include:
- commercial tenants, including 20 ventures from the University;
- three CRCs;
- 10 research groups from the University;
- two small-business incubator centres; and
- 16 start up companies.
The precinct has three programs to encourage commercialisation of ideas:

- a graduate enterprise program, that is, a diploma course taken while participants start a business;
- a graduate support scheme to encourage past graduates to start a business; and
- a graduate/industry linked entrepreneurial scheme to help students to develop ideas to commercial standards.

The precinct has an industry liaison program and develops relationships with companies on behalf of students, the precinct and the University generally. Overall, the technology park is quite successful and after its initial loan is self-supporting. It funds many activities and people at present, while also paying interest on the loan.

The participants in the precinct are often in clusters so that the researchers and industries with common interests are brought together.

University Culture

The University of Adelaide is the traditional collegiate model built on the quality of the researchers. At the same time, there is no framework that encourages awareness of best practice in research TT&C. For example, the impact of the CRCs is limited as they are concentrated in a small number of faculties. Adelaide has ‘fabulous and creative academic staff’ whose success owes much to serendipity.

There is, however, concern about the organisational framework, and many participants do not appear geared to be proactive in facilitating and networking. In the past, many staff members did not perceive the consideration of research end-user needs to be a high priority. However, a new generation of academics has now emerged, some with experience from working in the USA and many adept at building external relationships.

Competencies Databases

People outside do not know how to get at the University’s expertise and ‘we have no client database’. To do this, ‘we have got to build on each others’ information. We have no common database in Australia. We need something like the US Institute of Physics SPIN’ (Sponsored Programs Information Network).
Luminis

Some of the 'customers' of Luminis strongly advocate having people in the company who know how to 'deal', but these same advocates are inexperienced in external negotiation and object to paying fees.

The Role of Alumni

The University of Adelaide is exploring the Cornell and MIT use of alumni to facilitate external user relationships. For example, the MIT Technology Transfer Committee involves alumni or the 18 alumni chapters of MIT which help with business planning, technology transfer advice and small business services.

Performance Measures

The performance of The University of Adelaide against possible measures is summarised in Table 6 below.

Table 6: Performance Measures for The University of Adelaide

<table>
<thead>
<tr>
<th>Performance Measure</th>
<th>Year</th>
<th>Performance</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Total Category 3 Industry and Other Funding (excluding funding from syndicated R&amp;D and from donations, bequests and Foundations)</td>
<td>1994</td>
<td>$7 094 789</td>
</tr>
<tr>
<td></td>
<td>1995</td>
<td>$7 308 040</td>
</tr>
<tr>
<td>2. Per cent (excluding funding from syndication, donations, etc) of Total Research Income</td>
<td>1994</td>
<td>19 per cent</td>
</tr>
<tr>
<td></td>
<td>1995</td>
<td>16 per cent</td>
</tr>
<tr>
<td>3. Externally funded postgraduate students:</td>
<td>1997</td>
<td>279</td>
</tr>
<tr>
<td>- APA</td>
<td></td>
<td>23</td>
</tr>
<tr>
<td>- APA(I)</td>
<td></td>
<td>NA</td>
</tr>
<tr>
<td>- Other research user funded</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. University supported consultancies</td>
<td></td>
<td>NA</td>
</tr>
<tr>
<td>5. Patents</td>
<td></td>
<td>NA</td>
</tr>
<tr>
<td>6. Royalties and license fees</td>
<td>1997</td>
<td>NA</td>
</tr>
<tr>
<td>7. Spin-off companies</td>
<td>Active</td>
<td>Bresagen</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Camtech</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Chiptech</td>
</tr>
<tr>
<td></td>
<td></td>
<td>9 at Thebarton</td>
</tr>
</tbody>
</table>
Operating Issues

The University's overall research commercialisation performance by any performance measure is good to outstanding. This has been achieved primarily through the initiative of outstanding individuals working with a high degree of flexibility, rather than as a result of specific university structural, strategic or policy initiatives. The University's technology company has been very successful, particularly in engineering-related TT&C. However, it is also seen as having less expertise in areas such as the biosciences.

The central question is how to maintain the delicate balance between facilitation, flexibility and control. A comment made several times was that the best strategy was to limit the amount of bureaucratic interference where researchers are successfully involved in the commercialisation of research.

As compliance has been tightened, there has been concern in some areas about the fees charged by Luminis. This has been much less evident in engineering areas where there is clear recognition of the importance of protection on professional liability issues and Luminis staff involved have credibility among engineering researchers. Experience elsewhere in Australia has shown that it is essential for university company staff to have credibility with, and be respected and trusted by, researchers. This usually requires contact officers with established postdoctoral research records in similar disciplines. There is scope to improve this in the biosciences.

Relationship with External Research Users

Relations with external research users occur through the Industry Liaison Office at Thebarton, Luminis, the Research Centres and the Research Branch. The Industry Liaison Office maintains direct contact with industry people and supplements this with conferences and papers. However, the focus is generally Adelaide whereas much research and consulting is for organisations outside South Australia.

There have been discussions about developing an industry database for the University, and this would have merit in view of the number of people contacting industry. There were comments that business seeks a single (initial) contact point and maybe one for the three universities in South Australia. This means it is important to keep promoting the Industry Liaison Office.
Consultancies

The University allows staff to devote 20 per cent of their time to consultancies and has a policy statement (1994) that notes:

- permission is required from the department head;
- contracting is to occur through Luminis, particularly to provide professional indemnity insurance and use their experience in contracts;
- direct costs to the University need be charged and reimbursed;
- of the consulting fees (not expenses), 10 per cent are allocated to the department and 10 per cent to Luminis.

Whilst there is some reluctance to use Luminis, it was felt that little consulting bypassed it at present. An estimated 70 per cent of the consulting occurs outside Adelaide and this includes aid agencies. As well, it was noted that consulting led to a number of research contracts.

Spin-off Companies

During the review the study found two academics who had established companies to commercialise ideas.

One company operates in microelectronics and was established outside Luminis. The University had a significant equity investment in the company but this, as a percentage of total equity, has been watered down over time. The company is continuing to grow.

The second company operates in air-conditioning. The patents are held by Luminis, to which the company pays royalties.

In both companies the people involved had an attitude that entrepreneurial endeavours helped to validate intellectual ability by converting it into a profitable business.

Management of Intellectual Property

The University’s intellectual property policy (December 1989) sets out IP management responsibilities. It notes that the University asserts ownership of all IP arising from work within its divisions, faculties and research centres and sets out formulae for sharing the benefits of successful commercialisation.

The policy includes reference to written and audio-visual material and software and it notes the key role of Luminis. The company reviews IP and decides whether a patent or copyright is required and, if so, pays that cost.
As in other universities, there is some concern at the cost of patenting all IP and sensible analysis is required.

Apart from academic staff, the policy covers part time and casual staff and notes that, in the absence of a prior written agreement, the University owns the IP. For visiting staff the University claims ownership of over 50 per cent of the IP.

The position of students is also detailed, in that the student owns their IP, but an agreement to assign the students IP is signed as a condition of accepting the student’s research topic. Students receive a share of profits on the same formulae as for University staff.

External Inputs

The board of Luminis is composed of two representatives of the University, five external directors (including the Chairman) and the Managing Director. This provides an objective group to guide Luminis in its activities.

The research centres have advisory boards, and cases were noted where major industry participants and research users were involved. It is important to secure this participation across all research centres.

Other Matters

The review raised a few other matters that deserve comment:

- Despite various instructions, some staff lack expertise in costing consultancies and research. The University accounting system is not project-oriented and improvements are required.

- A number of research projects and research centres acquired equipment for their work which came to be used for other work and became a substantial benefit to the university.

- Attitude is important in developing entrepreneurship and is evidenced when researchers have findings and believe that ‘we should be able to use that for something’.

- The challenge is to promote commercialisation to academics and more should be done to promote role models and case studies of the significant achievements at Adelaide University. SPIRT grants, the academic networks and research supervisors also assist.

- The practical fields of engineering and science seem to be leading in commercialisation and entrepreneurship. Relevant subjects and lectures have been introduced to their final degree year and postgraduate courses. Other faculties and divisions need to take similar steps.

- Postgraduate students need courses or other learning opportunities in research project planning, milestones and timelines; gathering
documentation to ensure that dates and other essential data are recorded in the event that IP opportunities are generated; communicating by means of written and oral presentation; and understanding the expectations of an outside party.

Performance against Best Practice Criteria

*Table 7: Performance against Best Practice Criteria: The University of Adelaide*

<table>
<thead>
<tr>
<th>Criterion</th>
<th>Performance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Technical Soundness</td>
<td>Systems and strategies seem to be working with CRCs developed, successful added value to IP, many consultancies and the framework for spin-off companies.</td>
</tr>
<tr>
<td>Administrative practicality and cost</td>
<td>Luminis runs this activity as a low cost operation, servicing the University, its academic staff and external clients.</td>
</tr>
<tr>
<td>Acceptability</td>
<td>Senior people now provide strong support for research commercialisation. Academic attitudes are becoming more supportive, mainly so in engineering and science.</td>
</tr>
<tr>
<td>Research user involvement</td>
<td>Research users tend to deal directly with centres and have roles on some advisory boards. Perhaps there could be more focus on local SA businesses.</td>
</tr>
<tr>
<td>Originality and general utility</td>
<td>University policies and Luminis practices provide a consistent approach to contracts, IP management and business management.</td>
</tr>
<tr>
<td>Contribution to staff and students</td>
<td>The Commerce and Research Precinct provides an interactive concentration of research and commercial activity. Role models need to be promoted and case studies of success stories need to be developed.</td>
</tr>
</tbody>
</table>
## Interviews and Contacts at The University of Adelaide

<table>
<thead>
<tr>
<th>Name</th>
<th>Position</th>
</tr>
</thead>
<tbody>
<tr>
<td>Professor Ross Milbourne</td>
<td>Deputy Vice-Chancellor (Research)</td>
</tr>
<tr>
<td>Peter Hart</td>
<td>Managing Director, Luminis Pty Ltd</td>
</tr>
<tr>
<td>Rex Hunter</td>
<td>Director, Commerce and Research Precinct, Thebarton</td>
</tr>
<tr>
<td>Janet Dibb-Smith</td>
<td>Director, Research Branch</td>
</tr>
<tr>
<td>Professor Reg Coutts</td>
<td>Centre for Telecommunications</td>
</tr>
<tr>
<td>Associate Professor Bill Henderson</td>
<td>Director of Teletraffic Research Centre</td>
</tr>
<tr>
<td>Dr Peter Cole</td>
<td>Electrical &amp; Electronic Engineering</td>
</tr>
<tr>
<td>Professor Sam Luxton</td>
<td>Mechanical Engineering</td>
</tr>
<tr>
<td>Professor Chris Barter</td>
<td>Computer Sciences</td>
</tr>
<tr>
<td>Professor Peter Rathjen</td>
<td>Biochemistry</td>
</tr>
<tr>
<td>Professor Tony Parker</td>
<td>Engineering</td>
</tr>
</tbody>
</table>
The University of Sydney

The review of the TT&C practices of The University of Sydney (Sydney) took place over the period 11–13 May 1998. The review involved discussions with Sydney staff, people at the Australian Technology Centre at Eveleigh and telephone interviews with selected external research users. University people interviewed are listed at the end of this review. Research user interviews are listed in Appendix 6.

Organisational Structure

In addition to the Sydney campus, Sydney includes Cumberland College, Orange Agricultural College and the College of the Arts. Sydney is grouped organisationally into three colleges: Health Sciences, Science and Technology, and Humanities and Social Sciences, each reporting through a Deputy Vice-Chancellor.

In parallel, there is a Deputy Vice-Chancellor for International and Development whose Office has the following infrastructure:

Figure 4: Chart of Infrastructure of the Office of the Deputy Vice-Chancellor for International and Development

In this structure, the Director of the Business Liaison Office (BLO) is effectively on the third level of management below the Vice-Chancellor. At the same time delegations to the Pro Vice-Chancellor (Research) and strong working relationships between the responsible parties allow most day-to-day decision making and resource allocation to take place easily and quickly.

The Research and Scholarship group has responsibility for all large and small ARC grants and for all matters to do with postgraduate research students.
The Research Development group is concerned with:

- professional aspects of grantsmanship—that is, improving grant proposal writing skills; and
- building up research awareness in the newer parts of the University: and advising on collaborative grant proposals once an industry partner has been identified, but not making the initial connections (in the latter role, it works closely with and has some overlap with the Business Liaison Office).

Performance Measures

University of Sydney data against selected performance measures are shown in Table 8.

Table 8: Performance Measures for The University of Sydney

<table>
<thead>
<tr>
<th>Performance measure</th>
<th>Year</th>
<th>Performance</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Category 3 Industry and Other Funding (excluding funding from syndicated R&amp;D and from donations, bequests and foundations)</td>
<td>1994</td>
<td>$10 511 695</td>
</tr>
<tr>
<td></td>
<td>1995</td>
<td>$ 8 152 695</td>
</tr>
<tr>
<td>2. Per cent (excluding funding from syndication, donations, etc) of Total Research Income</td>
<td>1994</td>
<td>17 per cent</td>
</tr>
<tr>
<td></td>
<td>1995</td>
<td>14 per cent</td>
</tr>
<tr>
<td>3. Collaborative research grants:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- SPIRT</td>
<td>1995</td>
<td>Applications 13, funded 7. New funding $1.8m</td>
</tr>
<tr>
<td></td>
<td>1996</td>
<td>Applications 29, funded 16. New funding $29m</td>
</tr>
<tr>
<td></td>
<td>1997</td>
<td>Applications 60, funded 31. New funding $5.2m</td>
</tr>
<tr>
<td></td>
<td>1998</td>
<td>Applications 61</td>
</tr>
<tr>
<td>- R&amp;D START</td>
<td>1997</td>
<td>1</td>
</tr>
<tr>
<td>4. Externally funded postgraduate students:</td>
<td>1997</td>
<td>Masters and PhD (approx. 25% Masters) 3 323</td>
</tr>
<tr>
<td>- Total</td>
<td></td>
<td>488</td>
</tr>
<tr>
<td>- APA</td>
<td></td>
<td>14</td>
</tr>
<tr>
<td>- APA(I)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Other research users funded</td>
<td></td>
<td>60 (est.)</td>
</tr>
<tr>
<td>5. University supported consultancies</td>
<td>1997</td>
<td>Science &amp; Technology $1.9m</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Humanities &amp; Social Sciences $0.2m</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Health Services $1.5m</td>
</tr>
<tr>
<td>6. Patents</td>
<td></td>
<td>68 final specifications, 34 provisional specifications</td>
</tr>
<tr>
<td>7. Royalties and license fees</td>
<td>1997</td>
<td>$0.6m</td>
</tr>
<tr>
<td>8. Spin-off companies</td>
<td></td>
<td>Active About 20</td>
</tr>
</tbody>
</table>
The Research Development group is concerned with:

- professional aspects of grantsmanship—that is, improving grant proposal writing skills; and
- building up research awareness in the newer parts of the University: and advising on collaborative grant proposals once an industry partner has been identified, but not making the initial connections (in the latter role, it works closely with and has some overlap with the Business Liaison Office).

Performance Measures

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<tr>
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<th>Year</th>
<th>Performance</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Category 3 Industry and Other Funding (excluding funding from syndicated R&amp;D and from donations, bequests and foundations)</td>
<td>1994</td>
<td>$10,511,695</td>
</tr>
<tr>
<td></td>
<td>1995</td>
<td>$8,152,695</td>
</tr>
<tr>
<td>2. Per cent (excluding funding from syndication, donations, etc) of Total Research Income</td>
<td>1994</td>
<td>17 per cent</td>
</tr>
<tr>
<td></td>
<td>1995</td>
<td>14 per cent</td>
</tr>
<tr>
<td>3. Collaborative research grants:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- SPIRT</td>
<td>1995</td>
<td>Applications 13, funded 7. New funding $1.8m</td>
</tr>
<tr>
<td></td>
<td>1996</td>
<td>Applications 29, funded 16. New funding $29m</td>
</tr>
<tr>
<td></td>
<td>1997</td>
<td>Applications 60, funded 31. New funding $5.2m</td>
</tr>
<tr>
<td></td>
<td>1998</td>
<td>Applications 61</td>
</tr>
<tr>
<td>- R&amp;D START</td>
<td>1997</td>
<td>1</td>
</tr>
<tr>
<td>4. Externally funded postgraduate students:</td>
<td>1997</td>
<td>Masters and PhD (approx. 25% Masters)</td>
</tr>
<tr>
<td>- Total</td>
<td></td>
<td>3,323</td>
</tr>
<tr>
<td>- APA</td>
<td></td>
<td>488</td>
</tr>
<tr>
<td>- APA(I)</td>
<td></td>
<td>14</td>
</tr>
<tr>
<td>- Other research users funded</td>
<td></td>
<td>60 (est.)</td>
</tr>
<tr>
<td>5. University supported consultancies</td>
<td>1997</td>
<td>Science &amp; Technology $1.9m</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Humanities &amp; Social Sciences $0.2m</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Health Services $1.5m</td>
</tr>
<tr>
<td>6. Patents</td>
<td></td>
<td>68 final specifications, 34 provisional specifications</td>
</tr>
<tr>
<td>7. Royalties and license fees</td>
<td>1997</td>
<td>$0.6m</td>
</tr>
<tr>
<td>8. Spin-off companies</td>
<td></td>
<td>Active About 20</td>
</tr>
</tbody>
</table>
Business Liaison Office

This office is the primary source of institutional support to external research fund raising, TT&C in the University. It is specifically responsible for:

- standard agreements and procedures for routine services;
- drafting, review and negotiation of contracts and agreements;
- intellectual property advice and management;
- assistance in obtaining funding and industry support;
- advice on the formation of companies involving the University;
- marketing and promotion;
- assistance with CRC administration; and
- advice on University policies on interaction with industry.


The Director is a bioscientist with a proven record in both research and small biotechnology company management. The BLO structure under the Director includes:

- two assistant directors, each with a business associate, who share responsibilities for specific discipline areas with the Director (one of the Assistant Directors is a specialist in intellectual property licensing, and is currently President of the Licensing Executives Society in Australia);
- a senior administrative officer who looks after collaborative grants;
- a legal adviser from a private firm, who is in the office two half-days a week;
- a project coordinator; and
- a receptionist and secretary.

The BLO Director has direct involvement with the University’s Research Committee and is thus close to strategic research direction decisions.

Some years ago, The University of Sydney gave careful consideration to the establishment of a University technology and research commercialisation incorporated entity, but decided against such a move. The principal argument put forward by the BLO Director was that an internal office was better placed to provide flexibly a wider range of support services without having to be so concerned about making a profit out of such services. Many staff are more comfortable with this arrangement.
In recent years, the BLO has had a very significant impact on thinking about commercialisation across the whole University. It has produced excellent manuals and draft licence and research agreements and has created a high level of awareness about its function and existence with staff and postgraduate students. The relationship between the BLO Director and the University Research Office is excellent and there are effective working relationships both at pragmatic and at policy levels.

The expectation of staff on the role of BLO in facilitating commercial arrangements and finding commercial partners is unrealistically high. At the same time the ‘inventors’ need to show more entrepreneurial flair. There was some concern that the amount of time involved in commercial negotiations and finding partners was neither appreciated nor recognised.

Comprehensive listings of the skill base of staff are still at a very early stage. Such listings would improve interaction with industry when consultants or possible contractors are sought.

There was a strong impression that commercial facets of staff research portfolios had a negative influence on promotion and performance indicators.

Consultancies and Research Contracts

The BLO is ‘responsible for everything to do with commercialisation, contracts and consultancies’:

- consultancies: heads of departments can sign these off up to $30,000 in value;
- research contracts: all have to go to either the BLO or the Research and Scholarship Office;
- collaborative research grants, both SPIRT and START: BLO had just completed lodgment of 61 SPIRT grant applications; and
- patents and licensing: the Director is the University’s IP officer.

To facilitate these arrangements, the BLO with the assistance of its visiting lawyer has developed a series of standard agreements. People at later interviews stated that these were particularly valuable during the early stages of a negotiation to identify clauses that might pose problems to the outside party. Equally, they helped the BLO to overcome problems of overconfidence and lack of understanding that often resulted in prejudicial pre-negotiation arrangements that later had to be renegotiated.
Most importantly, BLO has developed and distributed an excellent manual, *The Business Liaison Office Guide to Interaction with Industry – Implementation of Projects – Patents and Patenting – Funds for Collaborative Research*. This document is written in user friendly language and is a model that should be considered by all other institutions. It is a very healthy supplement for those who rarely read legally worded statements on employment and IP policies.

**Financial Operations and BLO Resourcing**

The BLO is funded by an allocation from the University’s central funding. As elsewhere, this arrangement lacks flexibility and the BLO appears overloaded and under-resourced for what it is expected to do. Comments from later interviews suggested a need for more decentralisation with BLO people, possibly part time, in the schools and centres. However, such decentralisation might quickly lead to incoherent policy application. There is a strong case to allow the BLO to keep a levy off the top of consultancy and research contract income to give it greater flexibility in its own resource planning. This is of course easier to do with an incorporated entity.

The BLO sets up the basis for invoicing in all contracts, but the department concerned does the actual invoicing.

**External Promotion**

The BLO gives a one-day seminar on developing 15-minute presentations to support interaction with industry partners. A regular newsletter goes to a mailing list of 10 000 companies derived from a database of past contacts with the University. As a promotional measure, smaller companies tend to be charged minimal royalty rates.

An important promotional asset is an up-to-date database of University competencies. A key issue is whether the University should concentrate on establishing and developing means of updating its own competencies database, for example, on the University of New England model, or whether it should participate in the development of a national database, such as those developed in Singapore and the USA.
Training for Technology Transfer and Commercialisation

The BLO runs regular seminars on IP, legal contracts and SPIRT grant proposals. In this effort it works closely with the parallel Office of Staff Development. The core purpose is to change the academic mindset to recognise the value of TT&C.

An important initiative has been the proposed implementation of a course subject on new venture creation to be run at the Australian Technology Park.

The Australian Technology Park (ATP)

This centre is a very important joint initiative of The University of Sydney, The University of NSW and the University of Technology, Sydney, with the involvement of TAFE and initial assistance from the State Government.

Technology Transfer and Research Commercialisation Strategies

At the senior administrative level at Sydney, the importance of developing strong external relationships is clearly well recognised and there is evidence of commitment to provide the support services for such activity. A good example of this commitment is the Vice-Chancellor’s prize awarded to the best performing venture located in the technology incubator at Eveleigh.

At the same time concerns were expressed that the more applied and contract research involved was not given equal rating in central funding allocation to departments and in academic promotion. There was therefore some ambivalence in the signals perceived by staff. Several commented that one of the major hurdles was entrenched attitudes among their more conservative colleagues that technology transfer, if it existed at all, ended with conventional publication and conferences.

While new user enquiries had been generated by BLO promotional activities, external relationships resulting in consultancies, research contracts and spin-off or joint venture companies had in almost all cases resulted from a lot of hard work by the individual researchers. This involved both finding interested outside parties and then carefully building personal relationships with them. Having within the University individuals with world class reputations in their fields has been most important.
As elsewhere, the need is not to impose total control but to provide flexibility and adequate support services to facilitate and enhance individual initiative while still protecting the University from unacceptable risk. There will of course always be a high level of risk in the 'messy and serendipitous' process of innovation.

Consultancies and Research Contracts

For consultancies involving payments to a staff member of $20,000 or less, head of department approval is required. For larger amounts, approval from the college Deputy Vice-Chancellor is required.

The BLO has well-established requirements for charge out rates, overhead and direct project cost recovery. These are set out in its 1997–98 manual. The effective levy is high, being 23.1 per cent of total consultancy earnings before direct cost recovery. Recommended charge-out rates including overhead are similar to those in other institutions:

- Professor Level E $175 per hour
- Senior Lecturer Level C $130 per hour

Intellectual Property

The University revised its IP policy in 1997. Under this policy, University staff own only copyright except for software. Net income from patents used to be distributed according to the following diagram:

*Figure 5: The University of Sydney: Previous Policy on Intellectual Property*

Income (from license fees, royalties etc.)
less Payments to external parties
(eg income shared with another university)
less 7.5% to general university account
less Direct costs
(usually patenting and legal)
Net Income

| 50 per cent | 33.33 per cent | 16.67 per cent |
| Inventors   | Department    | Vice-Chancellor’s Innovative Development Account |
This policy on IP income distribution has been revised and now the income (with no overheads taken out) is divided equally three ways to the inventors (33.3 per cent), the department (33.3 per cent) and the Vice-Chancellor’s Innovative Development Account (33.3 per cent).

Students own their own intellectual property. In agreed situations, students are asked to sign agreements vesting their IP rights in the University in exchange for similar ownership arrangements that apply to staff. Under certain circumstances visitors are asked to sign similar agreements.

The University has a standing review committee on IP policy. There is also an ad hoc committee that makes decisions on individual patent filings. This consists of the Pro Vice-Chancellor (Research), the Deputy Principal Financial Services and the BLO Director.

Patent application initiatives come initially through heads of department to the BLO. The BLO uses both patent attorneys and outside specialist consultants to evaluate patent applications. Generally the University will not file a PCT or final specification unless it has a commercial partner. On average it agrees to fund about two PCTs a year at a total cost of about $20,000 without such a partner in place. Total patent activity has been high in recent years.

When there is a case to do more research to add value to IP, funding may come from faculty sources or from the Vice-Chancellor’s Innovative Development Account. The BLO Director indicated that these were usually adequate sources, but this appears to be an area where an incorporated entity with a strong balance sheet and appropriate delegations might provide greater flexibility and quicker response.

BLO staff have very strong links to local and overseas groups involved in IP management, including the Licensing Executives Society (LES) and the American Association of Technology Managers (AATM). Particular issues under discussion have included:

- the implication of the US Bayh–Dole Act for intellectual property ownership; and
- problems of joint ownership of intellectual property.

University Equity and Spin-off Companies

Spin-off companies as such are supported by the Vice-Chancellor and seen as an appropriate commercialisation route. Reference has been made earlier to engineering course initiatives on new venture creation and the incubator at ATP at Eveleigh.
The lack of an incorporated entity is theoretically no hindrance to such development. The key policy issues are as follows:

- The University has no firm policy on level of retained equity desired; decisions are made on a case-by-case basis.
- The Senate has to approve the University taking up 20 per cent or more equity in existing or starting new incorporated entities, but to date has not rejected any such proposals.
- Individual staff members have to obtain approval to become directors of a company.

The BLO has recently been involved with the establishment of three companies approved by the Senate:

- Benthic Geotech: University equity 25 per cent, three outside companies each with 25 per cent.
- Encompass: 100 per cent University owned, but two attempts were needed to get it through the Senate.
- ACM Ltd: doing research on financial systems.

Individual past or present academics and/or postgraduate students are believed to have established a number of start-up companies, but the exact number was not known to the BLO. Only 30 per cent of the 25 companies resident in the Eveleigh incubator had originated in one of the three Universities involved.

**Blockages and Barriers**

Discussion with The University of Sydney identified the following blockages and barriers to commercialisation:

- attitude of mind: lack of understanding by academics that good external relationships and commercialisation of research can not only benefit the country but also benefit the researcher in the focusing of their research;
- some relics of attitudes that research involving industry needs is ‘dirty’;
- researchers being required to be involved in research outcomes but not being resourced for this;
- hard work needed to generate understanding of IP issues, including importance of research documentation, dating and sign-off; and
- increased teaching loads due to reduced University funding making it hard to find the time and mental effort to develop external relationships.
## Performance against Best Practice Criteria

*Table 9: Performance against Best Practice Criteria: The University of Sydney*

<table>
<thead>
<tr>
<th>Criterion</th>
<th>Performance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Technical soundness</td>
<td>Policies and their implementation accord well with perceived best practice. IP management competence is impressive. There appears to be a balance between control and flexibility, appropriate to such a diverse institution.</td>
</tr>
<tr>
<td>Administrative practicality and cost</td>
<td>The benefit of being focused on delivery of a wide range of support services without concerns about profitability of a company has to be matched against relative inflexibility in funding and industrial relations environment. The present levy for consultancy type overhead is high. Does this reflect high operating costs?</td>
</tr>
<tr>
<td>Acceptability</td>
<td>Generally high approval for BLO support services. Some resentment about high levies on external consultancy income. Some continuing more conservative rejection of the need to support TT&amp;C involving more applied research.</td>
</tr>
<tr>
<td>Research user involvement</td>
<td>In the successful ventures, generally good. The University might explore ways of using people in its foundations to facilitate research user involvement.</td>
</tr>
<tr>
<td>Originality and general utility</td>
<td>Intelligent use of standard agreements and an excellent BLO manual. Generally a lower proportion of Category 3 industry revenue than for Adelaide and Queensland. The initiatives in engineering to develop course work and other learning opportunities in new venture creation need strong support.</td>
</tr>
</tbody>
</table>
Interviews and Contacts at
The University of Sydney

Professor David Siddle
Dr Claire Baxter
Kevin W L Croft
Dr Maurice Barton
Professor Trevor Cole
Professor Robert G. Gilbert
Professor John D. Carter
Professor Roger I. Tanner
Professor Yiu-Wing Mai
Professor Durham White
Dr Mark Screats
Stan Jeffery
Tom Forgan
Karen Whittingham
Professor Tony Underwood
Professor Peter Reeves
Professor Charlie Benrimoj
Dr Tim Littlejohn
Dr Tony Weiss
Dr Bruce Sutton
Professor Graham
Dr Coral Chamberlain
Stuart Granfield
Victoria Harper
Trish Powers

Pro Vice-Chancellor (Research)
Director, Business Liaison Office
Assistant Director
Industry Liaison Manager, College of Sciences and Technology
Executive Director, The Warren Centre
Polymer Centre, School of Chemistry
Department of Civil Engineering
Mechatronics, School of Mechanical Engineering
Photonics CRC
National Innovation Centre
Australian Technology Park
TAFE at the Australian Technology Park
Institute of Marine Ecology
Department of Microbiology
Department of Pharmacy
National Genome Information Service
Department of Biochemistry
Department of Crop Sciences
A. R. Johnston Department of Pharmacology
Institute of Anatomy and Histology
Secretary, Electrical Engineering Foundation
Medical Foundation
Chemical Engineering Foundation
The University of Queensland

The review of TT&C practices at The University of Queensland (UQ) took place over the period 14–15 May 1998. The review involved discussions with University staff and telephone interviews with external research users. A list of University people interviewed is given at the end of this review. A similar list of research users interviewed is given in Appendix 6.

Background

As well as its more conventional teaching and research departments and faculties, UQ has many research centres that sit both across and within departments and faculties. There are three or four other particularly successful groups that have the potential to develop into new centres when and if resources can be allocated to them. Centres are funded outside the recurrent block grant derived budget. They are focused around UQ’s strengths in agriculture, mining and molecular biosciences.

UQ starts with a strong and evident commitment from its present and immediate past Vice-Chancellors to building commercially viable external TT&C relationships, including spin-off start-up companies.

Tax driven R&D syndicated projects played an important role at UQ in encouraging a culture accepting of more rigorous planning and management control of R&D projects, milestone achievement, detailed research documentation (including standard notebooks), reviews and accountability—as well as being an important source of research funding. Outcomes from the R&D syndication program have led to further research and created a platform of confidence from which several commercialisation activities have developed.

UQ operates at a commercial level in many different ways and through diverse pathways in which centres, departments or UniQuest Pty Ltd, its technology marketing company, may take the initiative in commercialisation. The commercial development is carried forward with the University in either a lead or supporting role. These pathways to take initiatives and to manage commercialisation are continually being reviewed as a part of the ongoing commercialisation debate. The objectives are twofold:

- to maximise flexibility while retaining an adequate level of protection of the University and individual staff members; and
- to facilitate spin-off companies and other joint ventures, including finding means of funding the gap between where University research ends and venture capital funding can start.
This is all happening against a background of the past financial viability problems of UniQuest.

Overall, the UQ model comes very close to best practice for research commercialisation in a well-established institution. Its success is well illustrated by the performance measures in Table 10 below. One of the keys is generating an adequate cash flow and profitability in a University company. UQ achieves this with UniQuest by having a portfolio of activities that is commercially viable and not having itself imposed on the University where it might not be able to operate profitably. Equally, its planned future thrust into investment in new spin-off ventures is based on the need for a portfolio of such ventures. Only a few of them are likely to be very successful in terms of exit returns on the original investment. UQ also appears to have effective procedures for resolving overlaps and conflicts in the process.

Performance Measures

Table 10: Performance Measures for The University of Queensland

<table>
<thead>
<tr>
<th>Performance measure</th>
<th>Year</th>
<th>Performance</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Category 3 Industry and Other Funding (excluding funding from syndicated R&amp;D and from donations, bequests and foundations)</td>
<td>1994</td>
<td>$21,158,888</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>1995</td>
<td>$23,845,155</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. Per cent (excluding funding from syndication, donations, etc) of Total Research Income</td>
<td>1994</td>
<td>34 per cent</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>1995</td>
<td>34 per cent</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. Collaborative research grants:</td>
<td></td>
<td></td>
<td>Applications</td>
<td>Successful</td>
</tr>
<tr>
<td>- SPIRT</td>
<td>1997</td>
<td>27</td>
<td>7 (26%)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>1998</td>
<td>54</td>
<td>23 (43%)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>1999</td>
<td>69</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- R&amp;D START</td>
<td></td>
<td></td>
<td>5 approved, 2 submitted, 4 in preparation.</td>
<td></td>
</tr>
<tr>
<td>4. Postgraduate students:</td>
<td>1997</td>
<td>Masters</td>
<td>PhDs</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>46</td>
<td>1,202</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- APA</td>
<td>36</td>
<td>463</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- APA(I)</td>
<td>0</td>
<td>37</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- CRC</td>
<td>0</td>
<td>462</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Other research user funded</td>
<td></td>
<td>NA</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5. University supported consultancies</td>
<td></td>
<td></td>
<td>NA</td>
<td></td>
</tr>
<tr>
<td>6. Patents</td>
<td>1998</td>
<td></td>
<td>40 new provisionals</td>
<td></td>
</tr>
<tr>
<td>Current</td>
<td>423 completed applications</td>
<td></td>
<td>90 patents granted</td>
<td></td>
</tr>
<tr>
<td>7. Royalties and license fees</td>
<td>1997</td>
<td></td>
<td>NA</td>
<td></td>
</tr>
<tr>
<td>8. Spin-off companies</td>
<td></td>
<td>Active</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Policies and Structures

The only mandatory imposition on UQ staff is that UniQuest must handle all intellectual property protection and licensing, except for copyright other than software. Other University groups are very active on other copyright issues, particularly the Music Department on music copyright.

Policy is for the University to hold equity in a spin-off if the technology originated within the University. However, some of these spin-offs operate with almost total autonomy.

All collaborative grant applications and funding are handled through the Research Office, the Director of which reports to the Deputy Vice-Chancellor (Research). UniQuest and the Research Office retain the same percentage levy on funding that goes through each. There is thus no financial advantage through using one rather than the other.

Arrangements for consultancies are quite open, but to obtain professional liability insurance they have to be handled by UniQuest. Under the existing statute academic staff can make their own arrangements; subject to approval from head of department or centre director in relation to teaching and research loads.

UQ has a clearinghouse, involving the Deputy Vice-Chancellor (Research), Research Office and UniQuest, that meets every six weeks to make decisions on how and where particular research contracts should be handled. All groups involved are reluctant to formalise arrangements any further.

Future strategy will be strongly focused on helping start-ups to form, taking equity and licensing the IP. In many cases a start-up company is not the appropriate commercialisation pathway. For research outcomes in agriculture, the best pathways tend to be licenses or joint ventures with larger companies.

Consultancies and Research Contracts

Staff may spend up to one day per week on external activities. External consultancies and contracts require the approval of the head of department, centre director and the dean of faculty. Individuals acting as private agents are required also to get such approval. No overhead is levied on individuals’ earnings, but there has to be a separate agreement if University equipment and infrastructure are used. The individual is also advised to take out individual professional liability insurance, as such arrangements are not covered by UQ’s insurance.
Consultancies may also be managed by the University and covered by UQ’s insurance. They can be handled through either the Research Office or UniQuest. UniQuest supports consultancies as a service and makes minimum margins on this service. Department and centre heads are supposed to record all consultancy approvals on a specific form that goes to the Research Office. There is a general view that this does not always happen.

For some UQ supported consultancies and research contracts handled through UniQuest and in which UniQuest plays a significant management role, 50 per cent of revenue goes to the department or centre and 50 per cent is retained by UniQuest. In individual consultancies, a margin negotiated on a case-by-case basis is retained by UniQuest to cover its costs. Benefits to individuals involved have to be negotiated with department heads or centre directors out of their share.

In technology commercialisation projects, it has become practice that net commercial returns are split equally three ways between the original inventor(s), the host centre or department and the corporate University. UQ is in process of revising its guidelines on outside earnings and on full cost recovery. Drafts of these documents were made available for this study on a confidential basis. They appear to be clear and well developed. By comparison with other institutions reviewed, the levy on consultancies and research contract revenue that goes to the University (other than overhead and direct cost recovery) appears high.

**Patents and Other Intellectual Property**

Since around 1990 there has been an increasing awareness of the importance of protecting UQ’s intellectual property and making the process of securing and maintaining patents more professional. This has been part of the transformation of the institutional culture to one in which basic, strategic and commercial research co-exist, seemingly productively.

The drive to be more vigilant in protecting and managing IP and in commercialising the outcomes of UQ’s research has, in part, been forced by reductions in public funding and increased industry awareness of the potential commercial value of the University’s research outcomes. Since 1990, UQ and UniQuest have been extremely active in securing industry sponsorship for research and currently rank number one amongst Australian universities in the Research Quantum measurement of industry sponsored research—by a significant margin over the second ranked University, The University of Melbourne.
UniQuest has well developed procedures for soliciting and managing invention disclosures and determining whether or not the invention warrants patenting. The company has its own in-house legal counsel and several technology commercialisation professionals with a depth of experience in protecting intellectual property. The company makes extensive use of external patent attorneys at all stages of the patenting process.

Statute 41 and the University's Intellectual Property Policy govern policy and procedures for patenting and ownership of IP. Statute 41 puts the onus of responsibility on the researcher to notify the University in the event the individual proceeds to take out a patent. The practical outcome of Statute 41 is that researchers, as a matter of course, come to UniQuest before starting the patenting process and obtain the company's assistance at the earliest stages of the process.

UQ's Intellectual Property Policy sets the context within which detailed procedures have been and are being developed. The University claims ownership of all IP other than copyright for non-software products. Policy guidelines appear clear for staff and students.

For students, UniQuest is required to advise students that they should obtain independent legal advice before entering into any arrangements for commercialising their IP. This poses the question of how the student pays for this advice, a problem being worked on by UniQuest and UQ's Research Office. UniQuest's current policy is to attempt to provide exactly the same services to students as it provides to staff. It is working out detailed procedures to implement this policy.

Areas where UQ's IP policy is in the process of clarification and procedure development include rights of visitors, heredity rights, and detailed notebook procedures.

Contractual Issues

Availability of standard agreements is very important. The onus is on the external partner to make any commercial warranty. Contracts from the University's side should specifically include release and indemnity of the University by the outside partner and exclude any warranty or liability on the University in relation to non-achievement of outcomes, commercial outcomes or marketability.

Consultancies need to be covered by liability insurance, but it is very expensive to get such cover for the USA. Software contracts should generally be considered as consultancies.
Generation and Commercialisation of Intellectual Property

The trend is towards centres producing a larger proportion of the total of UQ’s IP that has high potential commercial value and is closer to readiness for commercialisation.

A key factor in UQ’s success in commercialisation is the outlook, motivation and skills of the entrepreneurial individuals who run the larger, most successful centres. Most of these researchers were recruited in the mid- to late-1980s, have been successful in attracting large investments in their research, have built strong industry linkages globally and over the past three to four years have produced research outcomes with increasing commercial potential.

These individuals are in the vanguard of the formation of spin-off companies at UQ and act as role models for younger, bright, entrepreneurial researchers, who are carrying this culture and outlook forward.

UniQuest’s and UQ’s policy is to gain equity in start-up companies formed around intellectual property sourced from UQ as a consideration for licensing IP to the start-up. UniQuest sees itself as a ‘hatchery’ and ‘incubator’ for new, early stage research based ventures and in most cases will play a hands-on role in assisting in the management and governance of the start-up during its early, formative stages of development. UniQuest’s policy is to pull out of day-to-day involvement once a substantial external investor comes in.

UniQUEST management estimates that the effort required to launch and manage the early formative development of a start-up company is approximately 10 times that required to negotiate and complete a standard licence agreement, with much of this effort after the start-up is formed.
University Companies and Spin-offs

The UQ company structure is illustrated in the following diagram.

*Figure 6: University of Queensland company structure*

It is planned for UniQuest to become a subsidiary of UQ Holdings Pty Ltd. The company will change its status from a company limited by guarantee to a company with shares and guarantee. The history and role of the various elements in this structure are discussed below. The history and proposed future of UniQuest are both interesting:

*Table 11: History and Proposed Future of UniQuest*

<table>
<thead>
<tr>
<th>Year</th>
<th>Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>1984</td>
<td>Formation</td>
</tr>
<tr>
<td>1987</td>
<td>Stock market crash</td>
</tr>
<tr>
<td>1987-90</td>
<td>Aftermath of stock market crash</td>
</tr>
<tr>
<td>1990-94</td>
<td>Recovery and R&amp;D syndication</td>
</tr>
<tr>
<td>1994</td>
<td>Incorporation of TechComm. Value adding objectives agreed</td>
</tr>
<tr>
<td>1995-98</td>
<td>Value added venture development Stage I</td>
</tr>
<tr>
<td>1998</td>
<td>Early stage venture fund to be spun-off</td>
</tr>
<tr>
<td>1998-2005</td>
<td>Value added venture development Stage II</td>
</tr>
</tbody>
</table>
UniQuest organises its TT&C projects in a technology portfolio that currently contains over 100 projects. UniQuest’s TechComm businesses generated revenues of approximately $8 million in 1997 and is expected to add significant asset value to the company’s balance sheet.

It was acknowledged by UQ at the time of making its $5.5 million investment in UniQuest at the start of 1996 that the TechComm business would be investing in value-adding well ahead of receiving returns able to cover its costs. The aim in 1995–96 was to start to produce a net cash profit in the company, covering all TechComm and other operating costs, by 2000. Current indications are that this objective will be achieved in 1999.

UniQuest’s TechComm strategy has a 10-year horizon of maximising the realisable value added to UQ’s intellectual capital assets over the period 1996–2005. The $5.5 million investment is deployed to increase the amount and quality of professional ‘hands-on’ effort that goes into project preparation and finding investors and to make small pre-seed and seed investments in selected projects. It is also used to fund two areas that, prior to 1996, were funded directly by the University, namely not-for-profit services to the University community (mainly in consulting areas) and payment of patenting costs, which is now a UniQuest responsibility.

UniQuest has a policy of commercialising technology by means of start-up companies, to the extent that its resources permit and provided that a start-up is an appropriate commercialisation pathway. To this end, over the past two years the company has devoted considerable attention to attempting to attract early stage venture capital companies to locate in Brisbane and to gear themselves to be able to provide the sort of pre-seed and seed capital required to add value to the types of projects in the UniQuest technology portfolio. UniQuest regards the lack of a ready supply of this type of financing in Australia as the greatest limitation on its ability to commercialise UQ’s research outcomes. UniQuest management is confident that at least one $30 million fund, with a genuine early stage investment capability of the type required, will soon locate in Brisbane.

Over the past three to four years, in parallel to UniQuest’s transformation into an aggressive technology commercialisation company, a number of major UQ centres have made the transition from a strategy based on contract research, in which the client gained ownership of the new IP produced, to a strategy based on adding value to its own IP and commercialising through start-up companies and joint ventures. Several of these centres are located in one building—the Gehrmann Laboratories—alongside several CRCs and research centres operated cooperatively by UQ, CSIRO and the Queensland Department of Primary Industries (QDPI). UniQuest expects that by the end of 1998 this building alone will have hosted more than 10 start-up companies.
UQ does not have a formal, designated incubator facility, but hosts the incubation of new ventures based on the outcomes of its research inside and alongside regular research facilities. The proposed Molecular Biosciences Building will extend this concept of ‘organised intermingling’. It will bring together, in a single, integrated research and incubator type of facility, much of UQ’s activity in the biological sciences with the Australian Genome Facility sequencing engine, extensive genetics related research activity by CSIRO, QDPI and a large number of invited companies, big and small.

Issues for the Future of UniQuest

The key issue at UniQuest is balancing effort put into adding value to UQ’s intellectual capital assets through equity deals and doing cash producing licensing and R&D contract management deals. UniQuest’s objective is to maximise the value added to UQ’s intellectual capital assets over the 10-year period, 1996–2005. The company sees that the best way to achieve this objective is to commercialise by means of start-up companies and joint ventures whenever there is an appropriate commercialisation pathway. This means that UniQuest invests time and money in projects well before income is received from them. Cash management will become a key issue over the next year or so while equity deals are gestating prior to realisation.

In 1995 UQ decided that significant return could be achieved by funding UniQuest so that it could professionalise its technology commercialisation work, hire top flight staff and invest pre-seed and seed capital. The University subsequently invested $5.5 million in UniQuest (the capitalised value of underwriting of the company’s service activities and patent costs, previously paid by UQ, forecast over a seven-year period). UniQuest proceeded to upgrade its technology commercialisation work over the period 1995–98 and to embark on a high risk, high reward strategy over this period.

Since the start of 1995, UniQuest has made cash pre-seed and seed investments to a total of over of $1 million in virtual companies that are destined to become start-ups. UniQuest’s target was to have 25 start-ups either fully operational or close to operational by December 1998. Twelve start-up companies currently in operation are based on UQ technology and/or UQ’s research capability and have been formed, or facilitated in their formation, by UniQuest.

UniQuest’s longer term strategy, subject to securing improved access to early stage venture capital, is to devolve selected functions to selected centres and entities within UQ, while maintaining final control of the management of IP. It also aims to assume more of the role of a technology licensing office, modelled on major US Universities such as Stanford, and to offload much of the risk in venture development to the fund(s) that it hopes will locate on its doorstep.
UniQuest has approached this new strategy with a high degree of professionalism. The challenge will be to graft onto effective management of consultancies, research contracts and IP licensing support services the much more demanding entrepreneurial risk management and financial skills to mentor and manage a portfolio of very early stage start-up ventures.

A Well-developed Assessment Framework

A typical UniQuest assessment process for assessing value adding investments is shown below:

- technology description;
- competitive advantage (that is, innovation);
- market potential;
- risk mitigation strategies;
- venture management;
- IP status;
- exit strategy options;
- what is the deal?
- timelines:
  - time to market,
  - time to initial public offering,
  - time to exit, and
  - time to major next stage investment.

Entrepreneurship and Incubators

Role models and examples of successful companies are very important. The chosen models include the Universities of Edinburgh, Heriot Watt and British Columbia. UQ plans involvement in a biotechnology incubator to be developed at Long Pocket in conjunction with QDPI and CSIRO.

Drivers and Blockages

Discussion with The University of Queensland identified the following drivers and blockages to commercialisation:

Drivers

- the need for more money both for individuals and to support their research: short and longer term financial reward;
- identifying new problems where more basic research is needed;
- looking for new challenges, a way out or a more flexible career;
- in centres, external contracts being essential to their research but good
  research having to come first; and
- change in Research Quantum weighting for applied research from 0.5 to
  1.0.

**Blockages and Constraints**
- lack of good access to early stage venture capital;
- disincentive of getting less from block grants if successful with external
  funding;
- the tendency to avoid conflict;
- lack of clear policy on what is permissible in external relationships and
  what is not;
- a salary structure that inhibits attracting people from outside to come in
  and work on seconment; and
- mismatch between perceptions of industry people and people within the
  University.

**Performance against Best Practice Criteria**

Performance against selected best practice criteria is set out in Table 12

*Table 12: Performance against Best Practice Criteria: The University of Queensland*

<table>
<thead>
<tr>
<th><strong>Criterion</strong></th>
<th><strong>Performance</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Technical soundness</td>
<td>UQ has maintained a high level of flexibility without excessive risk. Management of all external relationships is very professional and adequately researched.</td>
</tr>
<tr>
<td>Administrative practicality and cost</td>
<td>Two channels are open, the Research Office and UniQuest, with an arbitrator clearinghouse. Good people relationships make this work well, now.</td>
</tr>
<tr>
<td>Acceptability</td>
<td>Evident commitment from the VC and willingness to invest University funds in new developments. Still some individual researcher conservative attitudes and some usual concerns about those who run University companies, but generally high level of acceptability.</td>
</tr>
<tr>
<td>Research user involvement</td>
<td>The success of the centres, groups and spin-off companies derives from such involvement.</td>
</tr>
<tr>
<td>Originality and general utility</td>
<td>High-risk strategy to develop a portfolio of venture capital supported commercialisation and the ‘business angel’ and University funding to bridge the gap to early stage venture capital.</td>
</tr>
</tbody>
</table>
Interviews and Contacts at The University of Queensland

Professor Paul Greenfield  Deputy Vice-Chancellor (Research)

UniQuest Pty Ltd:
Dr David Evans  Managing Director
Ian Crebbin  General Manager, Operations
Cheryl McCaffery  Business Development Manager, Life Sciences
Philip Mendes  Adviser on Technology Law
Ray Gannon  Director, Glass Centre

University:
Professor Alan Luke  Graduate School of Education
Professor Art Schulman  Graduate Business School
Professor Ian D R Mackinnon  Centre for Advanced Microscopy and Microanalysis and Advanced Ceramic Development

Professor David Doddrell  Centre for Magnetic Resonance
David Barbagello  Distributed Systems Technology Centre
Dr Robert Hendy  Managing Director, CiTR Pty Ltd
Professor Peter Andrew  Centre for Drug Design and Development
Professor Tim Napier-Munn  Julius Kruttschnitt Mineral Research Centre.
The University of Newcastle

The review of the University of Newcastle took place on 19 and 20 May 1998. A list of people interviewed is included at the end of the review. Research users interviewed are listed in Appendix 6.

Organisational Structure and Research Strategy

The University of Newcastle was established in 1965. In the early 1990s, the University amalgamated with the Hunter Institute of Technology. The University of Newcastle’s strategic objective is to be the leading regional University by offering a comprehensive range of courses for Hunter Region people.

The University of Newcastle has four strong research faculties:

- engineering;
- medicine;
- science; and
- education.

In addition to this, there is a growing level of research publications in arts, sciences, economics and commerce.

The University of Newcastle has a target of achieving a higher degree enrolment rate equal to five per cent of the funded student load.

The areas of research are basically driven by individual members of the academic staff, whilst at the same time recognising the overall objectives of the University and the characteristics of the Hunter Region for example the importance of the coal mining industry. Research is concentrated in:

- three Special Research Centres, for example, Centre for Integrated Dynamics and Control;
- 10 other research centres, for example, Employment Studies Centre; and
- three CRCs, for example, CRC for Black Coal Utilisation.

Overall, The University of Newcastle claims it has approximately 50 research areas with an international reputation.

The organisational structure as it affects research commercialisation is shown in Figure 7.
Figure 7: University of Newcastle Organisational Charts

Deputy Vice-Chancellor (Research)  
Professor Ron McDonald

Research Support Units  
TUNRA  
Research Branch

Management of Research

Council

Vice-Chancellor

Deputy Vice-Chancellor (Research)

Faculties

Research Management Committee

Human Research Ethics Committee

Animal Care & Ethics Committee

Occupational Health & Safety Committee

Faculty Research Committees

Higher Research Degrees Committee

Faculty Ethics Committee

Academic Senate

Committee Structure Relating to Research
The Research Management Committee is the principal research committee in the University. It is chaired by the Deputy Vice-Chancellor (Research), and reports on funding matters to the Vice-Chancellor and on policy matters to the Vice-Chancellor and Academic Senate. It takes advice and recommendations from faculty research committees. The Research Higher Degrees Committee provides policy advice and decisions on individuals’ cases arising from research Masters and PhD degrees and research scholarships.

**Technology Transfer and Research Commercialisation Strategies**

The University of Newcastle has five basic technology transfer and research commercialisation strategic activity areas:

- collaborative R&D;
- licensing of intellectual property;
- consultancies;
- establishment of business divisions of the University company TUNRA; and
- establishment of spin-off companies.

The Research Branch manages the first of these strategies. The other strategies are managed by the University company, The University of Newcastle Research Associates Limited (TUNRA). TUNRA is a company limited by guarantee which is separate to, but associated with, the University. The respective roles of TUNRA and the Research Branch are shown in Figure 7 above.

**Performance Measures**

The University of Newcastle performance against possible performance measures is summarised in Table 13 below.
### Table 13: Performance Measures for The University of Newcastle

<table>
<thead>
<tr>
<th>Performance Measures</th>
<th>Year</th>
<th>Performance</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Category 3 Industry and Other Funding (excluding funding from syndicated R&amp;D and from donations, bequests and foundations)</td>
<td>1994</td>
<td>$3 795 197</td>
</tr>
<tr>
<td></td>
<td>1995</td>
<td>$3 772 849</td>
</tr>
<tr>
<td>2. Per cent (excluding funding from syndication, donations, etc) of Total Research Income</td>
<td>1994</td>
<td>23 per cent</td>
</tr>
<tr>
<td></td>
<td>1995</td>
<td>19 per cent</td>
</tr>
<tr>
<td>3. Collaborative Research Grants</td>
<td>1995</td>
<td>$114 000</td>
</tr>
<tr>
<td></td>
<td>1996</td>
<td>$135 000</td>
</tr>
<tr>
<td>4. Postgraduate students</td>
<td>1997</td>
<td>Masters</td>
</tr>
<tr>
<td></td>
<td></td>
<td>PhDs</td>
</tr>
<tr>
<td>- APA</td>
<td></td>
<td>8</td>
</tr>
<tr>
<td>- APA(I)</td>
<td></td>
<td>13</td>
</tr>
<tr>
<td>- Other research user funded</td>
<td></td>
<td>9</td>
</tr>
<tr>
<td>5. University consultancies</td>
<td>1996</td>
<td>$4 491 380</td>
</tr>
<tr>
<td></td>
<td>1997</td>
<td>$4 390 286</td>
</tr>
<tr>
<td>6. Patents</td>
<td>1998</td>
<td>9</td>
</tr>
<tr>
<td>7. Royalties and license fees</td>
<td>1996</td>
<td>$41 112</td>
</tr>
<tr>
<td></td>
<td>1997</td>
<td>$338 694</td>
</tr>
<tr>
<td>8. Spin-off companies</td>
<td>Active</td>
<td>2</td>
</tr>
</tbody>
</table>

### Relations with External Research Users

**Consultancies**

The University of Newcastle policy on consultancies makes a proper and clear distinction between University supported consultancies and those where the staff member acts as a private agent. There is clearly concern that not all private agent consultancies comply with rules about use of University letterhead and could therefore put the University at risk in terms of professional and other liabilities. Steps have been taken to address this problem. Academic staff are encouraged to use TUNRA, but if they wish to operate as private consultants they are not forced to work through TUNRA.
Key policy issues are:

- Staff may spend on average one day per week on external activities, including consulting.
- University supported consultancies are carried out through TUNRA.
- Consultancy revenue is distributed as follows:
  - TUNRA management fee 10.0 per cent
  - contribution to Scholarships Fund 2.5 per cent
  - staff member, department or centre 87.5 per cent
(split by negotiation)

Retainers

Although several academic staff are directors of outside organisations, no staff who received retainers (as opposed to fees for specific consultancies) from outside research users were identified.

Management of Intellectual Property

The University of Newcastle IP policy document sets out IP management responsibilities and the roles of the faculty Dean, Deputy Vice-Chancellor (Research), Research Branch and TUNRA. The University’s basic policy is to file for provisional patents/PCT whilst the inventor (also TUNRA) looks for a commercial partner. Normally the University will only make a final patent application if there is an agreement with a commercial partner. Advice on patenting strategy is provided to the Deputy Vice-Chancellor (Research) by TUNRA and its consultant patent attorneys.

Patents

There is no clear patent policy as part of The University of Newcastle staff employment conditions. The IP policy is binding on staff members by resolution of Council. The current IP policy document provides for net IP income to be distributed as follows:

- Researcher/research account 50 per cent
- Faculty 25 per cent
- University 25 per cent

The University of Newcastle’s patent portfolio is managed by TUNRA.
Copyright

The University of Newcastle claims copyright but cedes the copyright to indicated staff members. If the University commissions the work, then it owns the copyright. This area of IP is managed by the Office of the Deputy Vice-Chancellor (Research).

Accumulated Know-how

The University of Newcastle does not appear to have any policy regarding external use of accumulated know-how but encourages staff involvement in consultancies which use their know-how.

Students

Students normally own the copyright to their theses but the University can claim the IP. This area of IP is managed by the Research Branch.

Visitors

The University of Newcastle does not appear to have any policy regarding visiting academic staff.

Innovation Starter Scheme

The University plans to introduce an innovation starter scheme and will put up to $10 000 into promising projects, provided there is a matching grant from industry.

Blockages and Barriers

The Research Office and TUNRA have been reasonably effective in raising the profile of commercialisation and the protection of intellectual property.
The academic staff who were interviewed had by definition some sort of commercial connection, and expressed the view that the commercialisation of research was accepted somewhat reluctantly and that, in terms of promotional opportunities, a very strong commercial image may even be a disadvantage.

There seemed to be an expectation, possibly unrealistic, that the Research Office or TUNRA would have a larger role in facilitating or arranging commercial contacts. The policy in regard to the distribution of government research funds (which varies between faculties and departments) whereby no advantage accrues from obtaining outside grants or contracts is a point of friction.

Performance against Best Practice Criteria

Performance against selected best practice criteria is shown in Table 14.

Table 14: Performance against Best Practice Criteria: The University of Newcastle

<table>
<thead>
<tr>
<th>Criterion</th>
<th>Performance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Technical soundness</td>
<td>Strategy working for TUNRA in consultancies and licensing IP. CRCs in early stages, Creation of new spin-off companies depends on entrepreneurial attitudes of researchers.</td>
</tr>
<tr>
<td>Administrative practicality and cost</td>
<td>Practical and low cost, but TUNRA may be under-resourced.</td>
</tr>
<tr>
<td>Acceptability</td>
<td>Strong support for commercialisation from senior people. Limited but growing support from academics, many of whom see pure research as more important.</td>
</tr>
<tr>
<td>Research user involvement</td>
<td>Users appear to communicate primarily via TUNRA. User interviews suggest that these arrangements are effective! In medical areas, more care in partner selection was required.</td>
</tr>
<tr>
<td>Originality and general utility</td>
<td>Good professional implementation of University company standard approaches to contracts; IP management and business development.</td>
</tr>
</tbody>
</table>
### Interviews and Contacts at The University of Newcastle

<table>
<thead>
<tr>
<th>Name</th>
<th>Position/Department</th>
</tr>
</thead>
<tbody>
<tr>
<td>Professor Ron McDonald</td>
<td>Deputy Vice-Chancellor (Research)</td>
</tr>
<tr>
<td>Dr Soozy Smith</td>
<td>CEO, TUNRA</td>
</tr>
<tr>
<td>Mr Peter Fanley</td>
<td>Director, Research Branch</td>
</tr>
<tr>
<td>Professor John Chambers</td>
<td>Department of Mechanical Engineering (Director, TUNRA Bulk Solids)</td>
</tr>
<tr>
<td>Professor Graeme Jameson</td>
<td>Department of Chemical Engineering (Director, Jetflote)</td>
</tr>
<tr>
<td>Professor Terry Wall</td>
<td>Department of Chemical Engineering (Deputy Executive Director, CRC for Black Coal Utilisation)</td>
</tr>
<tr>
<td>Professor Roger Smith</td>
<td>Department of Maternal Health</td>
</tr>
<tr>
<td>Associate Professor Roy Green</td>
<td>Department of Economics (Director, Employment Studies Centre)</td>
</tr>
<tr>
<td>Associate Professor Graeme McIntyre</td>
<td>Department of Environmental Science</td>
</tr>
<tr>
<td>Associate Professor Rick Middleton</td>
<td>Department of Electrical and Computer Engineering (TUNRA CICS Automation)</td>
</tr>
<tr>
<td>Associate Professor Tim Roberts</td>
<td>Department of Biological Sciences</td>
</tr>
<tr>
<td>Associate Professor John Rostas</td>
<td>Department of Biochemistry</td>
</tr>
<tr>
<td>Dr Hugh Dunstan</td>
<td>Department of Biological Sciences</td>
</tr>
<tr>
<td>Dr David Kay</td>
<td>CRC for Marsupial Conservation and Management</td>
</tr>
<tr>
<td>Dr Bruce Penfold</td>
<td>Department of Electrical and Computer Engineering</td>
</tr>
</tbody>
</table>
Charles Sturt University

The review of Charles Sturt University (CSU) took place on 20 and 21 May 1998. The review involved discussions with CSU staff at two of the five campuses, Bathurst and Wagga Wagga. University people interviewed are shown at the end of the review. Research users interviewed are listed in Appendix 6.

Background

Two institutions, Mitchell CAE and the Riverina-Murray Institute of Higher Education, combined in 1989 to establish CSU. In its mission statement CSU notes that it will ‘conduct high quality research of regional significance and international distinction’. As CSU has been developing its research activities it has focused on a limited range. There are:

- four designated research centres that are supported by the University (the work of three of the centres relates particularly to the region);
- three designated research groups; and
- three CRCs, all of which have an agricultural or rural focus and all of which have national significance.

Professional research centres covering the wine and grape industry, rural health, psychology services and information studies are located in faculties but include research together with other activities.

Organisation Structure and Research Strategy

The Deputy Vice-Chancellor (Academic) has responsibility for:

- academic development;
- research development;
- research higher degrees; and
- outside professional activities.

The six faculties and four research centre directors of the University report to the Deputy Vice-Chancellor (Academic).

The strategic imperative for CSU has been to create one institution with common and accepted systems and procedures out of its two constituent institutions with their disparate cultures and recent histories. As part of this
process, new terms and conditions relating to academics’ external earnings and ways of managing outside professional work and intellectual property were promulgated in December 1997. The preamble notes that the special skills of the CSU should be available to the wider community and in particular the regions served by CSU. The policies have been developed to encourage outside work whilst protecting the individual against liability.

The new outside policy requires that all outside professional work be undertaken through the University or as an agent of the University. All outside work must be approved by the heads of school, who are responsible for the balance of effort of their staff, including research, teaching, community service and professional practice. The old policy of allowing 20 per cent of staff time for such activities has been removed. Before this policy was introduced, private consulting was possible without CSU involvement and the rules seemed to vary between the faculties.

The new policy is bringing activities back within the University and some are becoming small businesses, for example the Psychological Services Centre and the Regional Economic Research Unit. Potential is seen in legal, health and social work activities.

While the policy allows for private consulting on the recommendation of the head of school and subject to the approval of the Vice-Chancellor, staff do not expect that much private consulting will take place.

These policy changes have removed the right for academic staff members to spend 20 per cent of their time on research and consulting activities and have imposed an up front levy of 10 per cent on all approved outside consultancy earnings (as a contribution to infrastructure) with 50 per cent of the profit also being shared between the University and faculty. These changes put CSU at the ‘control’ end of the control/flexibility spectrum and have generated two quite different responses:

- staff, who had been active in consultancies and contract research, asked whether it was still worthwhile pursuing such opportunities; and
- staff, who were more focused on achieving excellence in research and less on immediate external commercialisation, welcomed the resultant flow of funds to the University which may allow better opportunities to reward excellence in research.

There appears to be a dilemma about whether these new policies are in fact supporting or inhibiting external fundraising through technology transfer and research commercialisation. Equally, there is the question whether imposing such a high level of control on even small private agent consultancies may tend to drive these ‘underground’.
Also, centralisation of the research contract approval process will require adequate resources in the Office for Research and Graduate Studies and its contracts section. Approval for consultancies is sought from the head of school.

All contracts are prepared by the Contracts Officer in the Office for Research and Graduate Studies. A standard contract has proved suitable for most outside professional activities and consulting, whilst providing the basis for more complex negotiations with research contracts.

CSU uses an in-house legal person to finalise contracts, and seeks advice from outside sources on commercialisation and more complex contracts. There is some concern over the limited experience of the contracts staff, especially in negotiating research contracts.

Technology Transfer and Research Commercialisation Strategies

As a young university, CSU has encouraged many of its staff to earn higher degrees, which reduces time available for research and consulting. However, the research activities are growing as noted in Table 15.

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Research Income $m</td>
<td>1.1</td>
<td>1.6</td>
<td>1.5</td>
<td>1.9</td>
<td>2.5</td>
<td>2.8</td>
<td>N/A</td>
</tr>
<tr>
<td>Higher Degree Students</td>
<td>N/A</td>
<td>N/A</td>
<td>158</td>
<td>198</td>
<td>208</td>
<td>225</td>
<td>268</td>
</tr>
</tbody>
</table>

CSU has a number of technology transfer and research commercialisation strategies relating to:

- consultancies;
- contract research;
- collaborative research;
- professional practice;
- testing services; and
- other commercialisation arrangements.
The testing services include situations where CSU facilities plus selectively purchased equipment are used for commercial work. They generate a cash flow to support research and make available additional equipment (not otherwise available) for University purposes.

Performance Measures

Available data on performance measures are shown in Table 16.

<table>
<thead>
<tr>
<th>Performance Measures</th>
<th>Year</th>
<th>Performance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Category 3 Industry and Other Funding (excluding funding from syndicated R&amp;D and from donations, bequests and foundations)</td>
<td>1994</td>
<td>$167,536</td>
</tr>
<tr>
<td></td>
<td>1995</td>
<td>$157,643</td>
</tr>
<tr>
<td>Per cent (excluding funding from syndication, donations, etc) of Total Research Income</td>
<td>1994</td>
<td>11 per cent</td>
</tr>
<tr>
<td></td>
<td>1995</td>
<td>8 per cent</td>
</tr>
</tbody>
</table>

Postgraduate Students

The total number of postgraduate students, including staff and those privately funded, is now 290. The analysis of APA and industry funded students is shown in Table 17.

<table>
<thead>
<tr>
<th>Category</th>
<th>1997 New</th>
<th>1997 Continuing</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Masters</td>
<td>PhD</td>
</tr>
<tr>
<td>APA</td>
<td></td>
<td></td>
</tr>
<tr>
<td>APA(I)</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Other University</td>
<td>3</td>
<td>5</td>
</tr>
</tbody>
</table>

Table 17: Postgraduate Students: Charles Sturt University.
Relations with External Research Users

An interesting initiative was a one-year secondment of a senior lecturer in marketing from the School of Marketing and Business to assist three of the research centres on health sciences and social sciences to find outside partners in order to apply for SPIRT grants. The person selected had worked in business and also had a background in research that made her credible to the researchers involved.

Apart from this example, it is up to researchers to identify potential research users and to build relationships. Hosting industry groups at workshops and conferences at CSU creates opportunities. There is limited industry liaison and communication and it will need to be increased over time.

Research Contracts

Contract research and collaborative research projects need to be approved by the Deputy Vice-Chancellor (Academic) rather than by heads of schools. Through the various research centres and activities there are good examples of research projects benefiting the region and projects where different research functions work together.

There are also instances of testing and consulting leading to research contracts, as in animal science.

Consulting

Consulting, research based consulting, other research contracts and other professional activities include a high degree of training and short courses. With the new policy, the head of school controls the volume of such activities to ensure that the core business of teaching continues successfully. It is possible for staff to buy out teaching time in order to undertake more work in consulting, research and professional practice. However, at the extreme, this may create problems of equity between staff.

Consulting income is allocated as follows:

- of the total consulting income including expenses, 10 per cent goes to the University for overheads;
- expenses and the staff members’ salaries are then paid; and
- the balance is divided between the academic 50 per cent, faculty 25 per cent and the University 25 per cent.
Accumulated Know-how

As in other fields, accumulated know-how develops in rural pursuits and can be the basis for further study and for communication with industry. Some agricultural R&D bodies seek to retain the IP whilst others are keen for it to be communicated to benefit the industry as soon as possible.

Management of Intellectual Property

IP includes copyrights and patents and is managed through the Office for Research and Graduate Studies. The Commercialisation Officer refers possible patents to a committee and develops a plan to exploit them as appropriate.

The IP policy notes that CSU owns all IP that is created by an employee of the University. Students own IP from their work unless it has involved input from CSU staff or pre-existing CSU IP. Students may waive their rights to IP in order to work on specific projects. In such cases the students need independent legal advice but are reluctant to pay for it.

At present there does not appear to be any mention of IP developed by visitors to CSU. This should be included in the policy.

Entrepreneurship Opportunities

The heavy emphasis on teaching and the disciplinary mix at CSU, with no engineering activities, probably make it less likely that such an institution will generate a significant number of spin-off or start-up companies with global market potential. There are, however, several activity areas where this might be possible:

- veterinary chemicals;
- spatial analysis to support cropping and agronomic and other land use activities; and
- software to support 3D tourist information delivery at locations such as Jenolan Caves, and to support environmental information and Geographic Information Systems (GIS) hydrology models.

This points to the need to consider how to generate in final year undergraduate and in postgraduate students a greater interest in, and commitment to, entrepreneurship and starting their own businesses.
It will also involve working with regional bodies to provide access to, and interaction with, innovation centres such as the one at Parkes.

CSU is planning to provide workshops for graduates in IP and project management, negotiation and conflict of interest. Postgraduate students in several faculties participate in an annual seminar that includes similar activities. There is also an annual seminar for postdoctoral research fellows to present their research to a panel of peers, supervisors and commercial staff.

All these activities provide an opportunity to promote commercialisation and the benefits that can be generated.

**External Inputs**

Research Centres have advisory boards. These provide an opportunity for interested outsiders to contribute to the process. Research users have a distinct role in the activities of consulting and research projects.

**Drivers**

The development of research and commercialisation seems to be driven by the enthusiasm of the researchers and the positive response from industry in the region and elsewhere.

There is good support from the top of CSU and from the faculty research committees and a sense of responsibility to build on the launching pads provided.

**Blockages and Barriers**

The University's high level of control on consulting and outside professional activities may be a disincentive. There is a need for more extensive industry liaison.

The separation of campuses produces problems with reduced interaction and differing cultures and generates additional workloads.
Performance against Best Practice Criteria

Performance against selected best practice criteria is shown in Table 18.

Table 18: Performance against Best Practice Criteria: Charles Sturt University

<table>
<thead>
<tr>
<th>Criterion</th>
<th>Performance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Technical soundness</td>
<td>Systems in place for IP management and research commercialisation. Involvement in three CRCs.</td>
</tr>
<tr>
<td>Administrative practicality and cost</td>
<td>Support comes from the Office of Research and Graduate Studies. Some concerns expressed over approval delays in external contract approvals.</td>
</tr>
<tr>
<td>Acceptability</td>
<td>Higher than normal percentage of external earnings appears to be retained by the University. CSU's own review suggests that staff per cent share is generous. Increased control over external activities could be a disincentive.</td>
</tr>
<tr>
<td>Research user involvement</td>
<td>Good research user involvement for projects examined. Users are on some advisory boards. Strong local community commitment.</td>
</tr>
<tr>
<td>Originality and general utility</td>
<td>Research relatively has a smaller role at CSU, but it appears to be well integrated with teaching. The Wine and Grape Centre is a good example.</td>
</tr>
</tbody>
</table>
Interviews and Contacts at Charles Sturt University

Professor Kathleen Bowmer
David Agnew
Luciano Mesiti
Mrs Jennifer Bostock
Associate Professor
Martin Sillence

Professor Geoff Scollery
Professor Bob Doyle
Dr Margaret Alston
Dr Frank Vanclay
Siti Amri
Brian Leis

David Meecham
Professor Jim Pratley
Tom Murphy
Greg Walker
Robyn Vines
Dr Johannes Baler
Dr Alexander Herr
Professor Terry Bossomaier

Deborah Lupton
Associate Professor
Warwick Blood

Deputy Vice-Chancellor (Academic)
Director, Office for Research and Graduate Studies
President Postgraduate Student Club
Postgraduate Student Adviser
Animal Science Unit
National Wine and Grape Centre
Centre for Rural Social Research
Spatial Analysis Unit
Professional Education Manager, Continuing Professional Education Centre
Director of Research and Consultancy
Farrer Centre
Rural Economic Research Unit
Psychological Services Centre
Johnstone Centre and Environment Studies Unit
School of Information Technology and Mathematics
Centre for Cultural Risk & Business School
School of Communications
1.8

Issues from University and Research User Data Collection

The project brief (Appendix 1) identifies a number of specific issues on which the study should comment. To these have been added the study’s findings in relation to drivers, barriers and constraints to research commercialisation.

Mechanisms for Technology Transfer and Commercialisation

The most important technology transfer channel is the employment of new graduates, particularly those with honours or higher research degrees. Collaborative research programs, such as SPIRT and the CRC program, have stimulated the demand for people with higher degrees by research and experience of working with industry. Importantly, much of this demand has come from industry sectors that have had no past tradition of employing people with higher degrees. Interesting examples are composite structures for aircraft and upstream petroleum. The next most important channels are academic researcher involvement in professional continuing education and in conferences involving research users. For technology transfer to low-tech industries, access to scientifically literate intermediaries is essential. The role and needs of such intermediaries have been examined in recent HRDC funded studies in the Australian citrus industry (Yencken 1997, 1998).

The reviews have shown that, after new graduate employment, consultancies and contract research have traditionally played the largest role in technology transfer and university research commercialisation, particularly for process innovation in sectors such as mining, mineral processing, chemicals, plastics and engineering. Universities with engineering schools generally have a long history of involvement in such innovation. Some of them are now starting to develop more formal marketing initiatives to help them to increase their funds generation through consultancies and research contracts. Engineering academic researchers are by the nature of their training more aware of contractual risks and how these need to be managed. Uncontrolled consultancies involving other disciplines appear to pose more serious professional liability risks to universities. All such activities are subject to competitive neutrality legislation.
Licensing of intellectual property is the most common mechanism in product innovation where a discrete product or new technology is involved, but new industrial processes can also be patented. IP licensing (and therefore IP protection and management) is central to new technology and product commercialisation in the high growth and highly and globally competitive bioscience, medical and information technology sectors. As a result of a series of initiatives from government and other agencies, effective university IP policies and practices are, as discussed later, generally in place. Over the last 20 years, commercialisation support services in the larger universities have developed considerable competence in the management of such licensing arrangements. Smaller institutions have more problems in funding the critical mass of disparate skills needed for such support and management. All universities are developing close relationships with specialist legal professionals.

The reviews showed many examples of the successful establishment of spin-off companies with various levels of university equity ownership. However, an American executive closely involved with a CRC commented at the 1997 CRC Association meeting that the only real difference between Australian and good US universities was the lack of commitment to entrepreneurship in Australia. Only a few local academic institutions have started to commit themselves to significant new venture creation and entrepreneurship development initiatives as the core of their research commercialisation strategies. Overseas experience suggests that such a strategy will generate a higher multiplier for university IP value than licensing and just royalties. It will also help to keep in Australia the technology development stage and early stage manufacture that otherwise might be done overseas by a multinational licensee—provided that the gap funding for this is available from ‘business angels’, university company retained earnings or other local sources.

Finally, successful commercialisation by whatever channel requires a lot of hard work by the ‘inventors’. The research infrastructure has to be in place—the reviews clearly showed the value of various ARC infrastructure funding mechanisms—and there has to be a champion who has credibility with the end users and understands their needs and expectations.

Customer Overview of Effectiveness of Current Policies and Practices

The interviews with research users showed many users are very satisfied with their university research partners. However, the executives from larger organisations with longer histories of dealing with several universities and many collaborative research projects showed serious concerns about the variations in performance, both between and within individual institutions.
The most serious concerns relate to delays and uncertainties when the negotiations involve university commercialisation support agencies or companies or, even worse, when decisions—for example, on new spin-off company formations—have to wait on approvals from governing bodies that meet infrequently.

The Mann success factors, as outlined above in Chapter 1.4, Australian Environment section, were tested in these interviews. Good researchers were most important in the medical and biosciences, but for all groups—and particularly for people working in commercialisation support services—understanding the other partner’s needs and expectations, including how they valued IP, was critical. The research customer wanted to be able to deal directly with the research provider. The support service provider has to help expedite this relationship, acting as a consultant/coach rather than as a project manager.

**Current University Intellectual Property Policies**

Monotti (1997), under an ongoing ARC Large Grant, has reviewed university IP policies and published an excellent review of the important legal issues. No attempt has been made in this study to duplicate this detailed review; rather the findings of the Monotti review have been used to identify where and how IP ownership and management policies and practices might be improved.

The preliminary university survey confirmed that all responding universities had in place well-developed IP policies and practices in relation to IP ownership for university employees. Almost all had policies in relation to postgraduate students. Few universities had formal arrangements on IP ownership with undergraduate students or visitors. The visitor question is important as, in the absence of formal contracts, any new IP generated by visitors may be owned by their normal employer rather than by the university that they are visiting.

There was considerable variation in policies and practices for sharing of any IP derived benefits between the ‘inventors’, the department or centre and the university. The only common point was that students and staff should have similar equity in such benefits. Almost all universities favoured a simple percentage sharing of net benefits after all costs rather than the more complicated Cambridge formula suggested by the AVCC.

**Academic Staff and Other University Employees**

In almost all universities employees are allowed to retain ownership of their publications unless these are university-specific course material or have
been commissioned specifically by the university. There are two contentious issues that individual institutions need to resolve:

- ownership of software copyright: policies and practices vary widely between institutions from full employee retention of ownership to full university ownership or, in the worst case, lack of definition of ownership; and

- uncertainty about ownership of IP generated by university employees off campus and/or outside normal working hours: Monotti (1997) has shown that this cannot be covered by a university policy edict, but must be specifically set out in any contract of employment.

Students

The most common arrangement was to recognise student ownership of IP and make individual contract arrangements to vest IP in the university or some other party only where this was required by specific research contracts or IP licensing arrangements. Generally, both in universities and in CRCs associated with universities, there was a preference not to involve students in contract research requiring high levels of confidentiality, to avoid problems of delayed approval for theses and other publications.

Monotti has identified what are potentially critical weaknesses in contractual arrangements on IP ownership vesting and transfer to the university or other agencies.

- The issue of coercion: was the student told that he had to sign the agreement and was he offered an alternative project that did not require transfer of IP rights?

- Independent legal advice: was the student advised to obtain independent legal advice before signing? If so, who might be available to provide such advice and who would be responsible for paying for it?

Monotti suggests that evidence of coercion and/or lack of advice to get an independent legal opinion might invalidate student transfers of their IP ownership rights. This is not only an important issue for universities. It is critical for agencies such as CRCs that rely on universities having legally valid procedures for the vesting of student IP rights. It is even more critical in research contracts and licensing agreements with external commercial parties, whose due diligence might throw up uncertainties about the legally valid ownership of the IP that they are buying or licensing. Commercial entities treat uncertainty about underlying IP ownership with great concern. This concern may lead to lengthy and expensive negotiation and, if unresolved, can result in the potential licensee walking away from the contract.
Implications for Research Training

The evidence from the university reviews is that involvement of university researchers in the commercialisation of their research generally has a very positive impact on postgraduate student research training. The positive impact is greatest where students have a high likelihood of later working in industry—and hence benefit from being employment ready—rather than following academic careers. The impact is less where the student is solely motivated by the opportunity to do basic research at the start of an academic career.

There are, however, many research contract or commercialisation projects where university departments prefer not to involve students because of client confidentiality issues and risks of excessive delays on publications, particularly on theses. Four years ago in CRC reviews these were major issues relating to education. More recently CRC directors have learnt to manage these issues. As a result, more students are involved in such projects and few students complain about publication delays. Minor editing changes can often overcome disclosure risks without affecting the value of the publication to the student in his career development.

The advantages to research training from university TT&C involvement (including CRCs) include:

- finding real world problems needing more basic research solutions, but still addressing industry priorities;
- better student access to equipment and research infrastructure;
- working in a team, establishing networks, and better access to other researchers for advice and help with problems;
- having associate supervisors (sometimes several) from outside the industry (for example, CSIRO, DSTO, AGSO, industry and other research users);
- opportunities to work with industry people and on projects within industry, leading to a better understanding of research user cultures and needs and to employment opportunities;
- learning opportunities on leadership, IP and commercially relevant topics; and
- training in industrial health and safety, quality assurance including laboratory notebook recording, research costs and project costing, and project management disciplines, including planning; regular reporting and meeting timelines.

Not all of these advantages, as indicated earlier, will be equally important to all students.
The disadvantages of research supervisors being involved in external commercial relationship do not differ greatly from those of a supervisor having too many students to supervise for a range of reasons. The quality of supervision can be inadequate whether the research is pure or applied. Research users expressed concern that very often senior academics, often those with high international reputations, took on too many external contracts, used students to carry these out, but were unable to devote enough time for effective leadership of the individual projects. This is a matter for the university’s internal management and supervisor quality assurance processes, but can result from uncontrolled encouragement of external funds’ generation and distraction by tangential issues.

The other potentially adverse impact is that availability of additional funding for postgraduate students as a result of CRCs or other external relationships may result in loss of research quality and challenge in the PhD projects selected. This is a particular risk that has been recognised in the CRC program. Once again, this is a matter for a university’s internal quality assurance. The university, not the CRC, approves postgraduate student projects.

Additional Learning Opportunities

An important issue at most reviews of CRCs has been innovation in research training. While there has been some limited support for heavy US-style course content in PhD programs, there is a more universally recognised need for access to semester length specific technology top-up courses where students do not have access to relevant undergraduate courses. Resistance to introducing more formal course work derives from inroads it may make into the three years normally available for a PhD research award.

Generally, adequate attention is given to oral and written presentation skills. The additional needs have been for learning opportunities in project and technology management, in IP related subjects, in commercialisation practices and in leadership. In a recent CRC review, 14 out of 15 postgraduate students interviewed indicated that they wanted to learn more about commercialisation practices. There is considerable scope for extending these CRC initiated practices across the postgraduate student body. This has been recognised in many universities in research student induction programs. The evidence is that these can be improved.
Drivers, Blockages and Constraints

Drivers

The primary driver for involvement in research commercialisation and technology transfer identified in the institutional reviews was money: both money to sustain department or centre activities that are not fully supported from core block grants or other university funding, and money to supplement academic salaries or to fund travel and individual researcher equipment and other support needs.

The secondary drivers are:

- wanting to put research outcomes to productive use or otherwise to achieve benefits for the outside community (a key driver also identified in a recent CSIRO internal survey);
- seeing an outside opportunity and having a solution to offer;
- identifying areas in industry where basic research can contribute, that is, catalysing changes in research direction;
- contributing to the public good, for example, in health or in environmental management; and
- finding a new challenge.

In addition, the university reviews show that, for many researchers, doing postgraduate or postdoctoral work in a US university had created an understanding of US reward systems and an awareness of the potential benefits from the commercial application of their research outcomes.

There are also a number of necessary conditions for the development of a successful external relationship leading to TT&C:

- the research infrastructure and necessary equipment have to be seen to be in place; this cannot wait until the contract is signed. The previous ARC Mechanisms A, B and C were very important in this context for many of the researchers interviewed during the reviews;
- the researcher must establish credibility with the potential external customer. Having available good researchers with international standing is thus very important;
- researchers must understand the users' expectations and see an opportunity, that is, a need or problem for which they have or can provide a solution; and
- a champion who has the commitment and skills to get the project off the ground must be available inside or outside the university.
A lot of hard work is needed to find and maintain successful external relationships; potential customers rarely come queuing at the researcher’s door.

Blockages and Constraints

Historically the biggest blockage has been traditional academic attitudes. People interviewed in the reviews suggested that about one-third of university academics are motivated to look for external relationships with research users and entrepreneurial activities. These conservative attitudes still exist and can be reflected in university promotional criteria and core fund allocation systems that often give a much lower weighting to more applied research activities. The recent change in DEETYA Research Quantum calculations to give greater weight to earnings in Category 3 Industry and Other is therefore an important signal.

With the importance of money as a driver, too high a level of levy on consultancy services for more support cost recovery or general university purposes can be a disincentive. It may make staff reluctant to put in the effort to find external customers. The evidence from the reviews is that levies of more than 15 per cent on consultancy type earnings (excluding cost recovery for use of university facilities) generate resistance. At the same time, it is important that staff clearly understand the costs to the university that are involved, for example, hostage or liability insurance.

The next biggest constraint is time. With staffing cuts due to reduced university funding, younger staff early in their careers are fully committed with their contracted teaching and research and with the need to generate an adequate level of refereed publications to qualify for both promotion and ARC grants. There is little time for the hard work needed to develop external customer relationships. At the more senior levels, associate professor and above, the fund raising imperative is creating what are in effect part-time academics. The rest of their time is spent on external customer development. In a number of situations this has led to the creation of what are in effect marketing positions. An interesting development at one university was to obtain the funding for such a position from alumni.

The third blockage can be a high level of control in the approval of external activities combined with inadequate resourcing at the research or business liaison office levels. Delays in obtaining approvals create disincentives for the staff concerned and drive away potential customers.

Finally, the key external constraint, even if the internal blockages are removed or alleviated, is the shortage of seed funding (Technology Development gap funding) and early stage venture capital in Australia, lack of community commitment to entrepreneurship and investors’ perception of risk. Universities can no longer assume that these constraints will remove themselves. Universities themselves will have to invest selectively, preferably in partnership with commercial interests, in adding value and
reducing investor risk in the technological innovation deriving from their intellectual property.

**The Strategic Dilemma**

National benefit objectives through commercialisation do not necessarily equate to institutional benefits from increased research and other funding access. This is an ongoing issue in assessing national economic benefit in START proposal assessments and in individual CRC reviews.

The strategic dilemma for universities—and particularly for members of boards of university companies—is whether the primary objective should be to maximise the financial and other benefits to the parent institution or to maximise the benefits in terms of wealth creation and jobs to Australia and to the State in which they are located.

Maximising the short to medium term financial and increased research funding benefits to the university will lead to a primary focus on consultancies, contract research and IP licensing targeted to larger companies, particularly multinationals. Much of the technology development stage will go overseas.

Maximising the benefit to Australia or to a State will mean a focus on ensuring that the technology development stage and initial manufacturing (not just building prototypes) is carried out in Australia. This will require a much greater focus on creating new Australian ventures with global market potential, that is, UMCs or ‘up-and-coming multinational companies’.

There are limited data on the relative benefits from licensing and taking equity in spin-off companies. A recent US analysis of 23 university derived spin-off companies showed that on average the university received US$420 000 when they cashed out their equity position after the company had become publicly traded. By comparison, almost all licensing fees fell between US$10 000 and US$50 000 (Bray & Lee 1998). Individual institutions will need to make explicit choices in relation to this dilemma.

**Conditions for Success**

For the vision set out at the start of this report to become a reality, significant change will be required. Australia will need the following:

- *A society which accepts the exploitation of S&T as the key to future economic success.* There needs to be mutual respect and trust between the academic and business communities, with an understanding, a recognition and an appreciation of the differing roles of the various participants. In parallel, there is a need for community based entrepreneurial spirit. Success stories and role models need to be continuously promoted.
• *An academic community* willing and able to play a central role in Australia’s economic development, with a commitment to commercialising its research in Australia. Within this community there must be access to adequate professional and management competence and resources to support research commercialisation and new venture creation.

• *A company sector, including multinationals, both able and willing to exploit and commercialise S&T in Australia.* This will mean more companies undertaking product development and availability of the full range of technical and managerial skills required to commercialise S&T in Australia. Overall the number of companies who feel at ease working with the research community also needs to be increased. For multinationals, Australia needs to be seen as the ‘value for money’ location/source for their contract research activities.

• *A higher education system that recognises the need for student exposure to the importance of a commitment to entrepreneurship,* including the skills needed and an understanding of potential benefits and risks involved in starting their own new ventures as an alternative to looking for a job with a large company or public sector employer (including an academic career).

• *A financial community that has the ability to make money from commercialising S&T and that positively seeks out potential opportunities.* Taxation structures can be supportive but too often can be inhibiting, for example, capital gains tax and double taxing of limited partnerships.

• *A public sector giving priority to commercialising the science base through a consistent set of policies for higher education, research and industrial competitiveness.* These need to include initiatives which help bridge the various industry-academic gaps, for example, a willingness to provide financial support to the commercialisation process and applied R&D, and a willingness to link academic research funding to its exploitation and commercialisation (adapted from Scottish Enterprise 1996).

Funding for collaborative research projects with industry involvement (such as SPIRT and START) have been important and will continue to be important. These require not only access to government funding, but also the ability of universities to find appropriate industry partners.
Australia has moved a long way towards satisfying these conditions. For university communities, they form the underlying considerations that lead to considerations of best practice in TT&C. People in universities also have a wider role, through their standing as educators and intellectual leaders, to influence other sectors of the community.

While each of these communities has a distinct role, each must see itself as an integral part of the process. Each of the communities will need to be less self-contained, breaking down historical boundaries. Each must be committed to action and to improving its own contributions to the process.

*(Scottish Enterprise 1996, p. 9)*
Part 2

A Discussion of Issues and Approaches for Technology Transfer and Commercialisation Practices
2.1

Scope and Structure

Development of Issues and Approaches for Technology Transfer and Commercialisation Practices

The issues and approaches for technology transfer and commercialisation practices were derived from the literature search and the various surveys and reviews. A draft of the issues and approaches were then reviewed in a consultation workshop. The participants included university people involved in research and business liaison management, executives of university technology commercialisation companies and people with practical experience in the commercialisation of research, both in large industry and in smaller start-up companies.

The issues and approaches are primarily targeted to university administrators rather than to research users. However, they recognise the highly variable performance of universities in their external relationships with users of their research and the frequent and relatively high levels of dissatisfaction expressed in the interviews with research users. This dissatisfaction focused particularly on early contact and contract negotiation stages. At the same time there were many highly productive and mutually satisfactory relationships with large and small companies and public sector agencies.

These issues and approaches recognise both the diversity of the 37 Australian universities and the diverse nature of activities within any individual university. The first of these was illustrated simplistically by the DEET University Research and Research Quantum Category 3 Industry and Other Funding statistics shown in Appendix 3, Table 2. The second was evident in the survey of research users that indicated marked differences in practices and in user satisfaction both between institutions and between units in the same institution (Appendix 7).

It is not possible within the funding scope of the present study to recommend operational models to cover external and internal commercialisation benefits for the large number of variables, such as differing institutional cultures, differing stages of technology development, differing risk management competence and differing abilities to fund support services.
The starting point to the study was to develop notional strategic directions and objectives. The criteria were:

- to identify and draw on best practice from whatever sources local or overseas, that is, when some strategies or practices were seen to be effective (for example, the Scottish Enterprise strategic directions), they were used in these issues and approaches with modifications as appropriate; and
- to provide a checklist which individual universities, commercial arms, departments or faculties can use to assess their own performance and subsequently to improve their performance.

Best Practice is not about reinventing the wheel. It is about identifying and describing the best wheels.

Scope and Strategic Directions

The ARC project brief (Appendix 1) refers to assessing technology transfer performance and commercialisation effectiveness. To allow this, notional Australian objectives and strategies for research commercialisation derived from the Scottish enterprise strategy are presented below. The issues and approaches have been developed against these objectives. Suggested performance measures are given in Chapter 2.13 of this discussion.

The aim of the strategy is to generate employment, prosperity, industrial competitiveness and economic growth in Australia through the improved TT&C of its higher education science base. To achieve this, the strategic objectives are:

- to maximise the benefits to Australia from TT&C of university knowledge and research outcomes;
- to increase the commercialisation of the science base by companies located in Australia (as a first priority) and overseas (if commercial markets so dictate); and
- to increase the economic impact of new ventures created to exploit the science base by increasing the number that start, survive and grow.

To these three, the university’s strategic objective must be added:

- to maximise the realisable value and return to the university from its intellectual capital.

Achievement of these objectives will feed back to benefit the universities through increased income for research and returns from adding value to their intellectual property.
As indicated towards the end of Part 1 of the report (The Strategic Dilemma section), the dilemma for universities, and particularly for members of boards of university companies, is whether the strategic objective is to maximise the financial and other benefits to the parent institution or to maximise the benefits in terms of wealth and jobs to Australia and to the State in which the university is located.

A greater focus on generating new ventures, through which the university’s IP is commercialised (start-up or spin-off companies), can on the evidence from overseas and locally lead to a higher multiplier on the university’s investment in IP in the longer term. However, universities must recognise that this course of action will need more initial investment and generate greater risks in the short term. It will also require new management skills.

Individual institutions will need to recognise the above dilemma and make explicit choices to take one route (maximising university benefit) or the other (maximising national benefit).

**Strategic Directions**

To achieve the strategic objectives, the Scottish Enterprise strategy which is fully confirmed by this present Australian study recognised that action is required by individual institutions under six strategic directions. These have been adapted to create strategic directions for Australia.

1. *Create the right academic environment:*
   - Institutions and individuals within them are committed to increasing the opportunities and rewards for commercialisation.
   - Research and administration people improve their understanding of the commercialisation process and of the expectations of research users.
   - The university removes disincentives, such as core finance allocation, promotion criteria that discount external research commercialisation activity, inadequate support services.
   - The university maintains agreed and effective policies and practices on IP ownership and management.
   - The university encourages and facilitates entrepreneurship.

2. *Develop effective commercialisation support structures:*
   - Bridge the gap between academics and industry by building on existing organisations and where necessary creating new mechanisms and improving networking.
   - Ensure adequate support resources.
3. Develop and expand relationships with existing companies:
   - Increase the number of academic-industry links.
   - Improve access to university competencies.
   - Build new relationships.
   - Work hard on maintaining existing relationships.

4. Facilitate and increase the number of new spin-off companies derived from university research activities:
   - Help to increase the number of new ventures (particularly those with global market potential) based on science and technology.
   - Assist their survival and growth.

5. Strengthen the corporate base:
   - Work with government and industry organisations to increase the number of companies in Australia able to commercialise science and technology.

6. Increase the amount of finance available for the commercialisation of research and technological innovation:
   - Increase access to both private and public sector investment, particularly seed and early stage venture capital finance.

The first four of these strategic directions lie at the core of the best practice criteria from this present study. The remaining two are also most relevant. Performance in the first four directions will be important for these last two, but government policy settings, global markets and resulting financial market behaviour will be the key determinants.

These strategic directions need to be complemented by a campaign to raise awareness amongst the key players of the significance of commercialising the science base, and to increase understanding of how S&T can be commercialised more effectively.

Operating Principles

The Scottish Enterprise study identified a number of operating principles for successful research commercialisation. This present review fully endorses these. The following principles have been adapted and edited for the Australian environment:

- **Involvement must be based on participants’ own long-term interest.** The business and financial communities must be involved because the strategy enables them to make money. There must be equally tangible benefits to the academic community.
• **The necessary actions are strongly interrelated.** There is no simple or single solution.

• **Diversity must be recognised and accepted.** The process of innovation is essentially 'messy and serendipitous'. The role and contribution of individual academic institutions will vary. There is no single correct approach and institutions have differing roles and may adopt differing approaches to, for example, the exploitation of intellectual property, whether it be patents or accumulated know-how. The commercialisation process varies between industries and there are many different ways of creating and growing spin-off companies.

• **The entire commercialisation process matters.** Success occurs first when the science base is successfully exploited in Australia, but can also generate valuable feedback through overseas exploitation. There is little benefit, for example, in further strengthening the science base or generating industrially relevant research if there are no mechanisms or inadequate mechanisms for ensuring that it is commercialised.

• **Collaboration and partnerships are essential.** Different players are involved at different stages of the commercialisation process. To make it work effectively, cooperation and good working relationships are key requirements.

• **Learning is important.** There must be openness to new ideas, and a willingness to take appropriate lessons from both overseas and local experience. Success depends on getting the details of delivery right.

• **Global and local perspectives are compatible.** Both companies and universities must act in the global market. However, academia, business and the financial sector all benefit from a strong economy which in turn can strengthen their global position.

• **Existing resources must be used differently.** Implementation cannot be dependent upon additional public sector resources.

While there are many academic-industry links within Australia, too little of Australia's research is commercialised here. There is a need, for example, to ensure that not only working prototypes but also the technology development stages and early stage manufacturing stages remain in Australia.

Australia has the research competence and quality in its universities. Both academia and business believe that more can and should be done to exploit and apply these strengths. There are, however, some notable weaknesses. One is the shortage of people who can manage the technology development stage; another is the lack of gap funding (usually in the range $100,000 to $500,000) for the technology development stage. This funding is necessary to take the new technology or invention to the point at which an experienced early stage venture capitalist can make a reasonable decision on whether to invest.
Structure of the Research Commercialisation Issues and Approaches

The presentation of issues and approaches essentially follows the hierarchy of strategic directions listed above. In summary, these are:

- create the right environment;
- market effectively, create the opportunities, build relationships;
- provide excellent and cost effective support services;
- attend to intellectual property issues;
- create a strong platform to support research commercialisation and technology delivery:
  - publication and conferences,
  - education and training,
  - consultancies,
  - research contracts,
  - IP licensing,
  - spin-off companies,
  - technology parks; and
- agree and use quality assurance and performance measures.

These issues and approaches will be discussed in the following chapters.
2.2

Creating the Right Environment

Creating the right environment will involve all elements of the institution, including incorporated entities in which it has equity interests. More specifically, people with responsibility for implementing TT&C strategies need to be involved in their development and in the dialogue on policy involved in their implementation.

The issues for creating the right environment for research commercialisation and technology transfer leading to profitable commercialisation include:

1. *Evident commitment and understanding* from the Vice-Chancellor, senior officers and the institution’s governing body. This can include:
   - clear and regular statements of support;
   - commitment to entrepreneurship by staff and students (for example, Vice-Chancellor’s prizes as at the Australian Technology Park incubator at Eveleigh);
   - support for university investment in adding value to IP; and
   - willingness to collaborate with other institutions to improve critical mass of available resources, for example, through CRCs.

2. *An agreed and clearly documented university strategy* for TT&C activities with agreed performance measures, including remits or charters to entities responsible for TT&C that are both flexible and give appropriate protection to the university.

3. *Regular reporting* (at the minimum annually) on commercialisation activities, performance against performance measures, successes and benefits to individuals and to the institution.

4. *Systems for core fund allocation and academic promotion* that are at worst neutral and do not penalise applied research and externally focused commercialisation and transfer activities (for example, allocation of Research Quantum back to those who earn it).

5. *Legally sound intellectual property policies and individual agreements* with staff, students and visitors on IP rights vesting and ownership that are acceptable.

6. *Established procedures*, such as technology audits, to identify potentially valuable intellectual property.

7. *Adequate resourcing of IP management, commercialisation and external contracting support* (see Chapter 2.4).

8. *Internal training, learning opportunities and other support* for both staff and students on intellectual property and TT&C issues, including availability of mentors both internal and external (see Chapter 2.7).
9. *Maximising opportunities for working in industry and with industry people* for later year undergraduates, postgraduate students and staff on short-term secondment.

10. *An ongoing communications outreach program* to create awareness of the university’s competencies, particularly directed at local companies and larger organisations that might benefit from specific areas of university global excellence.

11. *Putting in place structures and mechanisms* (such as the University of Sydney Foundations) to involve *alumni* in facilitating external relationships and in advising and assisting with new start-up proposals (as in the Massachusetts Institute of Technology 1998 and Cornell University 1988 models).

12. *Generating a commitment to entrepreneurship:* the missing link. This requires access to business incubators and an internal and external communications program that focuses on success stories and role models.

13. *Finally, a commitment to quality assurance and management* that includes monitoring and learning from both successes and failures.

At the operational level, it is a great help to be able to give staff an up-to-date manual of TT&C related policies and procedures. An excellent example is The University of Sydney Business Liaison Office Manual produced by its Business Liaison Office (BLO 1998) and available on its website: [http://www.usyd.edu.au/su/blo](http://www.usyd.edu.au/su/blo)

### Control Versus Flexibility

An important management issue is the degree of control that is exercised by university administration over consultancies and other external relationships, that is, the balance between protecting the institution and its staff and flexibility that removes disincentives to such activities.

A related issue is the awareness and accountability of heads of schools and centres of contractual and risk management issues and whether adequate training opportunities are available to them in these areas.

### Legal and Legislative Issues

The recent focus on IP issues for Australian universities has resulted in the establishment generally of sound policies on IP ownership.

There is now a need for a better focus on the legal aspects of risk management and competitive neutrality. Risk is discussed later.
Competitive Neutrality and Project Costing

The competitive neutrality issues are central to project costing. Costing models are not discretionary. Full account of all direct and indirect costs is required. This includes provision for space costs, which also takes into account return on capital investment and adjustment to take into account any artificially advantageous tax structure. Similarly, recovery of administrative overheads must be fully demonstrated. Pricing may differ from costing, but the university then has to show a net return over all commercial activities.

Best practice involves access to detailed advice and understanding of the requirement for compliance. Such control is not discretionary. The various State Acts and regulations prescribe heavy penalties for non-compliance.

Quality Management and Assurance

The central theme in the interviews with research users was the wide variability in performance in university research contracts and commercialisation both between and within individual institutions.

Within this theme, processes of negotiation were much criticised. These criticisms point to the need for much more effective quality management and assurance by universities, with a major focus on continuous improvement. No one approach will suit all institutions. The following questions are addressed:

- Who has or should have responsibility for quality assurance in relation to external commercialisation and research contracting relationships?
- What quality outcomes require regular monitoring and assessment, for example, contract negotiation, performance against agreed timelines, quality of technology outcome, available leadership and other resources to meet external project commitments, benefits achieved for research users, repeat business and research student experience?
- How and to whom is quality performance reported?
- What initiatives are indicated to improve performance, as seen by both the external user and the university?
2.3

Marketing, Finding Opportunities and Building Relationships

One of the strategic directions identified earlier was to increase the number of existing companies with which a university has TT&C relationships. Another was to improve the capabilities of these companies to add commercial value to university research outcomes. Both of these strategic directions involve the building and maintaining of relationships. At the start there is a need to identify two different types of relationships.

The first concerns existing organisations with problems and specific research needs which are looking for solutions, even if they are not always aware of the nature of the problem. These lead to consultancies and contract research. The customer will usually take the initiative to approach selected researchers, but he cannot do this if he has no information on available competencies. At the same time, the reviews identified situations where researchers were aware of an industry problem, believed that they had or could develop a solution and proactively approached the potential research user. An example of this approach concerned the need to replace asbestos in building products. Such situations are essentially market driven.

Activities to generate interaction with these research users need to be based on established good practice for marketing professional services.

The second type of relationship involves finding licensees and/or partners for the development of new inventions and new technology involving new IP generated by research breakthroughs.

The literature survey showed that models for the commercialisation of new research discoveries are more complex than the traditional linear new product or technology adoption models that apply for market driven research in industry itself. The "inventor" will need marketing, professional and legal support, but the initiative in devoting time and effort to finding appropriate partners and technology development funding sources involves commitment, time and intellectual effort from the inventor. This will usually pose conflicts with teaching and ongoing research commitments, particularly for more junior academics still seeking to establish their academic standing and research grant performance. Inventors may think twice about jeopardising their academic career development.

It was very clear in the reviews of individual universities, as in the interviews with research users, that researcher initiatives to find commercial
partners were critical. ‘Research users do not usually come knocking on our doors.’ Success in commercialisation of research outcomes involves:

- having a champion who sees an opportunity;
- identifying the party likely to benefit from this opportunity;
- establishing the researcher’s credibility with that party; and
- getting the timing of the approach right in terms of the potential customer’s own business cycle.

An individual university needs to develop a well-coordinated, multi-level approach to building relationships. This must involve all levels, but with different roles, from governing body members, alumni, Vice-Chancellor and senior administrators, senior researchers, research offices and business liaison people.

There are four main issues:

- Public relations. How effectively does the university present its skills, competencies and accumulated know-how to people who may be potential commercial users?
- Access to competencies database. How well does a university handle an external enquiry for assistance? Is there a quick and accurate route to the person who may be able to help?
- Individual researcher initiatives. Does the university provide adequate ‘free time’ and support services to individual researchers who see an opportunity, problem or need, have a solution, and want to find an external partner to whom they can sell their solution?
- Maintenance. Do researchers understand the importance of maintaining and building on relationships? Are there adequate support services to help them with this task?

Public and Community Relations

An important element in any TT&C strategy will be defining responsibility and assigning resources for an ongoing program of communication with potential research users, particularly those in the immediate local community.

Clearly this has to complement other public relations activities in relation to teaching and research training.

Specific TT&C related activities could include:

- using a register of consultancies to maintain a database of people with whom the university is already working;
• adding to this register people with whom it would like to be working;
• keeping in touch with, and reporting progress to, these people with regular newsletters and a program of visits by the university to them and by them to the university;
• regularly reporting progress on major projects to stakeholders;
• organising and participating in conferences that involve scientifically literate industry participants;
• participating in local events and field days, for example, Science Week, Werribee Technology field day; and
• identifying and communicating with key skilled intermediaries (including equipment and other suppliers) that can be valuable interaction channels to low-tech industry for example, transport and low-tech SMEs.

Competencies Databases

Most of the universities reviewed were considering establishing competencies databases to facilitate their responses to external enquiries, as a basis for responding quickly and effectively to external enquiries for assistance and to promote their public relations activities. The database might need to include some or all of the institution’s people, research, accumulated know-how, data and equipment competencies (as seen to be relevant to potential research users). However, there was concern about the difficulties of maintaining such a database. The unresolved issue was whether this can be done by the institution alone (the University of New England is a good example) or by a group of institutions (as in Singapore or for the American Institute of Physics SPIN database in the USA). This question might be addressed at ATICCA or even by the AVCC.

Individual Researcher Initiatives

These initiatives are the key to successful TT&C. The best practice issue is to maintain the researcher motivation and reward success, while ensuring that there is adequate ‘free time’ to take on these initiatives. Once the initial contact has been established, the relationship may require the involvement of professional support people as well as the individual researcher. These support services need to be accessible and affordable.
Maintenance of Relationships

The best practice issue is improved and continuing communication between the researcher, other university people and the external research user. Lack of such communication in the past has recently been cited as just as critical as lack of venture capital:

...those organisations and companies that do hang in there and learn how to share skills and other resources find that the rewards far outstrip any individual company's fear of indecent business exposure.

(Dalling 1998, quoted in The Age, 29 June 1998, p. 2)
Support Structures

All universities have recognised the need to support their staff in their TT&C relationships with research user customers.

These support services fall into two groups with different management requirements, but are often provided by the one entity:

- staffing and managing the marketing, contractual and logistic (and sometimes manufacturing) interface needed to support individual researchers and the university and its departments in their external relationships; and

- adding value to intellectual property and supporting entrepreneurial activity.

The consultation workshop which was convened to consider the draft report identified three key issues:

- the need to recognise institutional diversity: what works well in one institution may not be the best approach in another;

- the importance of having access to a critical mass of professional, legal and management skills: this can be a problem for universities with less well-developed research profiles, particularly if there is no engineering school (which normally has very well developed and historical external relationships); and

- good relationships between the research office and the business liaison entity, whether incorporated or part of the university administration: this is a people issue.

Interviews with research users identified other issues. Senior executives of large companies were generally critical of there being too many layers of decision-making in dealing with universities. They were generally able to identify people that they wanted to work with and then wanted to be able to negotiate directly with them or their head of department. They recognised the need for their contacts and heads of department to have access to contractual and legal support services and they generally supported the availability of standard agreements as the starting point for negotiations.

With some exceptions, they saw liaison offices and university companies as adding complexity and cost rather than value in such negotiations. Those who had been involved with new start-up companies with university equity were all critical of the delays involved when ultimate approval had to be given by a governing body that met infrequently.
Marketing, Contractual and Logistic Support

These support needs involve the provision and management of a high quality marketing, training, contractual, logistic and even manufacturing interface between academia and outside research users. As indicated earlier, having access to a critical mass of such support people is vital. Functions can include some or all of the following:

- marketing university competencies, including managing competency databases, and particularly identifying collaboration partners for SPIRT and START grant applications;
- awareness creation and training for staff and sometimes students on intellectual property, licensing, finding the right partner, project management and new venture creation;
- developing standard agreements for outside contracts;
- risk management in relation to external commercial activities;
- management and support in negotiation of contracts and licence agreements;
- assistance with progress reporting on contract research performance;
- arranging insurance and similar protection for the university and staff members involved for example workers’ compensation, professional and public liability or hostage insurance;
- management of larger projects, particularly large overseas aid projects; and
- organising the manufacture and distribution of products, such as scientific instruments, and services developed within the university.

Organisational Options

Three main organisational arrangements are used at present to provide TT&C services:

- for smaller institutions with developing research profiles, the research office, with much of the activity left to the individual units in the university (for example, Victoria University of Technology and Charles Sturt University);
- an administrative unit within the university structure but separated from the research office (for example, The University of Sydney Business Liaison Office), but usually reporting to the same Deputy Vice-Chancellor or Pro Vice-Chancellor as the research office; or
• a separate incorporated entity, with its own charter or remit from the university, but usually with an independent board chair and several independent outside directors. Such an incorporated entity may be a proprietary company with shares usually 100 per cent owned by the university, or by a parent trust with all the assets and earnings fully controlled by the university, or it may be a company limited by guarantee which has been a less common approach in recent years.

Importantly, a company directly owned by a university cannot engage in any activities that are not permitted for the university under its enabling legislation.

The strengths and weaknesses of each of these models are summarised below in Table 19:
<table>
<thead>
<tr>
<th>University Model</th>
<th>Advantages</th>
<th>Disadvantages</th>
</tr>
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| A. All through research office | 1. Low cost, even with a full time contracts officer  
2. Under close control of people making research related decisions | 1. Usually badly under-resourced with delays in approvals  
2. Easily bypassed by people in departments  
3. General lack of flexibility |
| B. Separate business liaison office | 1. Focus on service delivery with less emphasis on service profitability  
2. Acceptability as part of the administrative system | 1. Constraints of working within university human resources and financial systems  
2. Less flexibility in matching people and financial resources to needs  
3. More complex decisions in finding funds to add value to IP |
| C. University owned company | 1. Independent management  
2. Discipline of operating profitably and building a balance sheet  
3. Better access to independent commercial inputs  
4. Flexibility in recruitment and reward systems and in financial management  
5. Ability to respond to changing needs  
6. A vehicle for other commercial activities as funds generators  
7. Surplus funds available for adding value to IP, if appropriate | 1. Need to generate initial cash flow and profitability  
2. Can become alienated from the university and resented if imposed on the university  
3. Staff need to be able to operate in both academia and industry markets |
Any of these structures could contain the necessary critical mass of people providing support services. In practice, this appears most likely to happen with either a separate business liaison office or a separate incorporated entity.

The choice of structure will depend on each individual institution’s circumstances. In a university, changes will require wide consultation. Under these conditions, if a structure is working effectively, it is advisable not to try to change it.

If the decision is made to have an internal business liaison administrative unit, whether as part of, or separate from, the research office, the following criteria have to be satisfied:

- It has to be adequately staffed and have the flexibility to respond to changing needs.
- It must be adequately funded to obtain the legal contract and IP advice that it needs.
- Its role must be seen to be the support and service of research commercialisation and technical transfer, including protection of the institution and its staff, not just control—acting as a consultant/coach rather than as project manager.

If the decision is made to establish a university company (or revive an existing one):

- It must have a charter that is supportive not restrictive.
- It should only be imposed on staff in defined areas such as patent management; otherwise it should have to sell itself to staff, demonstrating the benefits of working through it.
- It needs to develop its own cash flow generating portfolio of activities; it will not survive without early cash flow, by relying solely on income from fees of 10-20 per cent for managing contracts and consultancies or if it regularly has to be re-funded by subsidies from the university.
- Its performance measure is the cash that flows through it back to the university; it needs also to make a profit to build its balance sheet to allow it to take on larger projects and invest in adding value to intellectual property, where this is commercially attractive.
- Its board should have an independent chair, preferably a member of the governing body, and at least two independent outside directors (education of board members is important to ensure that they have an understanding of TT&C processes and the risks involved).

Unless these conditions can be satisfied, it will generally be safer to build the necessary support resources into the research office or a parallel business liaison unit.
Staffing is a more critical issue than structure. Whether in a business liaison office or in a university technology company, management and key contact staff must be credible to academia. This usually means that they are seen to have respectable postdoctoral research records. Credibility to physical scientists and engineers, however, does not necessarily equate with credibility to bioscientists. People with appropriate but different backgrounds will usually be required. At the same time, they must have the entrepreneurial drive and learn the commercial skills needed to work with external commercially motivated research users.

**Important Role of Heads of Schools, Centres and Departments**

Whatever the structure, the roles of heads of schools and centres must be clearly defined and any delegations documented. Such delegations for smaller consultancies and projects up to, say, $30,000 appear useful in facilitating negotiations with research users and reducing unprofitable loading on liaison entities. Experience, however, suggests that the use of such delegations should be restricted to consultancies and research contracts that use the university’s standard agreements.

**Quality Management and Assurance**

Similarly, for any structure, the responsibility for quality management and assurance has to be identified and clearly defined.

**Adding Value to Intellectual Property and Supporting Entrepreneurial Activity**

One of the advantages of having an incorporated entity fully owned by the university is that it will have management in place and can become the channel for the development of spin-off companies, both research companies and actual marketers of products and services. University companies can also hold and control the university’s equity investment in start-up companies.

Management skills will be adequate for managing companies providing established services or products. However, the management and commercial skills to manage a portfolio of research based start-ups can be quite different from those required to manage research contracts and consultancy support services. The history of entrepreneurial activity by university companies has been very varied. Best practice in relation to start-up and spin-off companies is discussed in Chapter 2.11.
Funding of Support Services

There are a number of possible funding mechanisms:

- subventions from the central administration budget;
- project fees or levies;
- a seed fund, for example, initial capitalisation based on future patenting expense stream; and
- income from associated activities, for example, courses, selling computers or software.

The choice or mix will depend on the particular institution. The issues include the following:

- project fees: these should be transparent in terms of the various components and be applied as flexibly as possible; and
- subventions: these need to reward rather than penalise success; success (as measured by finance flowing through the agency back to the university) may make it difficult or even impossible to stay within a fixed operating expense budget.
2.5

Intellectual Property

The Australian literature is heavily focused on intellectual property (IP) issues for universities. The legal position is analysed in detail by Monotti (1997).

For industry research users, protecting both their own know-how and any new IP in which they invest is critical. They want exclusive access to IP and need to be able to trust researchers to maintain secrecy. They want legal agreements that are quickly made, inexpensive and fair. They want to be able to revisit these agreements should their objectives and expectations change. ‘Eventual publication will be valuable, but not now and industry must approve publication and content’.

Universities want recognition for their knowledge base. For this they want publication as soon as possible. While publication remains the basis for successful grant applications and promotion, there will be increasing pressure for publication, particularly for junior academics and, even more so, for postgraduate students. Whether publication continues to be the most appropriate measure is outside the scope of this study.

People in universities need to recognise and understand the value of their IP. They also need to understand the very high costs of patenting and defending patents, $50 000 or more if overseas filings are involved, and for remote, small Australia these are usually essential.

The objective is to maximise the net benefits after all costs from maximising the value of IP.

Policies, Ownership and Agreements

The key issues are listed below:

1. The university should have clearly defined policies on ownership of all intellectual property: patents, copyright, eligible layouts and registered designs.

2. It should clearly define legal and other ownership issues for staff, students and visitors.

3. Policies for sharing in future benefits from sale and licensing of intellectual property need to be equitable between the inventor and the institution, easily understood and capable of being administered without grounds for dispute. On these grounds, most institutions interviewed preferred a simple percentage sharing of net benefits after recovery of all costs (including patenting and protection) between the inventor(s), their department or centre and the university. More complex models, such as
the Cambridge model recommended by the AVCC are designed to maximize inventor benefit and hence incentive for smaller projects (and without deduction of direct costs). These were viewed as too complex to administer with the potential for leading to disputes about benefit threshold levels.

4. For all ownership issues other than those that derive from employment, standard agreements for vesting of ownership in the university, where this is required, should be available and agreed with the parties involved.

5. For all such agreements, individuals should be advised to seek independent legal advice. The university should establish in advance listings of possible sources of such advice. The university also needs to establish how that advice might be paid for, if the student cannot afford the legal fees.

6. Students should have the right to seek research topics that do not require surrender of IP rights. If students do not wish to sign such agreements, they should be offered alternative topics with no IP vesting requirements.

7. Students and visitors who vest IP rights in the university should be no worse off than staff in the sharing of any benefits.

8. Rules and provisions for delaying publication, particularly of postgraduate student theses, should be clearly defined and communicated both to staff and to students, and also to outside parties involved in consultancies and research contracts.

9. Policies should clearly state whether future IP benefits are retained should the individual concerned move and whether they can be transferred to another party, including heritability in the event of death.

**Intellectual Property Management**

The key issues in the management of IP include the following:

1. Universities should carefully monitor and report their own investment in patenting. It can quickly lead to an expensive portfolio with little commercial potential.

2. Universities should clearly define responsibility for decisions on filing of patents at the three different levels: provisional, Australian final and overseas.

3. A university needs easy and affordable access to professional IP competence, either in house or close at hand. Considerable skill and judgment are needed in decisions on whether or how to protect IP. There are times, even in universities, when keeping know-how secret may be preferred to disclosure through patenting.

4. Decisions whether or not to file a patent specification are a matter of commercial judgment. Each case must be considered on its merits. In
most but not all cases, universities should be seeking a commercial partner before filing final Australian or overseas applications. Such a partner carries some or all of the patenting costs and brings understanding of the technology, potential markets and commercial issues involved. Exceptions to this practice should be rare. Generally, and particularly when no commercial partner is involved, independent external advice may be needed on the potential value of the IP by comparison with patent related costs and other value adding and risk reducing investment to make the invention commercially viable.

5. There will always be the need to patent some inventions in the public interest. Such decisions should be endorsed at Vice-Chancellor or governing body levels.

6. There is a strong case to introduce standardised laboratory notebooks and procedures for recording and signing off research data leading to patentable inventions. Under US patent law, this is a requirement to claim as the date from which protection starts a date of invention that may be earlier than the date of filing. An example of best practice is attached at Appendix 9.

7. No agreements should be entered into that result in shared ownership of intellectual property, as opposed to sharing in the benefits. Shared ownership provides little protection if the other party decides to go it alone in developing the IP. The preferred route is to retain sole ownership but grant exclusive or non-exclusive licences to use the IP. Consideration of background IP ownership and value is essential before entering into contracts that might generate new IP with shared access.

8. Generally, licensing rather than assignment of patents is preferred. In the event of assignment, there should be performance provisions in the contract and agreed procedures for default reassignment to the original inventors if contracted performance is not achieved. This is an important safeguard to prevent assignees 'sitting on' the technology for their own competitive reasons and not exploiting it, or in the event of assignee bankruptcy or liquidation.

9. A key issue in IP management is the facilitation (and avoiding unnecessary delays) of publication where IP is involved. This requires:

- consultation with any actual or potential licensee;
- professional advice on any edits required to avoid disclosure, for example, of claims not covered in the provisional specification; and
- agreement of the author.
2.6

Publications and Conferences

Traditional academic publications and conference presentations continue to be important channels for technology transfer and generating awareness of new technology that might lead to commercially successful innovation.

These channels are particularly effective for larger organisations with scientifically literate management and for SMEs whose owners or chief executives are scientifically literate in the disciplines involved. They are much less efficient as communication channels to people in low-tech industries, but can be effective to intermediary agencies that are commercially involved in the interpretation and packaging of new technology for use by such industries.

Conferences in which scientifically literate people from larger and high-tech SMEs participate are particularly valuable channels of communication with potential research users and commercialisers.

The issues are threefold:

- Universities need to ensure adequate support for their research providers to present and be present at conferences with high industry participation—from larger technology dependent companies, high-tech SMEs and the intermediaries who service the technology needs of low-tech industries.

- Procedures need to be in place to monitor publication (journals, theses, conferences, websites) to avoid premature publication of potentially valuable and protectable IP. The CRCs have had to establish very tight processes for approval of publication, usually only approved by a CRC Director.

- Regular technology audits may be required to identify potentially valuable inventions or research outcomes. Such audits are well reported in the European literature. ANUTECH Pty Ltd used a similar audit process earlier to identify scientific instrument developments that might be suitable for commercial sale scientist to scientist, for example, surface forces apparatus, ion probes.
2.7

Education and Training

The core function of universities in their role in undergraduate and postgraduate education, and also in experiential research training at postdoctoral level and in professional continuing education, is the most important channel for technology transfer, diffusion and cooperating with industry.

The CRC program has been particularly effective in its influence on both undergraduate and postgraduate training. In undergraduate training, it has developed and subsidised delivery of specialist niche courses of importance to both researchers and research users. The Mercer–Stocker report summarises the benefits from the CRCs’ involvement in education.

Postgraduates

- with a better awareness of user needs;
- experienced in user-oriented research;
- enhanced career prospects;
- focussed postgraduate training in areas of priority for industry.

(Mercer & Stocker 1998, p. 27, extract from Table 3-3 Benefits from CRCs: Strengthening the National Innovation System)

Much of this experience has diffused into other areas of universities. Most universities now have formal induction programs for postgraduate students, but they vary considerably in content. The experience of CRCs has been that they cannot rely solely on such programs to provide their students with the learning opportunities they need, for example, IP, project management, use of laboratory notebooks and commercialisation processes. However, not all postgraduate students will need the same level of exposure to industry and other research user need-related learning opportunities.

Another important training issue that is emerging from a number of CRCs is recognition of the need to ensure an adequate level of training of technicians needed to service and maintain new technology, for example, new optical fibre based devices. This requires a much closer involvement with the TAFE system.
Education

Technology transfer primarily involves people. The technology transfer issues in education include the following:

- **for undergraduate education:**
  - facilitating and finding funding for niche courses of special importance to specific industry sectors, but which do not attract enough students to be funded entirely from core funding grants;
  - giving the maximum possible number of later year students the experience of project work in industry (a suggested target for the science and engineering disciplines is that 50 per cent of final year and honours year projects should be involved in industry based projects); and
  - giving students the opportunity to work on their projects in self-managing groups to learn about operating as a team.

- **for all researchers (postgraduate students and staff), access to ongoing learning opportunities on topics such as:**
  - intellectual property understanding (but a little knowledge here can be dangerous without access to IP professionals);
  - research and project planning and management;
  - occupational health and safety;
  - use of laboratory notebooks, research data and invention recording and sign-off requirements, particularly for US patent applications;
  - written and verbal communication and presentation;
  - understanding external research user technical and commercial expectations and needs, and how to satisfy them;
  - grantsmanship, particularly how to find external partners for collaborative grants; and
  - entrepreneurship and new venture creation, management and financial survival.

- **for all students:**
  - course work and other learning opportunities in project management, research documentation, intellectual property, new venture creation and entrepreneurship.
Students Funded by SPIRT Collaborative Grants and Other Industry Funding

The proportion of postgraduate students funded by SPIRT grants or directly by industry is an important technology transfer performance measure. Many of these students are likely to end up working with their sponsors. Two useful ARC funded studies by Margaret Powles at the Centre for the Study of Higher Education have reported on APA(I) participants’ experiences (Powles 1994 and 1995).

Training

Professional and sub-professional training and continuing education are important elements of new technology commercialisation and transfer.

The reviews identified three issues:

- Involvement in the continuing education of professionals is both a very effective means of new technology updating and diffusion and a potentially profitable activity.

- So often cutting edge research on industry problems runs ahead of industry’s expectations and ability to understand its implications. An effective solution can be to bring industry managers and regulators to university professional and sub-professional courses. An excellent example of this has been the initiatives in fire engineering training at VUT. First, the technology was developed. Next, training started with continuing education for architects and engineers, and subsequently developed into certificate level courses for building inspectors. VUT is now moving to include the subject in undergraduate courses.

- Sub-professional training supports new technology introduction. The Australian Photonics CRC recognised that widespread adoption of new optical fibre technology required that the technicians and service people be available to support the new technology. It has developed a program with TAFE NSW to achieve this.
2.8

Consultancies

Consultancies involving university staff are very important, often as the first stage of a developing external relationship that can lead to research contracts, graduate placements and other ongoing benefits to the university. Therefore, while consultancies need to be encouraged, they can also pose risks and lead to legal actions against staff members and/or the university involved. The degree or scale of such risk does not appear to be related to the dollar value of the consultancy or research contract.

Most Australian universities allow staff to spend a proportion of their time (usually 20 per cent) on non-university business. This is usually subject to head of department, faculty or centre approval that the external involvement is compatible with the staff member’s contracted teaching and research commitments. There has been considerable recent debate about the degree of control that universities need to protect themselves from legal action resulting from essentially private consultancies by their staff. The universities own insurance policies will cover liability where contracts are with the university directly, but will not cover staff engaged in personal consultancies.

The Curtin University of Technology New Consultancy Policy well states the benefits and the risks of engaging in consultancies (Curtin University of Technology 1998):

**Benefits**

- funds to maintain support staff
- funds to purchase and maintain equipment
- salary supplementation
- problem solving for the business/industry/community
- promotion of university image as a problem solver
- income used to offsets costs of teaching and research
- potential to build interactions into larger programs
- professional development of staff
- a source of information.

**Risks**

- litigation: damages for negligence and trade practice infringements
- bad publicity affecting the university’s image
- drawing scarce resources away from core businesses of teaching and research
- bad debts.
Nature of Consultancy

The reviews identified three main types of consultancy relationships:

- provision of testing and data analysis services, generally involving no or little intellectual input;
- professional practice (for example, psychological counselling); and
- solving a problem, involving significant intellectual inputs and drawing on accumulated know-how and university IP and hence properly involving some charge for the use of this IP.

There is a need for clear policies and adequate liability protection for all three categories. The first two, however, lie outside or at the periphery of this study and are not discussed further here.

The differentiation between consultancies and contract research is important. Under the definition of research used by DETYA, contract research generates Research Quantum credits but consultancies do not. The general view is that consultancies never involve contract research. However, there appear to be differing views about whether and when software development is contract research or a consultancy.

Essentially there are two types of situations:

1. *Private consultancies*, where the staff member either directly or through an entity engages in advisory or consultantancy activity. For these consultancies, it is standard practice that:

   - university letterhead must not be used;
   - if university facilities are involved, the staff member must pay for these at full cost recovery rates;
   - the staff member may have to buy out some or all of his committed teaching and research responsibilities; and
   - the staff member is not covered by professional liability or other insurance.

2. *University consultancies*, which may or may not involve some element of software development or contract research, where the contract is with the university and is negotiated by, or with the knowledge and support of, the university group responsible for external contracts.

Best practice starts with ensuring that the university has up-to-date legal advice on all aspects of the risks involved and on competitive neutrality requirements. The latter will differ between States.
Private Consultancies

Private consultancies can pose professional liability and other risks to universities. If they are to be permitted, and it is likely that some will be, universities need to have in place clear and well communicated policies based on up-to-date legal advice. These policies will need to stress quite specifically the university's disassociation from the private consultancy and the need for it to be indemnified against any potentially resulting liability.

University Consultancies

For university consultancies:

- The university charges an appropriate overhead on the staff members' salaries, may charge for access to university IP and expects full cost recovery for the use of its facilities, subject to competitive neutrality considerations but with adjustment for what the market will bear.

- The university will make its own analysis of the risks involved to it and to the staff member/s (for example, hostage risks in overseas aid contracts) and see that they are appropriately covered under the university's insurance arrangements.

There are two other issues:

- For several of the institutions reviewed, it was believed that many private consultancies were not reported or approved. This may generate unknown professional liability risks for the university.

- There is considerable administrative effort in approving, recording and managing or overviewing risk in small consultancies. If the relevant administrative resources are stretched, delays occur and external consultancy activity is discouraged both for the academic and for his potential client.

The central management issue is control versus flexibility, that is, whether the costs and inherent bureaucratic disincentives of total control over consultancies are justified by the protection against risk that it should afford.

This is an area where institutional diversity will be apparent. A university like the University of Queensland where a risk management culture is well established will lean to greater flexibility. A university like Charles Sturt, where the strategic imperative is to make one institution out of two predecessors with different organisational cultures, will lean properly to a much higher level of control and administrative conformity.
The issues that emerged from the reviews for university consultancies, with or without contract research, were as follows:

- If no contract research is involved, individual staff members in consultation with their head of department or centre are free to decide whether the consultancy is managed within the department or by the university contracts office or company. Fees will be based on charge-out rates, including overhead recovery, plus recovery of all direct costs. It is generally advisable that the business liaison people be consulted and or involved in the negotiations.

- If a staff member wishes the contracts office/company or research office to be involved or if contract research is involved, the appropriate business liaison unit or company will be involved in risk assessment, assistance with negotiation and approval recommendations to the Deputy or Pro Vice-Chancellor (but with approval by head of school or centre delegated for contracts up to, say, $20,000 or $30,000 in value if standard agreements are used).

- Contract price will include a fee for the support services used. This will need to be contained unless there is a deliberate objective to curtail consultancy initiatives, but will necessarily vary between institutions.

- Any contracts in which the university is involved will be subject to competitive neutrality considerations.

The aim is to be flexible and to avoid overloading administrative systems with the approval of a lot of small contracts while still managing the various aspects of financial and other risk. Some contracts may go through the research office, some through a business liaison office or company. It is important that fees levied be the same in both cases and that arrangements, such as a clearinghouse, be in place to resolve which unit should service which contract.

Finally, academics involved in consultancies and contract research need to work hard on understanding research users’ needs and how these can change and be sure that they are solving the right problem.
2.9

Research Contracts

Research contracts, historically and presently, are the main source of university external earnings from industry. This will continue. They can be stand-alone contracts or can be an important benefit component of IP licensing deals.

The main operational differences between research contracts and consultancies is that the former involve significant use of university facilities and can generate IP, the ownership of which has to be clearly defined at the start. They most likely will also make use of university or the industry partners' background IP. The industrial partners will be most anxious to ensure that there is no leakage through university staff or students of their confidential know-how. This need may limit opportunities to involve students in such projects.

University research customers interviewed indicated university contract research performance was very variable and 'only about 20 per cent of university departments performed well against the Mann success factors' (see Chapter 2.13). The key criticisms included:

- the constant need for university people to find money, with the result that senior academics tend to work on too many projects and not give enough time to leading the work on individual projects, indicating a resource management need; and

- the tension between teaching and research and between publication and creation of intellectual property.

These interviews with research users particularly showed the importance in research contract management of:

- good planning, project management and research documentation;
- delivery of agreed outputs on time;
- understanding the research partners' needs and expectations; and
- solving the right problem.
Common Issues in Consultancies and Research Contracts

There are three common issues:

- the negotiation process and standard agreements;
- project costing and competitive neutrality; and
- quality management and assurance.

Standard Agreements and Contract Negotiations

Major agreements with larger companies and multinationals will almost always need to be handled on a case-by-case basis, even if initially based on standard agreements or templates. However, the reviews showed the value of starting with standard agreements in consultancy and research contract negotiations. They help to define possible areas of dispute. Generally, a university should have standard agreements for:

- consultancies (software contracts may be best treated as consultancies);
- research contracts; and
- intellectual property licensing.

Important issues that may arise in such negotiations include:

- understanding by overseas companies that universities do not pay tax in Australia and therefore that any discounting of benefits because they are tax exempt is not acceptable;
- stamp duty payable on IP licenses or assignments;
- withholding tax and overseas VAT on royalties and other fees;
- onus to rest with the commercial partner to make any commercial product or service warranty and specific inclusion of release and indemnity of the university in relation to such warranties;
- exclusion of any warranty or liability on the university in relation to non-achievement of outcomes, commercial outcomes or marketability; and
- who has the responsibility, and with what options, for defending patents and other intellectual property.

Particular attention must be given to liability issues if there will be US based customers of the end product. Litigants can look through the immediate supplier to the original owner of the IP or new technology involved. Liability insurance in the USA is very expensive.
Project Costing and Competitive Neutrality

These issues have already been addressed earlier in Chapter 2.2. To repeat, costing models are no longer discretionary. While the legislative provisions vary between States, the penalties for inadequate control of costing practices can be significant.

For consultancies, universities can establish loaded rates for different levels of staff that include an appropriate provision for overheads. These may be $1,000 per day or more for a professor and should generally be comparable to those charged elsewhere. They should be seen as minimum or guidelines. Some people with international standing will certainly charge more.

For larger consultancies and research contracts that involve use of university resources and IP, project cost elements are separately costed and a profit margin is added. The contract price will thus include:

- fees/remuneration to staff member, including on-costs;
- overheads;
- project direct costs; and
- profit.

In setting the final price, consideration has to be given to what the market will bear, any discounting because of potential future IP or other benefits to the university, and competitive neutrality legislation.

Charging policies and practices need to be clearly set out and communicated for example, in a commercialisation practice manual produced by The University of Sydney. Particular care is needed in being able to justify the university’s overhead costs, including the cost of space use in each of its buildings.

Quality Management and Assurance

Any institution that seeks to be heavily engaged in the business of generating research contracts must have a commitment to ensuring that the user perceives value in the contract. The research user interviews stressed the learning curve in building relationships. The issue of quality management and assurance was discussed above in Chapter 2.2. It is at the core of generating value from research contracts.
Contract Research Negotiation and Management

The issues in contract research management include:

- clear policy on responsibilities for decisions on new research contracts and provisions for resolving conflicts for example, a clearinghouse;
- good liaison with the research office and heads of schools and centres to ensure that resources are available to satisfactorily carry out the contract and meet the user’s output quality and timelines;
- involvement of business liaison professional staff in conjunction with the researchers in negotiating the contract agreement and price;
- clear definition of future IP ownership—the university should at the minimum retain the right to use any new IP generated in its own research, but will need to document university ownership of any future IP deriving from this beyond the period of the contract;
- documentation of background IP being contributed by either party and any constraints on future access to it;
- ensuring proper research documentation, progress reporting and involving industry liaison professionals in monitoring performance against user timelines and quality requirements;
- maintaining effective communication throughout the contract;
- using successful contract research outcomes to promote role models and publicise successes both within the university and outside; and
- willingness to learn, thoroughly exploring causes of any performance failures so that they do not happen next time.
2.10

Licensing

The key strategic objective is maximising the value of a university’s IP. This must start from policies and practices on ownership and management of that IP, as set out in Chapter 2.5.

The next input is management of the licensing of that IP. Generating ongoing net value from investment in IP is totally dependent on commercially effective management of the licensing process. The fact that the process of innovation is inevitably ‘messy and serendipitous’ only reinforces the need for good, sensitive and risk accepting management. The skills and experience required are specialist professional and management skills. These are not usually found among an academic administrator’s or researcher’s competencies, however good the researcher. Success also requires a critical mass of the mix of skills required.

The University of British Columbia—Industry Liaison Office website (www.uilo.ubc.ca) contains an excellent set of procedures and practices for research commercialisation through IP licensing. Similar documentation of Australian origin can be found in the papers by Turner to the World Intellectual Property Organization (WIPO) Symposium in Vietnam in March 1997 (Turner 1997).

IP can be licensed to an existing company or to a new company set up for the purpose. The first decisions are about:

- whether to license, assign or sell the IP now rather than later;
- whether to develop further the invention alone or with joint venture partners;
- what resources are required to reduce investor risk and whether it is economic to invest these resources;
- whether there should be a commercial partner who might carry major patenting costs;
- whether to seek to deal with an existing company, set up a spin-off company or facilitate a new independent start-up, perhaps involving staff or students;
- whether to offer an exclusive or restricted licence or just first refusal in exchange for payment of patenting costs and funding for more research to add value to the IP;
- what the present value and likely future value of the IP are: there may be significant differences between the university or researcher’s expectations and the potential licensee’s view; and
what benefit the university should be seeking: outright sale, payment of patenting costs, additional research funding, a future royalty stream, or further development and manufacture in Australia.

Inexpert management can result in accumulating expenses with no commercial return, for example, patents. Equally, it can result in selling off IP access too cheaply or allowing the development work to take place somewhere other than Australia. It can result in unnecessarily difficult and expensive negotiation or even litigation about IP access and use.

Developing the Commercialisation Strategy

These initial activities lead to the formation of the commercialisation strategy for that particular invention or group of inventions. This in itself is a complex and involved process. It requires not only critical and independent assessment of the commercial potential of the IP, often requiring external market research and feasibility analysis, but also knowing how to go about finding potential development and licensee partners. In some industry sectors, it may be important to deal direct with product champions in an overseas home office rather than with the local subsidiary. The starting point in each case will be a lot of hard work to find an interested existing company or potential partner in a new company. Two questions need to be answered:

- Which company will benefit most from the use of the IP?
- Who is the product champion in that company for this type of product?

Whatever the route chosen (other than immediate sale and divestment of the IP rights), this will require investment of substantial resources for a medium- to long-term return. Failures can be very expensive.

A proactive approach is essential. The availability of university standard agreements has clearly been helpful in the initial stages of a negotiation in identifying areas of possible dispute that need to be resolved. However, good these standard agreements, multinational companies particularly will have their own standards. Major contracts and licensing agreements will involve much expensive legal work by senior commercial lawyers on both sides.

Agreements and negotiation have been discussed above in Chapter 2.9. Important additional issues in licensing agreements are:

- performance clauses and provision for the IP to revert to the inventors in event of performance default;
- awareness of taxation differences, stamp duty and VAT in the various country jurisdictions involved;
- continuing university access to IP for research purposes;
• either party’s rights in relation future deals with same licensee; and
• rights to future IP that may arise in parallel with, or as a result of, licensing and associated contract research arrangements.

While licensing and putting the deal together are an end process, the deal is never put to bed completely. It should be regularly revisited.

Forming a New Spin-off Company

The University of British Columbia UILO describes:

...a UBC spin-off company as a new enterprise created to: license a UBC technology, fund research at UBC with the aim of developing technologies for license by the company, or provide a service which was originally offered through an existing UBC department.

(UBC 1998, Section 2)

Often there may be greater benefits and more control over development of the IP by establishing a new company with some university equity and grant this new company an exclusive or restricted licence, including a future royalty stream to the inventors and/or the university. The other partners in such a venture might include:

• an existing group with engineering, software development or similar capabilities needed for the next stage of development;
• an ultimate end user of the resulting innovation; and
• a ‘business angel’ to provide some of the initial funding.

A key benefit of such a development strategy is that such a company with university equity can be eligible for quite large R&D START grants.
2.11

Spin-off and Start-up Companies

Until recently, the standard practice throughout North America has been to license university technology to existing companies, especially to companies who are in a business related to that to which the university technology should apply... is it better to license a technology to an existing company or to a spin-off? ... Alas there are no easy answers. In fact one of the main reasons for trying the spin-off company route was the difficulty that the Ultro experienced in finding licensees amongst existing companies.

(UBC 1998, Section 2)

Once again the Scottish Enterprise thinking is followed. Commercialisation of the [Australian] science base through the formation and growth of spin-off companies offers the greatest potential impact on the [Australian] economy.

- There are obvious job creation benefits.
- By keeping the development phase in [Australia], the original inventors can play a more significant role in the development process, even if manufacture ultimately moves offshore for commercial market reasons.
- In places like Austin and San Diego, one or two academic spin-offs have subsequently spawned further new ventures. Over time this creates a high-tech regional economy with an indigenous corporate base.
- There is the opportunity to gain greater value multipliers through exit strategies such as public offerings and trade sales (adapted from Scottish Enterprise 1996).

In the university reviews there were excellent examples of spin-off companies spawning global business ventures, demonstrating that this is already happening in Australia.

Practices may involve mentoring and nurturing the future entrepreneurs, both staff and students, and helping them to find the gap funding needed to survive to the point where early stage venture capital can make a reasonable decision whether to invest.
There is no single route. The options include:

- a company wholly or partly owned by the university;
- a fully independent company; or
- a company fully or partly owned by its academic inventors (staff or former students).

There are others that 'are very loosely based on intellectual property or know-how arising from academic work'. Generally, there is a case to have researcher equity involvement if the researcher wants this and is able to do so.

There is a large literature on the engineering of start-ups. This has been reviewed in the earlier literature survey. Two useful references are:

- The University of Chicago ARCH Development Corporation Virtual Company concepts (www.arch.uchicago.edu/Virtual_Co); and

For a university, the important issues include the following:

- What is being done or should be done to release and generate a commitment to entrepreneurship among staff and students: later year courses, promotion of successful entrepreneur role models and incubators?
- What is being done and should be done to support individuals or groups of staff and students wanting to set up new ventures?
- Is there access to effective business incubators in interactive environments, such as the Australian Technology Park at Eveleigh or the University of Adelaide’s similar facility at Thebarton?
- What criteria should be used to select start-up groups for support? The criteria for entry to the Eveleigh Business Incubator include:
  - enough money to pay the rent,
  - a product or service with global market potential, and
  - the first customer in place.

An important issue can be how to handle post start-up conflicts when staff may be working both in the university and in the company.
Assessment of Potential Investments

The University of British Columbia practices cited in Chapter 2.10 above and University of Chicago practices cited earlier in this chapter contain good material on selection of investments by the university.

Good practice in the process of assessment of potential investments include a series of evaluation tasks, such as those generally used by UniQuest:

- technology description;
- competitive advantage (i.e. innovation);
- market potential;
- risk mitigation strategies;
- venture management;
- IP status;
- exit strategy options;
- what is the deal?
- timelines; and
- time to market:
  - time to initial public offering,
  - time to exit, and
  - time to major next stage investment.

Should Universities be Involved as Equity Investors?

A central issue is whether and to what extent should universities be involved in commercialisation through new ventures. The following issues should be considered:

- Has the university the quality research and commercialisation resources to develop, facilitate and invest resources in a stable of start-ups, not just one or two, as many will fail?
- Is this a proper commercial investment of university resources?
- Might the resources be better used in generating more short-term benefits through contract research and IP licensing as opposed to larger long-term benefits through holding and the ultimate sale of equity in spin-offs and start-ups?
- Might a smaller university join with other similar institutions to have available the critical mass of managerial and monitoring skills (as with TIMS Pty Ltd in Western Australia)?
- Even where a university has well-staffed and experienced commercialisation support structures competent to manage research contracts, IP and licensing, where will the new skills required to develop and support a stable of start-ups come from? They will surely pose different management demands.
Managing a Portfolio of Spin-off Companies

Management is the central issue if the development of a portfolio of spin-off companies is to be financially successful. Relevant issues are listed below:

- The initial investment must be large enough to develop a portfolio of start-up ventures, not just one or two. Some will surely fail.
- Stay close to experienced ‘business angels’ and early stage venture capitalists and understand their expectations and particularly their valuation methods.
- Focus on ventures with global market potential.
- Find the first leading edge customer quickly.
- Have available people with the required management skills and experience. These will rarely be the original ‘inventors’.
- Obtain the best possible external advice before the investment decision is made, even if with hindsight it will usually be wrong!
- Regularly review the vision for each venture: is it still there?
- Have well defined exit strategies and targets and focus on the next exit option.

Financing Start-ups

Experience in the process of adding value to IP suggests three levels of funding need. These are set out in the following table.

*Table 20: Levels of Funding for Start-ups*

<table>
<thead>
<tr>
<th>Funding type</th>
<th>Scope</th>
<th>Likely cost per project $</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Short-term applied research funding: retained commercialisation earnings and other university funds, family</td>
<td>To take a project close to proof of concept and possibly cover initial patenting costs</td>
<td>$50 000 to $500 000</td>
</tr>
<tr>
<td>2. Seed capital: business angels or nearby seed capital fund</td>
<td>To fund the ‘D’ stage and get ready for venture capital investment</td>
<td>$200 000 to $500 000</td>
</tr>
<tr>
<td>3. Venture capital in several tranches</td>
<td>To fund commercial launch</td>
<td>$1 million to $5 million per tranche</td>
</tr>
</tbody>
</table>
The critical funding gap is for the applied research, development, IP protection and initial market investigations and generally investor risk reduction. This is needed to bring the enterprise to the point at which an experienced early stage venture capitalist can be interested and can make an adequately informed decision whether to invest or not.

If a university or universities decide to build a stable of start-ups by investing in adding value to their IP, it is unlikely that they will be able to produce the early stage seed funding (Stage 2 in Table 20 above) from their own resources. They will need to find external ‘business angel’ investors to establish a seed fund ‘close by’. State government support for this will be important, but government must be kept out of project selection and management (compare Victorian Economic Development Corporation).
2.12

Technology Parks and Precincts

Universities have invested in and developed technology parks and precincts. Many of these have been real estate deals. A case study, involving visits to technology parks, was undertaken to develop criteria for considering the actual or potential role of a technology park in support of, or as part of, university TT&C activity.

Details of the case study are not included in this report. However, its key conclusions were as follows:

- The management style was critical: high enthusiasm and people skills were essential.
- Any individual park should involve an interactive mixture of tenants, and the greater the variety the better, for example, university research centres, CRCs, large and small businesses, a business incubator that focuses on new ventures with global market potential (not local small real estate businesses) and a TAFE facility.
- Business incubator rental costs must fall within the financial resources of new entrepreneurs.
- The space planning should maximise opportunities for interaction, for example, the location of the coffee shop at the Australian Technology Park at Eveleigh.
- There must be evident commitment from senior university people to entrepreneurship generally and new venture creation at the park specifically, including an understanding that technology parks are not just real estate deals to make money for the university.

As part of the case study referred to above, a review of the literature was undertaken. It suggested that the following checklist should be considered in the analysis of any new technology park proposal.
Technology Park and University Related Factors

Technology Park factors include whether:

- the park has created a cluster of organisations and industries;
- development of personal and organisational networks has been achieved;
- linkages with regionally significant industries have been achieved;
- the park selects tenants carefully;
- the park is only one component of a wider commercialisation strategy;
- co-location has resulted in technology transfer and commercialisation;
- the park provides a supportive environment for spin-offs;
- the park focuses on high-technology enterprises only;
- the park is a cost-competitive location for tenants;
- the park has received government support;
- the park has access to a skilled labour force;
- the park is in a quality environment;
- the park has a favourable address/image; and
- economic conditions have been favourable to the park’s development.

University related factors include whether:

- the university is world class and/or renowned internationally;
- the university has a commercialisation arm;
- the university has a research commercialisation culture and/or entrepreneurial focus;
- the university provides business and incubator support;
- the university provides business education and training;
- the university provides venture capital;
- the university allows tenants access to facilities and expertise;
- the university trains innovators and entrepreneurs; and
- the university encourages staff and students to develop spin-off companies.
2.13

Performance Measures

The earlier analysis in Chapter 2.1 suggested four strategic directions that directly involve universities and two others where university people can influence policy and other outcomes. In this chapter we suggest appropriate performance measures. Some of these were tested in reviews of selected institutions. ‘You cannot improve what you don’t measure’ (ADL 1998). Developing performance measures and associated targets are core elements of a university research commercialisation strategic plan. It is important, recognising diversity, that each institution should work out its own measures and targets. This is central to effective transfer of ownership to those who will be working towards these performance measures. In this chapter examples are given as guidelines.

The Arthur D. Little Hierarchy

In a recent presentation, ‘QPC Conference: Performance Measures for R&D’, by Arthur D. Little International Inc., some guiding principles were proposed for metrics (or performance measures), based on the ‘Balanced Scorecard Approach’ developed by Kaplan & Norton (1993). These suggested a hierarchy of performance measures:

- **Lagging**: provides information on past performance;
- **Real time**: provides information on the current performance status;
- **Leading**: provides information on the likely future performance; and
- **Learning**: provides information on the rate at which the organisation is improving its performance.

Below are suggested indicators in each of these categories and, where relevant, possible targets derived from the reviews of selected universities and workshop deliberations.
Lagging

Table 21: Past Performance

<table>
<thead>
<tr>
<th>Indicator</th>
<th>Possible target</th>
</tr>
</thead>
<tbody>
<tr>
<td>Research Quantum: Category 3 Industry and Other (excluding syndicated R&amp;D and donations, bequests and Foundations)</td>
<td>$50,000 per EFT as Category 3 Industry &amp; Other Funding with indicated exclusions.</td>
</tr>
<tr>
<td></td>
<td>30 per cent of Total Research Funding.</td>
</tr>
<tr>
<td>Collaborative research grants obtained</td>
<td>Will vary between universities.</td>
</tr>
<tr>
<td>Number of users directly involved</td>
<td>First find out how many at present. Target might be to double this.</td>
</tr>
<tr>
<td>Number and value of consultancies and research contracts</td>
<td>Find out present value. Target might be to double this.</td>
</tr>
<tr>
<td>Patents and other IP</td>
<td>This will depend on the university. No general target can be set.</td>
</tr>
<tr>
<td>- number final patent specifications</td>
<td></td>
</tr>
<tr>
<td>- per cent recovery of patenting costs</td>
<td></td>
</tr>
<tr>
<td>- licensing royalty income</td>
<td></td>
</tr>
<tr>
<td>Active spin-off companies</td>
<td>This will depend on selected commercialisation strategy.</td>
</tr>
<tr>
<td>- University equity</td>
<td></td>
</tr>
<tr>
<td>- staff/student equity</td>
<td></td>
</tr>
</tbody>
</table>

Real Time

- number/per cent of postgraduate students with collaborative or direct industry funding;
- number of companies beating a path to your door;
- customer satisfaction and repeat business;
- number of provisional patent filings;
- real engagement of alumni;
- number of new start-ups involving staff and/or students; and
- staff commitment and satisfaction.
Leading

- number of world class researchers/leaders in their field;
- leading edge infrastructure/equipment in key areas;
- proportion of final year undergraduate and postgraduate students involved in projects with industry;
- corporate culture:
  - commitment to innovation,
  - strategic plan, and
  - resources allocated;
- collaborative research grant applications; and
- training:
  - involvement in new venture training course work, and
  - per cent of students wanting to go into start ups or innovative industries.

Learning

These are essentially $\delta$ (Lagging indicator value)/ $\delta$ (Time):

- rate of improvement;
- rate of increase in start-ups, licensing agreements;
- rate of increase in proportion of new funds from outside;
- rate of increase in collaborative research grants; and
- rate of increase in postgraduate students funded by industry.

Individual Project Success Factors

The second set of performance measures were success factors at the commercialisation project or enterprise level. These are listed in descending order of importance as seen by industry research users. They were derived from analysis by Professor Leon Mann at the Melbourne Business School:

- good planning;
- personal contact;
- understanding partner's needs;
• good researchers;
• integration of expertise;
• financial support;
• equipment and infrastructure; and
• attracting work/flexibility.

The interviews with research users suggested that 'understanding the partner's needs' should rank higher and that 'good planning' needed to be broadened to include project management and research documentation.
2.14

Conclusion

The literature emphasises the ‘messy and serendipitous nature’ of technological innovation. It also points to the more complex and non-linear processes involved with university research that essentially starts from the discovery of new knowledge rather than from an identified market need or opportunity.

To promote commercialisation, US and European universities are moving towards creating new ventures rather than licensing IP to an existing business. This has arisen because it is difficult to find enough existing businesses that are willing to invest in technology development and marketing resulting from university research.

In Australia, while there have many successes, research users almost all agreed that the performance of universities in research contracting and collaborative research varied greatly both between universities and within the one university. Universities need to improve the quality and timeliness of their contract negotiation, contract performance and the meeting of user expectations.

The role of the CRC program, as shown in the Mercer–Stock (1998) review, has probably been the major influence in changing university attitudes to collaboration and commercialisation. Special Research Centres, identified in the university reviews, have been important in achieving a critical mass of research competencies both to develop improved research tools (for example, the Centre for Microscopy and Microanalysis at the University of Queensland) and to serve important sectors of industry (for example, the Photonics CRC grew out of a Special Research Centre). The emphasis on TT&C in these SRCs varied significantly.

The key internal drivers within universities to more research commercialisation are financial. The key internal constraints are remnants of a culture that regarded being involved in commercial applications as somewhat ‘dirty’. This in turn has led to inadequate recognition in promotion criteria and rewards for staff who are active in commercialisation activities. In some instances it also impacts on core funding allocations and leads to inadequate funding of services to support commercialisation.

The key external constraints are:

- the short time horizons of institutional investors and hence public company senior management (also an issue in the USA); and

- taxation arrangements in Australia (such as the high rate of capital gains tax in Australia by comparison with other countries) and the resulting shortage of both technology development gap (‘business angel’) funding and early stage venture capital.
The prime output of the study is a set of issues and approaches for technology transfer and commercialising university research. Because of the diversity of Australian universities, these issues and approaches are presented as a checklist based on practices in Australia and overseas. Rather than making narrow prescriptions that may not apply to the many and diverse needs of individual universities, the issues and approaches are structured to encourage institutions to apply them to their individual needs and circumstances. They address key issues:

- creating the right environment;
- adequacy and organisation of support services;
- marketing and building relationships; and
- the legal and management issues involved with IP, consultancies and research contracts, licensing, entrepreneurship and new venture creation.

It is fitting to conclude with industry perspectives on the critical success factors for an industry-oriented CRC. These align well with the issues and approaches set out in this study.

The following critical success factors are based on Australian Mineral Industry Research Association Submission and Focus Group meetings with industry representatives, as quoted in the Mercer-Stock review (1998):

- effective strategic planning including the clarification of the prima facie critical success factors;
- commitment from participants who have both something to give and who can get more out of the joint venture than by operating alone;
- clarification by the board of a CRC of each party’s expectation of the others and the development of an integrated research agenda;
- clarification by the board of the ownership and management of IP;
- a CRC board chairman who is active and industry oriented, some experienced independent directors or a board dominated by industry (this applies equally to a university owned company);
- clarification of the criteria for allocation of the CRC program funding;
- a focus on relationships with the participants rather than the creation of spin-offs and patentable IP (this is perhaps more contentious and reflects larger company experience and the needs of process industries);
- first class leadership of the CRC and its major programs and preferably a CRC director with industry experience;
- key researchers who provide a substantial proportion of their time to the CRC; and
- regular and comprehensive communication among stakeholders.
Appendices
Appendix 1

Australian Research Council Project Brief

The Development of Best Practice Criteria for Commercialisation/Technology Transfer Practices in the higher education system

BACKGROUND

In response to a reference from the then Minister for Employment, Education and Training, the Australian Research Council and the Higher Education Council delivered advice, entitled Maximising the Benefits: Joint ARC/HEC Advice on Intellectual Property, in August 1995. The advice was concerned with raising awareness about, and maximising the benefits of, intellectual property in higher education.

The Australian Research Council and the Higher Education Council developed their advice against the background of recent studies on intellectual property, which helped to clarify many legal issues associated with intellectual property protection. In the joint advice, the Australian Research Council and the Higher Education Council moved away from critique of intellectual property law which had characterised past reports. Instead it focussed on specific issues of concern to the higher education sector, including the perspective of the inventor for developing options for maximising the benefits arising from research. The advice commends to institutions the model used by the University of Cambridge. However, it should be noted that since the advice was written the University of Cambridge has modified its policy on intellectual property.

The advice also identified further work which would explore the role of university commercial arms or other university bodies in maintaining a good dialogue between industry and the higher education research sector.

It is also relevant to note that the Government has, on several occasions, emphasised the importance of improving collaboration between industry and universities and of developing more effective means of commercialising research and development.

THE PROJECT

The proposed project will assess technology transfer effectiveness and commercialisation performance at a number of selected universities. It will also establish criteria for developing a code of best practice for universities in Australia.
Issues around the commercialisation of university research include:

- identification of best practice and market impediments;
- roles and effectiveness of university commercial arms in providing market access, developing strategic alliances, providing expert services and carrying finance for the commercialisation of research;
- role of Cooperative Research Centres, Special Research Centres and other Government programs designed to foster university-industry linkages in the commercialisation process;
- university intellectual property policies, their implementation and effectiveness in fostering investment in commercialisation;
- competitive effectiveness of government and industry/commercial funding on research program formulation, implementation and commercialisation within universities;
- effectiveness of technology transfer in terms of information dissemination;
- assessment of alternative international models; and
- impact that the commercialisation of research might have on research training in some areas.

The main outcome of the project will be an outline of a code of practice which the Australian Vice-Chancellors' Committee might find useful in the handling of intellectual property technology transfer and commercialisation of research in Australian universities.

KEY TASKS

In particular the consultant will undertake the following tasks:

- review typical university intellectual property policies with samples drawn from a variety of institutions within the Unified National System, i.e.
  - large, research intensive, well-established
  - medium size with well developed research profile
  - developing research profile
  - regional and metropolitan
  - science and engineering orientated
  - humanities/social sciences orientated.
- assess the mechanisms for commercialisation of university research through selected case studies.
- develop a customer overview of the effectiveness of current policies, shortcomings and opportunities to increase effectiveness.
- develop an overview of current university intellectual property, technology transfer and commercialisation policies, together with key factors in establishing best practice.
- look for evidence of how the commercialisation of research affects or might affect research training.
Appendix 2

Consultant Work Program
<table>
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<tr>
<th>Stages</th>
<th>Stage 1: Project Definition</th>
<th>Stage 2: Institutional Reviews</th>
<th>Stage 3: Case Studies and Customer Overview</th>
<th>Stage 4: Consultation (Key Factors and Best Practice)</th>
<th>Stage 5: Reporting</th>
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<td>Tasks</td>
<td>1. Review ARC and other stakeholder expectations.</td>
<td>1. Collect preliminary survey data for selected institutions, using AVCC clearinghouse.</td>
<td>1. Carry out customer overview interviews.</td>
<td>1. Plan and facilitate a search format 1-2 day conference with about 20 university academic and administrative staff (including people from university companies), university commercialisation customers and other stakeholders to review possible Code of Practice elements.</td>
<td>1. Consult with key stakeholders about the recommended Code of Practice and amend as indicated.</td>
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<td>2. Agree work program, key milestones and project review processes.</td>
<td>2. Visits and face-to-face interviews and focus groups discussions with appropriate staff (academic and administrative) at selected institutions to:</td>
<td>2. Carry out selected case studies.</td>
<td>2. Prepare the final report of the project setting out:</td>
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<td>3. Review relevant literature and identify any additional data collection requirements.</td>
<td>- clarify existing practices and their effectiveness;</td>
<td>3. Prepare briefing papers as inputs to the consultation conference in Stage 4 including:</td>
<td>- the findings of the research;</td>
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<td>4. Preliminary survey, using AVCC clearinghouse, of possible institutions to be included.</td>
<td>- identify key external users/customers for the customer overview;</td>
<td>- issues arising from the literature and institutional reviews;</td>
<td>- key factors, performance measures and Best Practice in relation to university intellectual property management, technology transfer and commercialisation;</td>
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<td>5. Develop data collection questionnaire and interview checklists for institutional review, including typical university intellectual property objectives, policies, technology transfer and commercialisation practices, and impacts on research and research training.</td>
<td>- explore evidence on impacts on research and research training; and</td>
<td>- the findings of the customer overview and the case studies;</td>
<td>- a recommended Code of Practice; and</td>
<td>a recommended Code of Practice; and</td>
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<td>6. Develop detailed methodology for customer overview and case studies.</td>
<td>- select case study projects.</td>
<td>- key factors in commercialisation processes, appropriate performance measures and Best Practice in relation to these.</td>
<td>- suggested implementation and application strategies for adoption and use of this Code of Practice.</td>
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<td>7. Prepare Inception Report, including selection of institutions and detailed methodologies.</td>
<td>3. Prepare Progress Report No.1 setting out:</td>
<td>- respondents to be included and methodology for the customer overview;</td>
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Appendix 3

Statistical Performance Indicators
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<tr>
<td>James Cook University of Nth Qld</td>
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<td>4.82</td>
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<tr>
<td>University of New England</td>
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<td>18</td>
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<tr>
<td>University of Wollongong</td>
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<td>8.20</td>
<td>18</td>
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<tr>
<td>La Trobe University</td>
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<td>229</td>
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<tr>
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<td>193</td>
<td>2.70</td>
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<tr>
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<td>54</td>
<td>2.30</td>
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<tr>
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<tr>
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<td>260</td>
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<tr>
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<td>131</td>
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<td>Charles Sturt University</td>
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<tr>
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<td>1.00</td>
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<tr>
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<td></td>
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<tr>
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<td>0.60</td>
<td>3</td>
<td></td>
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<td></td>
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<tr>
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<td>87</td>
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<tr>
<td>Edith Cowan University</td>
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<td>na</td>
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</tr>
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<td></td>
</tr>
<tr>
<td>Marcus Oldham Farm Mangt</td>
<td>0</td>
<td>2</td>
<td>na</td>
<td>na</td>
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<tr>
<td>ADFA</td>
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<td>na</td>
<td>na</td>
<td>na</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ANU - Faculties</td>
<td>na</td>
<td>na</td>
<td>na</td>
<td>na</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ANU - IAS</td>
<td>na</td>
<td>na</td>
<td>na</td>
<td>na</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Source: Andrews et al 1997
Appendix 4

Questionnaire for Preliminary University Survey

This appendix contains the questionnaire and the covering letter sent out to all Vice-Chancellors inviting them to participate.

Covering letter
Dear Vice-Chancellor

Study on
The Development of Best Practice for Commercialisation/Technology Transfer practices in the higher education system

This study has been commissioned by the Australian Research Council (ARC) to develop a code of best practice for Commercialisation/Technology Transfer practices in the higher education system. I understand that Professor Vicki Sara, Chair of the ARC, has sought and obtained clearance from the AVCC to request data from institutions about their intellectual property policies and commercialisation practices. I am writing to seek your University’s participation in the survey that forms the first stage of this important study.

Study work program
The study will consist of a number of stages:

1. A survey of present arrangements to support commercialisation and technology transfer in Australian Universities.
2. A survey of the local and overseas literature on University research commercialisation practices and recent initiatives.
3. More detailed reviews by two of the consultant team in each case of practices, successes and problems, both in commercialisation and in the impacts on postgraduate research training; about six Universities of different types will be selected for these reviews.
4. About six case studies of specific commercialisation projects, including technology parks.
5. Interviews with research users involved with Universities selected for the reviews.
6. A workshop involving about 20 people from the Universities and industry to review the findings of the study and identify the key Best Practice criteria to be included in the consultants’ final report.

Consultant team
The consultant team involved under my leadership includes John Yencken, Professor John Coghlan, Donald Anderson and Marcus Spiller.

Initial survey
Our questionnaire for the initial survey is attached. I would appreciate your direction of this request to your university’s designated contact officer. Should you or your designated colleague wish to discuss further any aspects of this survey or the study, my telephone number is (03)9827-8943 and my FAX number is (03)9827-9899. E-mail should be directed to karecons@ozemail.com.au. My colleague John Yencken is available by telephone on (03)9827-4433.

We would like have your response to the attached questionnaire by January 30 to allow us to meet our progress reporting deadline to the Australian Research Council.

Participation
We also ask if you will be interested to nominate a participant in the proposed workshop to review commercialisation Best Practice criteria. We look forward with much interest to working with you and your colleagues in this important study.

David Cripps
Partner, The Melbourne Consulting Group Pty. Ltd.
Questionnaire

The Melbourne Consulting Group Pty. Ltd.

Australian Research Council Consultancy

Development of Best Practice Criteria for Commercialisation/Technology Transfer Practices in the Higher Education System

Name of University ........................................... Date ....../....../......
Name of officer responding ........................................
Contact: Telephone: ....................... FAX: ............... E-mail: ..................

Confidentiality: If any of the information supplied is to be kept Confidential by the consultants and not disclosed to any third party, please indicate accordingly in your covering letter.

Reports and Policy statements
If available, please attach
1. a copy of your latest Annual Report.
2. a short statement on your University’s research commercialisation and technology transfer policy and objectives.
3. an extract from your Terms and Conditions of Employment that set out conditions for academic staff
   • taking on external consultancies and directorships
   • sharing in external earnings such as royalties from licensing of patents and other intellectual property
   • other technology related external earnings.
4. an extract on your policy on undergraduate and postgraduate student rights to shares in intellectual property ownership and other royalty income while studying at the University.
5. copies of or references to any studies carried out in your University on commercialisation of University research.

Q.1 What % of consultancy earnings are retained by the University when a staff member organises a consultancy through the University or one of its companies? ......%
Q.2 How many postgraduate students did you have in 1997 with the following awards?

<table>
<thead>
<tr>
<th>Type of award</th>
<th>No. Masters students</th>
<th>No. PhD students</th>
</tr>
</thead>
<tbody>
<tr>
<td>Australian Postgraduate Award</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Australian Postgraduate Award - Industry</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cooperative Research Centre scholarship</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Other University award</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Own funding or external award</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Q.3. Have intellectual property arrangements been agreed with the various student associations? Circle one.

Undergraduate YES NO
Postgraduate YES NO

Q.4. Please place a tick (✓) in those cells in the table below that best describe the way in which your University manages its external research related fund generating activities.

<table>
<thead>
<tr>
<th>Activity</th>
<th>External consultancies and advisory services</th>
<th>Contract research</th>
<th>Patents</th>
<th>Licensing of intellectual property</th>
</tr>
</thead>
<tbody>
<tr>
<td>University role option</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. No formal University role.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. University role limited to ensuring that terms and conditions of employment (external earnings and time limits) are satisfied.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. Deans and Heads of Schools, Faculties and Centres have prime responsibility.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. These matters are handled by a section of the University administration.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5. The University has set up a separate company to manage these matters.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6. Other arrangements: please specify.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Q.5. Please list the companies concerned with research commercialisation and technology transfer, including training, that are fully or partly owned by your University or in which the University has a beneficial interest, together with their roles and activities, including spin-off companies:

<table>
<thead>
<tr>
<th>Name of Company</th>
<th>Contact officer</th>
<th>Contact Telephone No.</th>
<th>Role and activities</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Q.6. The table below indicates a number of disciplines and activities that may generate external earnings or important new commercial relationships with your University. Please place the most appropriate of the following codes in each cell of the table below:

A = External earnings potential $1 million pa or greater.
B = External earnings potential $100,000 or greater and < $1 million pa.
C = External earnings potential >$10,000 and < $100,000 pa.
D = External earnings potential $10,000 or less
<table>
<thead>
<tr>
<th>Discipline / Year</th>
<th>1996</th>
<th>1997</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Royalties &amp; licence fees</td>
<td>Research Contracts</td>
</tr>
<tr>
<td>1. Biosciences / medicine</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. Physical sciences</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. Engineering and engineering sciences</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. Economics</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5. Other social sciences</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6. Humanities</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7. Fine arts</td>
<td></td>
<td></td>
</tr>
<tr>
<td>8. Other</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Q.7. Please indicate your annual expenditure over the last two years in supporting your external earnings and technology transfer activities by placing one of the following codes in each cell of the table following:
A = Expenditure $1 million pa or greater.
B = Expenditure $100,000 and greater and < $1 million pa.
C = Expenditure < $100,000 and > $10,000 pa.
D = Expenditure $10,000 or less.

<table>
<thead>
<tr>
<th>Discipline / year</th>
<th>1996</th>
<th>1997</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Royalties &amp; licence fees</td>
<td>Research Contracts</td>
</tr>
<tr>
<td>1. Biosciences/ medicine</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. Physical sciences</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. Engineering and engineering sciences</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. Economics</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5. Other social sciences</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6. Humanities</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7. Fine arts</td>
<td></td>
<td></td>
</tr>
<tr>
<td>8. Other</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Q.8 Please list your five major successes in the last three years in technology transfer and commercialising research outcomes from your University.

<table>
<thead>
<tr>
<th>Activity</th>
<th>User or Partner Company (unless Confidential) or industry</th>
<th>Additional research funding obtained by University $'000s</th>
<th>Potential economic benefit to client $'000s and relevant time period, eg per annum</th>
<th>Cost to University in achieving successful commercialisation $'000s</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.</td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>3.</td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>4.</td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>5.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Q.9 Please list any projects which have been less successful than you might have wished in achieving effective commercialisation of your research and indicate your understanding of the reasons for such failure(s).

<table>
<thead>
<tr>
<th>Activity</th>
<th>Reason for failure</th>
<th>Cost to the University $'000s</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Q.10 Please indicate any initiatives taken by your University to provide further training to your academic and administrative staff on research commercialisation, intellectual property, consultancy management and related issues.

-------------------------------------------------------------------------------------------------

-------------------------------------------------------------------------------------------------

Q.11 Please list any technology parks or precincts that are owned and/or operated by the University.

<table>
<thead>
<tr>
<th>Name / description</th>
<th>Location</th>
<th>Area (ha.)</th>
<th>Manager Name / Identity</th>
<th>Telephone Contact</th>
<th>Year in which started</th>
<th>Activities</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
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<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
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<td>3</td>
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<tr>
<td>4</td>
<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Q.12 Which of the following statements best describes the University's objectives in establishing these technology parks/precincts? Please tick(✓) only one.

1. Generating income from land surplus to the University's teaching and research activities
2. Attracting industry/commerce with which the University has established commercial relationships
3. Attracting new industry/commercial interests of potential value to the University
4. Generating new research commercialisation and technology transfer opportunities with local industry
5. Generating more jobs locally
6. Other, please specify
Q.13. How well has your technology park/precinct satisfied each of the six objectives listed below?

Please score points out of ten maximum, eg 5/10 for about average.

<table>
<thead>
<tr>
<th>Objective No.</th>
<th>Achievement of objective Score ?/10.</th>
<th>Reasons for indicated achievement</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Income from surplus land</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. Attracting established industry/commerce</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. Generating research funds from industry</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. Attracting new industry</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5. Improving technology transfer to industry</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6. More local jobs</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Q.14 We plan to select six different Universities for more detailed review. Please indicate whether you will wish to participate in one of these more detailed reviews. Please circle one of the following.  
YES NO POSSIBLY

Q.15 We plan to organise a workshop in mid May to which we will present the findings from this study. This workshop will because of budgetary constraints involve people from some but not from all Universities.

Do you wish to participate in this workshop? Please circle one.  
YES NO

If YES, please nominate one or two people that you would like to participate in this workshop:

1. ........................................ Position ................................ Telephone
2. ........................................ Position ................................ Telephone

Thank you for your cooperation in completing this preliminary survey.

If you wish to discuss any aspects of this survey, please contact David Cripps on (03)9827-8943 or John Yencken on (03)9827-4433 FAX (03)9827-8299 E-mail karcons@ozemail.com.au.

David Cripps, Director, The Melbourne Consulting Group Pty. Ltd.
<table>
<thead>
<tr>
<th>University Code No.</th>
<th>Activity</th>
<th>Reason for failure</th>
<th>Cost to University</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>Directional antenna, cellular</td>
<td>Unable to convince user and NIH syndrome</td>
<td></td>
</tr>
<tr>
<td></td>
<td>telephone</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Cardioactive plants</td>
<td>No commercial interest</td>
<td>$100,000</td>
</tr>
<tr>
<td>10</td>
<td>ATM switch</td>
<td>No commercial interest</td>
<td>$100,000</td>
</tr>
<tr>
<td>13</td>
<td>Signal processing software</td>
<td>Premature publication</td>
<td>$10,000</td>
</tr>
<tr>
<td>14</td>
<td>Air conditioning</td>
<td>Inadequate technology</td>
<td>$300,000</td>
</tr>
<tr>
<td></td>
<td>TRUST software</td>
<td>Delay in achieving research goals</td>
<td>$0.5m</td>
</tr>
<tr>
<td></td>
<td>Solar dryer</td>
<td>Lack of funds for prototype</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Novel antibiotic</td>
<td>Excess time taken to produce pure material.</td>
<td>$2m</td>
</tr>
<tr>
<td>28</td>
<td>Patent for malaria drug</td>
<td>Major pharmaceutical company discontinued licence</td>
<td>$20,000</td>
</tr>
<tr>
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<td>Silicon metal recovery from</td>
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<td>dross</td>
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<tr>
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<td>Stump jump plough</td>
<td>Company too small to commercialise</td>
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<td>Modem for communications</td>
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<td>Water proofing construction</td>
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*Source: MCG University Survey*
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<td>VUT</td>
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Source: MCG University Survey
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<tr>
<th>University Code No.</th>
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<th>Cost to university</th>
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<td>13</td>
<td>Adelaide</td>
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<td>Adelaide Brighton</td>
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<td>$2m pa</td>
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<td>University Code No.</td>
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<td>50%</td>
<td>50%</td>
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<td>7%</td>
<td>16%</td>
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<td>71%</td>
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<td>14%</td>
<td>21%</td>
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<td>37%</td>
<td>7%</td>
<td>17%</td>
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<td>D = Earnings $10k or less</td>
<td>7%</td>
<td>7%</td>
<td>7%</td>
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<td>14%</td>
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<tr>
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<td>0%</td>
<td>0%</td>
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Source: MCG University Survey
Appendix 6

Research User Interviews

Checklist for Research User Interviews
(Telephone Interviews with Users of University Research)

CONFIDENTIALITY: Responses will be aggregated.
No individual response will be quoted directly.

Background
- Name:
- Position:
- Tertiary qualification: first degree/diploma, Master’s, PhD
- Organisation:
- Universities with which involved:
- Disciplines:

Relationship

How did the first contact take place? When? Your initiative? University person’s initiative? If University initiative was it from the academic researcher or from the University’s commercialisation office or company or from some other person?

How well has the university concerned handled these relationships? How good is the trust between you? Any communication problems? Any confidentiality or publication issues?

When you approach a University with a problem, what do you expect out of your first contact? Eg.
where the expertise is speed of response
getting on to the right person.

What is your experience in dealing with University companies or Business Liaison Offices as opposed to individual academics?

Specific agreements

How many formal relationships with each institution since then? Does this tend to be repeat business with the same group within the university?

Explore
- Consultancies
- Research contracts
- IP licensing
- Spin-off companies.
How well did the University people handle the negotiations? How could they do it better?

What have been the main problem areas?

Professor Mann of the Melbourne Business School has identified a number of success factors and asked industry users to rank these: Do you agree with this ranking? Are there other success factors?

1. Good planning
2. Personal contact
3. Understanding the partner’s needs
4. Good researchers
5. Integration of expertise
6. Financial support
7. Equipment and infrastructure
8. Attracting work/flexibility

Are there any other comments that you would like to make?
List of Companies/Agencies Interviewed

General Category (20 interviews)
- AMCOR Ltd.
- AMRAD Ltd.
- Australian Pulp and Paper Institute
- BHP Ltd.
- Ceramic Fuel Cells Pty. Ltd.
- Circadian Technologies Pty. Ltd.
- CRA Ltd.
- CSIRO
- CSL Ltd.
- Energy Research and Development Corporation
- F.J. Faulding & Co. Ltd.
- Fujitsu Australia Ltd.
- General Motors Holden Automotive Ltd.
- Glaxo Wellcome Ltd.
- Hawker de Havilland Australia Ltd.
- J&J Research Pty. Ltd.
- Kodak (Australasia) Pty.Ltd.
- Orica Ltd.
- Rothschild Australia Ltd.
- Strategic Industry Research Foundation

Specific University Project Category (19 interviews)
- A Goninan & Co. Ltd
- A medical practitioner
- An oncologist
- Cadia Holdings Pty. Ltd.
- Cardia Mining Ltd.
- Chr. Hansen Pty. Ltd.
- Comalco Ltd., Weipa
- Ericsson Australia Pty. Ltd.
- Fire Code Reform Centre
- Future Fibre Technologies Pty. Ltd.
- MD Research Pty. Ltd.
- MIM Technologies Pty. Ltd.
- Mouldflow Pty. Ltd.
- Novogen Pty. Ltd.
- Pittwater Council
- Regal Cream Products Ltd.
- SGE International Ltd.
- Sugar Research Institute
- TUNRA Pty. Ltd.
Appendix 7

Research User Interviews: Summary of Findings

These are included in the following pages.
<table>
<thead>
<tr>
<th>Industry sector</th>
<th>Disciplinary area</th>
<th>Initial contact</th>
<th>Finding out where expertise is</th>
<th>Speed of response</th>
<th>Duration of relationship</th>
<th>Getting on to the right person</th>
<th>Relationship type</th>
<th>Negotiation and performance</th>
<th>Experience with university companies/ liaison offices</th>
<th>Key success factors</th>
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<tbody>
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<td>2 Pharmaceutical, Medical technology</td>
<td>Biochemistry, Chemistry, Pharmacology</td>
<td>University researcher. Used networks, not the university office.</td>
<td>OK through networks.</td>
<td>OK</td>
<td>OK through networks.</td>
<td>Prefer joint ventures 60% company, 40% university. Research agreements. IP licensing. Spin-offs.</td>
<td>OK, but always tension over publication. Prefer to work with one contact. Use them to compete for the agreement at the finish.</td>
<td>1. Good researchers; 2. Understanding partners' needs, and 3. Planning. Other integration expertise is poor. Equipment infrastructure varies from good to poor.</td>
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<td>3 Pharmaceutical</td>
<td>Chemistry</td>
<td>Mostly from approaches by university researcher. Usually hard to find out where the expertise is</td>
<td>Slowish</td>
<td>Often difficult</td>
<td>10 years</td>
<td>Research collaborations, Occasional consultations.</td>
<td>OK, Good trust. But negotiations can bog down by minor/technical matters. Educate researchers</td>
<td>Academics open, easy to deal with. Companies/Offices can be too protective.</td>
<td>1. Good researchers; 2. Integration of expertise. Researchers know little about expertise on campus outside their own area, 3. Understanding partners' needs usually poor, 4. Good planning, and 5. Personal contacts a bonus!</td>
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<td>4 Pharmaceutical</td>
<td>Chemistry, Engineering, Pharmacology, Veterinary Science</td>
<td>Company approaches universities</td>
<td>No problems</td>
<td>Often slow</td>
<td>No problems</td>
<td>All models. Good for 75%, disaster for the other 25%</td>
<td>No issues with publication negotiations usually OK, but one hard case.</td>
<td>Very, very poor. Lack of critical mass of skilled and competent people</td>
<td>Suggests reducing the number of technology transfer offices from the present 10 to one in each State that could afford to have competent IP managers.</td>
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<td>Industry sector</td>
<td>Disciplinary area</td>
<td>Initial contact</td>
<td>Finding out where expertise is</td>
<td>Speed of response</td>
<td>Duration of relationship</td>
<td>Relationship type</td>
<td>Negotiation and performance</td>
<td>Experience with universities/ liaison offices</td>
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<tr>
<td>5 Medical diagnostics</td>
<td>Pharmaceutical, Medical Science</td>
<td>Initial contact many by researchers 20 approaches have resulted in only 3 research contracts.</td>
<td>University central knowledge poor.</td>
<td>Slow, need more delegations.</td>
<td>Used networking based on own knowledge of the university</td>
<td>18 months</td>
<td>All modes, including several spin-off companies.</td>
<td>Generally not well. In one case excessively slow and logistic.</td>
<td>Usually OK. Universities should try to create more companies to create critical mass of investment expertise.</td>
<td>Creating trust is a problem area. 1. Personalities, 2. Planning, and 3. Good research</td>
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<tr>
<td>6 Pharmaceutical</td>
<td>Immunology, Cell &amp; Molecular Biology</td>
<td>Pre-existing contacts and company understanding of technology and expertise</td>
<td>All modes</td>
<td>Slowness at some stages, but no real problem areas.</td>
<td>Most collaborations involve SPINT grants. All initial contacts with researchers. Business liaison people only involved over IP.</td>
<td>1. Good research researchers; 2. Personal contact; 3. Planning; and 4. Understanding partners needs.</td>
<td>Others in Monn order.</td>
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<tr>
<td>7 Medical technology</td>
<td>Medicine, Chemistry, Pharmacology</td>
<td>Usually technology transfer office calls about discovery and then they are visited</td>
<td>Spin-off and start-up companies</td>
<td>A nightmare due to involvement of university bureaucrats, inexperience of technology transfer offices and companies in negotiating equity in spin-offs and lack of delegations by university governing bodies on new spin-off equity investment.</td>
<td>Lack of experience in start-up company equity investment negotiations. Decisions need to be delegated to a company board or other group that meets frequently and regularly and which has external commercial experience. NOTE: US experience is equally variable but Southern universities less so</td>
<td>1. Understanding partners' needs; work at what the other party wants to get out of the deal; 2. Experience in negotiating spin-off equity investment; 3. Speed and diligence in processing agreements; 4. Bring in private sector people and give them and university company managers a slice of the action, eg. options or having a group of business angels or a seed fund nearby; and 5. Look in Australia of experienced technology development managers.</td>
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<td>8 General</td>
<td>Most disciplines</td>
<td>Performance is very variable between and within Universities. Some are very good.</td>
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<td>1. Understanding partners' needs; 2. Personal contacts; 3. Good researchers; and 4. Good planning.</td>
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<tr>
<td>9 Information Technology</td>
<td>Computer Science</td>
<td>Mixed university interested in equipment, user interested in university capabilities. In one situation, joint participation between Australian and parent company researcher established the credibility bond.</td>
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<td>Research contracts and research joint ventures.</td>
<td>Issues are how research might be commercialised and targeted university cash, contribution has to be in-kind. Key issue is always IP. Universities getting more realistic about IP value.</td>
<td>World class and recognised credible researchers. Australian researchers are competing in a highly competitive global market. Rest of the world does not share Australia's innovation self-image. Essential to go out and find niches opportunities and establish credibility as world class researchers. A big selling job. Government should be able to help</td>
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<td>10 Energy</td>
<td>Physics, Engineering</td>
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<td></td>
<td>Factors affecting performance include tension between teaching and research, tension between publication and creating salable IP, the constant need to find money that results in senior academics taking on too many projects and not giving enough time to lead individual projects</td>
<td>Performance in relation to the Mann criteria is very variable. Only 20% of university departments/academics perform well against the Mann criteria. Suggested added criterion is delivery of agreed outputs.</td>
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<td>11 Pulp &amp; paper</td>
<td>Chemistry, Physics, Chemical Engineering</td>
<td>University had resources complementary to the company user</td>
<td></td>
<td></td>
<td>Collaborative SP/RT grants, testing services,</td>
<td>Relationships through CRC vary strongly. Direct other university relationships suffering because of differing business cycle commercial imperatives, so emphasis on cost reduction rather than new packaging solutions and associated user/company management changes</td>
<td>Little contact</td>
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<td></td>
<td>1. Personal contacts; and</td>
<td>2. Understanding user needs, maybe continuing education and laboratory visits if research directions run ahead of user awareness of need.</td>
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<tr>
<td>Industry sector</td>
<td>Disciplinary area</td>
<td>Initial contact Who by?</td>
<td>Finding out where expertise is</td>
<td>Speed of response</td>
<td>Duration of relationship</td>
<td>Relationship type</td>
<td>Negotiation and performance</td>
<td>Experience with university companies/ liaison offices</td>
<td>Key success factors</td>
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<tr>
<td>12 Pulp &amp; paper</td>
<td>Chemistry and Chemical Engineering</td>
<td>Universities need to invite industry research and other managers to come and give talks in post-graduate seminars</td>
<td>18 years. Research contracts, CRIs</td>
<td>Would like to see a bit more interest. Many are not trying to build bridges to industry. Need more emphasis on proper project planning</td>
<td>The best comes into a negotiation very well prepared</td>
<td>1. Keeping tabs on what the industry challenges are, but equally industry needs to be proactive in telling universities what its problems are; and 2. university people need to recognise how important time is to commercial people</td>
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<tr>
<td>10 Mining</td>
<td>Chemical Engineering, Materials, Physics, Mathematics</td>
<td>Mixture, but more likely to approach researcher with ongoing relationship. Tend to have repeat business with a selected group of providers.</td>
<td>Not too bad, own networks and CSIRO help</td>
<td>Many years</td>
<td>Consultancies, research contracts, IP licensing</td>
<td>Dealing with university companies can be complex. There must be a critical mass of negotiation and IP competence and understanding of the options, eg royalties versus more research funding</td>
<td>1. Understanding other partner's needs; what each party wants to get out of the agreement; 2. personal contact building relationships with other groups; and 3. good planning</td>
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<tr>
<td>14 Materials</td>
<td>Several</td>
<td>User has perceived need and uses networks to identify Head of Department as first contact</td>
<td>Large company executives have established networks. This can be very difficult for SMEs.</td>
<td>Many years</td>
<td>Consultancies, research contracts, IP licensing</td>
<td>Negotiations directly with Department head generally go smoothly. While company has own standard agreement, a standard is useful in early stages</td>
<td>Less satisfactory cooperation when university company/office indirectly involved. Some very professional, but others show intellectual arrogance and seek unrealistic IP conditions and payments</td>
<td>Generally agree with Mann factors. Ranking of top four of these can vary</td>
<td></td>
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<tr>
<td>15 Industry research support</td>
<td>Biosciences, IT</td>
<td>Mainly researcher initiative. Generally the earlier the better for the connection between the researcher and the user/funds provider</td>
<td>Many years</td>
<td>Problem is inability of research providers to move quickly and natively. The researcher needs to get used to the way in which an investor thinks - time consuming</td>
<td>Low view of university companies. They do not add much value. Also problems of multiple layers of lawyers</td>
<td>All Mann factors are relevant. Researchers often raise investor expectations, but have difficulty in producing results, risk and timelines. Researchers loath to be cancelled and are not able to produce and stay with investor realistic timelines</td>
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<td>Industry sector</td>
<td>Disciplinary area</td>
<td>Initial contact</td>
<td>Finding out where expertise is</td>
<td>Duration of relationship</td>
<td>Relationship type</td>
<td>Negotiation and performance</td>
<td>Experience with university companies/ liaison offices</td>
<td>Key success factors</td>
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<tr>
<td>16 Photography, chemicals</td>
<td>Physics, Chemistry, Chemical Engineering</td>
<td>User initiative, usually via postgraduates, student supervisor or personal contact</td>
<td>Personal contact</td>
<td>Many years</td>
<td>Research, contracts (usually long term), scholarships. They keep company in touch with the researcher. If urgent or important, do the work in-house</td>
<td>Directly with researcher. We understand/ know/ trust each other. It takes years to build this trust. The problem researchers are those with their hands out for support</td>
<td>Disaster. They overstate their worth. But they can help to tidy up after an agreement muddle</td>
<td>1. Personal contact 2. Trust and 3. Understanding partner's needs</td>
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</tr>
<tr>
<td>17 Chemicals</td>
<td>Chemistry, Chemical Engineering</td>
<td>By user to supervisor or former supervisor. Often researchers approach the company, but if not consistent will not get contracts. Look for long-term active relationship</td>
<td>Personal contact</td>
<td>Few retainers. Most project based contract research</td>
<td>Directly with researcher using company's standard contracts giving company worldwide use of IP, but researcher can still own it. Generally happy with AVCC/IP policy recommendations</td>
<td>Recognise role is to safeguard universities from unproductive interactions between users and inexperienced staff. Only deal with them if this cannot be avoided</td>
<td>Agree with Marine factors 1. Good personal contacts and relationship</td>
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<tr>
<td>18 Aerospace</td>
<td>Aeronautical Engineering</td>
<td>Long term relationships with universities that provide aeronautical engineering courses</td>
<td>Personal contacts, particularly through CRCs</td>
<td>Directly through CRCs. Cadeishes, scholarships, research contracts</td>
<td>Directly with researcher. But too many researchers think commercial involvement is grubby</td>
<td>Always a problem as they seek a percentage of the action. But there is a need for central help with costing, proposals, contracts</td>
<td>Agree with Marine criteria and general ranking</td>
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</table>

### Individual relationships

<p>| 1 Engineering | Engineering | By University researcher looking for funding involvement | Need a directory of academic and research interests. Problem is keeping up-to-date | Spin-off company | Frustratingly slow through having to work at too many levels. Head of Department, Dean of Faculty, Vice-Chancellor's Office, Senate | Not much involvement. They need to work on streamlining procedures and the total approach to contract negotiation | 1. Understanding partner's needs academicians do not understand commercial practices and commercial time deadlines; 2. good researchers need to protect individual creativity and 3. project management and team building skills are needed at the TD stage |
| 2 Processed food | Food technology | Approach by university researcher | Collaborative research grant, involving a masters student | Very pleased. No problem areas | Not involved | A loose agreement, but agreed timelines have been met |</p>
<table>
<thead>
<tr>
<th>Industry sector</th>
<th>Disciplinary area</th>
<th>Initial contact</th>
<th>Finding out where expertise is</th>
<th>Speed of response</th>
<th>Duration of relationship</th>
<th>Relationship type</th>
<th>Negotiation and performance</th>
<th>Experience with university companies/liaison offices</th>
<th>Key success factors</th>
</tr>
</thead>
<tbody>
<tr>
<td>3 Processed food</td>
<td>Food technology</td>
<td>University seen to be world authority</td>
<td>A long time</td>
<td>Research contracts with IP licensing</td>
<td>Excellent with present university, but poor in earlier situation.</td>
<td>Very satisfactory.</td>
<td>1. Trust developed from previous relationships; repeat business; 2. Quality of researchers; and 3. Meeting agreed deadlines; no problems to date.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5 Mineral processing</td>
<td>Engineering</td>
<td>A long time</td>
<td>Contract research and IP/technology licensing</td>
<td>Excellent personal relationships and commercial relationships within the university.</td>
<td>1. Good understanding of partners’ needs; 2. Good research teams; and 3. Well supported with necessary equipment.</td>
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<tr>
<td>6 General</td>
<td>Engineering &amp; Medicine</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1. Planning is good; 2. Good personal contacts; and 3. Good-quality research.</td>
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</tr>
<tr>
<td>7 Engineering</td>
<td>Engineering</td>
<td>10 years</td>
<td>Testing and contract research.</td>
<td>Generally supports Mann criteria and excellent performance of university against them.</td>
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<td>8 Oncology</td>
<td>Medicine</td>
<td>User initiative because of university reputation in the field.</td>
<td></td>
<td>Generally supports Mann criteria and excellent performance of university against them.</td>
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<tr>
<td>9 Biological research</td>
<td>Medicine</td>
<td></td>
<td></td>
<td>Company is very good, not just money handling agency. It adds value to both the researchers work for its clients and the relationships with these clients.</td>
<td>Generally supports Mann criteria and excellent performance of university against them, particularly the ‘added value’ referred to earlier.</td>
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</tr>
<tr>
<td>10 Pharmaceutical</td>
<td>Medicine</td>
<td>User initiative, but via alumni.</td>
<td>Already had strong relationship</td>
<td>3 years</td>
<td>Generally good for individual researchers and business liaison/IT company people, but cultural blockages still; mouth desire to do more, but not entirely friendly to research commercialisation. Problems in dealing with a conservative monolithic structure.</td>
<td>Generally good experiences with companies/offices and individual researchers, but unreflective. US universities look for benefits beyond the immediate bottom line, eg public image, alumni perceptions and hence generosity.</td>
<td>Tremendous resource of good researchers in Australia, but is the people in US universities that come to us.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Industry sector</td>
<td>Disciplinary area</td>
<td>Initial contact</td>
<td>Finding out where expertise is</td>
<td>Speed of getting on to the right person</td>
<td>Duration of relationship</td>
<td>Relationship type</td>
<td>Negotiation and performance</td>
<td>Experience with university companies/ liaison offices</td>
<td>Key success factors</td>
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<tr>
<td>11 Agriculture</td>
<td>Chemistry, Engineering</td>
<td>Conferences, followed by user initiative</td>
<td>We know before about people and what they can do.</td>
<td>Collaborative research, including IP licensing</td>
<td>Personal relationships are critical in some Universities, researchers individual relationships are difficult.</td>
<td>Collaborative research, including IP licensing</td>
<td>The good experience was in the thoroughness with which the proposal was prepared.</td>
<td>Little contact</td>
<td>All relevant 1. Close individual relationships, and 2. Strong planning collaboration; joint planning is not a problem for engineers and applied research institutes.</td>
</tr>
<tr>
<td>12 Energy</td>
<td>Engineering, Science</td>
<td>University initiative</td>
<td>Research contract</td>
<td>Very much a mixed bag at all levels. Difficulty in getting an agreement. With some exceptions, it is generally difficult to negotiate with Universities.</td>
<td>The good experience was in the thoroughness with which the proposition was prepared.</td>
<td>Research contract</td>
<td>Very much a mixed bag at all levels. Difficulty in getting an agreement. With some exceptions, it is generally difficult to negotiate with Universities.</td>
<td></td>
<td>1. Responsiveness to the real market; and 2. Understanding that you have to invest or go into debt, is risk management.</td>
</tr>
<tr>
<td>13 Construction</td>
<td>Engineering</td>
<td>Research user initiative due to concern about lack of trained people</td>
<td>User knew about expertise</td>
<td>Directly with researcher. Very easy. But after lawyers got involved on IP issues, much more difficult.</td>
<td>Not involved</td>
<td>Some research contracts postgraduate and sub-professional education</td>
<td>Directly with the scientists. A lot of hard work, but early recognition of common objectives</td>
<td></td>
<td>Close cooperation and trust. Always need to keep track of what is expected of both partners and for the outcome.</td>
</tr>
<tr>
<td>14 Environment</td>
<td>Marine biology</td>
<td>Workshop led to user initiatives</td>
<td>Workshop on inter-state environmental protection</td>
<td>Support for community outreach programs, environmental modeling</td>
<td>Not involved</td>
<td>Workshop on inter-state environmental protection</td>
<td>Support for community outreach programs, environmental modeling</td>
<td></td>
<td>Key issue was scientific theory of local government intermediary who could interpret advanced marine biology concepts for use in a community programme.</td>
</tr>
<tr>
<td>15 Minerals</td>
<td>Chemistry</td>
<td>University researcher</td>
<td>Synthesis company with university equity</td>
<td>University company only 20% involved. Most dealings were with the researcher. Company people were more pragmatic and had a different agenda</td>
<td>Not involved</td>
<td>University researcher</td>
<td>University company only 20% involved. Most dealings were with the researcher. Company people were more pragmatic and had a different agenda</td>
<td></td>
<td>1. Keeping the investors heavily involved; 2. Fundamental belief that the technology 'has legs' - how it fits into the market, how it can make money, increased user role - the reality check; and 3. Understanding the engineering risk, and that TTO requires different skills company brought in management to do the D stage.</td>
</tr>
<tr>
<td>16 Metals</td>
<td>Company approached university looking for a PhD graduate</td>
<td>Very easy, university people keen to work with industry</td>
<td>Major issue was slow response by university solicitor</td>
<td>Collaborative research with PhD student</td>
<td>Generally good. Company was looking for marketing benefits from involvement with a world renowned group</td>
<td>Collaborative research with PhD student</td>
<td>Generally good. Company was looking for marketing benefits from involvement with a world renowned group</td>
<td></td>
<td>1. Good researchers, and 2. Personal contacts / understanding partners' needs: it takes time to build these relationships</td>
</tr>
<tr>
<td>Industry sector</td>
<td>Disciplinary area</td>
<td>Initial contact</td>
<td>Finding out where expertise is</td>
<td>Speed of response</td>
<td>Getting on to the right person</td>
<td>Duration of relationship</td>
<td>Relationship type</td>
<td>Negotiation and performance</td>
<td>Experience with university companies/ liaison offices</td>
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<td>17 Telecommunications</td>
<td>Electronics, Physics</td>
<td>Company approached university, as having required expertise and resulting from earlier personal contacts</td>
<td></td>
<td></td>
<td>Several years.</td>
<td>Research contracts and IP licensing</td>
<td>Good experience when dealing directly with senior university researcher who handled aspects involving other university people. Biggest problem is time availability and commitment to meet agreed deadlines.</td>
<td>In two other situations, the involvement of university administrators or companies generated delays and complexity. Particularly unattractive was university company wanting part of the action.</td>
<td>Available level of commitment and ability to meet timelines and user expectations, given heavy teaching loads. Otherwise generally supported the Mann criteria.</td>
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<tr>
<td>18 Mining</td>
<td>Environmental Science</td>
<td>User approach, arising out of Environmental Impact Study. Researchers seen to understand local flora and fauna</td>
<td></td>
<td></td>
<td>3 years</td>
<td>Research contracts, consultancy</td>
<td>Frustration on both sides, particularly having to deal with people in two different locations. Unnecessarily complex.</td>
<td>Objection to 10% surcharge to maintain competitive neutrality</td>
<td>Good researchers first. Planning to meet commercial timelines. Performance good, but slower than commercial sources in delivery.</td>
</tr>
<tr>
<td>19 Telecommunications</td>
<td>Electronics, Computer Science</td>
<td></td>
<td></td>
<td></td>
<td>Many years</td>
<td></td>
<td>Performance very variable between Universities. Key is attitude and calibre of the leader of the department concerned.</td>
<td>Mann criteria generally relevant: 1. Understanding partners' needs; 2. good researchers; 3. personal contact; and 4. good planning</td>
<td></td>
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<tr>
<td>20 Chromatography equipment</td>
<td>Chemistry</td>
<td>Use networks to identify individual researcher, then direct contact</td>
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<td></td>
<td>Performance very variable, both between and within institutions. Function of the individual, not the institution</td>
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</table>

Source: MCG Research User Survey
Appendix 8

Checklist for Reviews of Selected Universities
(Chapter 1.7 refers)

1. Adequacy of IP and Commercialisation Policies
1.1 Review documentation and history of implementation
1.2 Review roles in implementation of central administration, research or commercialisation office, Deans and Directors, separate incorporated entity
1.3 Review implications for staff appointments and promotion, research student training and other University issues
1.4 Discuss reasons for recent changes, if any
1.5 Identify scope for improvement and whether planned
1.6 Review any commercialisation or research contract earnings objectives or targets and performance against them

Incorporated Entity
1.7 What is the rationale and role for a separate technology company, if there is one? If there is not one, why not?
1.8 What are the areas of activity of the company?
1.9 What objectives does the University set? Is it a source of funds or a conduit for funding of support for research commercialisation with all the proceeds going directly to the University or the inventors? Does it engage in entrepreneurial investment in new research? Any established venture capital relationships?
1.10 Does the company have internal funding resources to support additional applied research or market studies to add value to intellectual property before sale or licensing? If so, how are decisions made on the use of such funds?
1.11 Is the University happy with the performance of their company? How might it be improved?

2. Commercialisation of Research
2.1 Explore
• Authority to take out patents
• Staff and student access to commercialisation benefits
• Are commercial partners involved and when? (For each patent)
• Number of existing patents and total investment in them
• Handling of patent licensing
• Benefits received to date
• Benefits expected in future
2.2 Handling of copyrights, particularly software
2.3 Handling of any other formal IP, eg registered designs
2.4 Any other arrangements for research commercialisation not involving patents or copyright
2.5 Explore procedures and practices for finding a commercial partner when a patent has been filed, including timing of search for a partner in relation to timing of provisional application. How effective are they? How could they be improved?
2.6 Explore generation of spin off companies by the University or by University researchers: if any, assess their performance and the University’s support or barriers to such generation
2.7 What have been the key success factors and how might performance be improved?

3. Technology Transfer
3.1 Policies on academic staff secondments to industry and past practice and experience
3.2 Proportion of postgraduate research students with APA (I) awards
3.3 Explore attitudes to APA (I) awards
3.4 Marketing of APA(I) awards to industry and incentives and barriers at either end.
3.5 Industry experience for Honours year students: policy, if any, and past experience
3.6 Benefits to the University, eg contacts, closer collaboration, new research contracts, improvement to teaching from industry staff and student secondments
3.7 Problems created for the University on increasing such industry secondment, including degree award and staff promotion issues
3.8 Explore technology transfer initiatives through continuing professional and technician level training courses and programs.

4. Generation of Research Contracts and Other Commercial Relationships
4.1 Does the University produce an up-to-date skills database, eg hard copy or an Internet site, available to people in industry and elsewhere with problems or other research needs?
4.2 Does the University maintain a database of local and overseas companies and the various ‘product champions’ within them?
4.3 How effective is networking with research users? Are there any established strategies at university or School/Centre levels? What is the networking role of the university company?
4.4 Does the University have any strategy for the marketing of its research skills?
4.5 Does the University have any system for keeping regular personal contact with past and potential research users? At what level? Is it successful?
4.6 Explore for a number of recent research contracts how the first contact happened?
4.7 What else could be done to improve personal contact with potential research users and technology licensees?

5. Performance Criteria
Identify the key Best Practice Criteria under each of the following headings and assess the University’s performance in relation to such Best Practice criteria:

5.1 Technical soundness
- Does a practice achieve its ends? Does it work?
- How well does it work? How effective is it?
- What is good about Good Practice?
- How effective is access to good researchers and equipment?

5.2 Administrative practicality and cost
- What is the cost of the practice in relation to the benefit?
- How well does a practice fit with existing administrative structures and procedures?
- Are special arrangements necessary?

5.3 Acceptability
- What is the degree of support from the chief executive, staff at all levels, staff unions etc.?
- To what degree does the practice reflect Commonwealth, State or institutional policies?
- Are there any ethical or social issues?

5.4 Research user involvement
How effective are the following:
- Networking
- Planning
- Matching research user expectations
- Research sensitivity and cost/benefit assessment
- Early integration of research users into the research project
- Achievement of commercial outcomes
- Economic and employment benefit to Australia

5.5 Originality and General Utility
- What might be done differently?
- What are the lessons?
Appendix 9

Laboratory Record Keeping

The importance of good record keeping of experimental work has been highlighted by changes in US law in relation to the earliest priority date claimable in the US by overseas inventors. US inventors have previously been able to rely on “first to invent” provisions to entitle them to the award of a patent even though another foreign party may have filed an application with an earlier priority date than that belonging to the US inventor. These provisions previously allowed only US inventors to rely on laboratory records to establish the date of the making of an invention. Foreign patent applicants in the US were able only to claim the earliest priority date of their patent application (usually filed in a country with first-to-file laws) as the date of making of their invention. Thus, inventors outside the US were severely disadvantaged in proceedings to establish the date of the making of an invention.

It is now possible for overseas applicants in the US to rely on invention dates rather than filing dates, if evidence can be provided of prior invention. The burden to prove an invention date earlier than the filing date of a patent application is on the inventor claiming the earlier date and requires a very high standard of laboratory record keeping. It is well established that an inventor’s testimony, without corroboration, is not sufficient to prove an earlier invention date.

There are two basic elements considered in determining whether evidence is sufficient to prove an earlier invention date:

1. The invention must be independently corroborated.

2. There must be a diligent demonstration of “conception” and “reduction to practice” of the invention.

The best way of meeting the requirement for an independent witness is through witnessing laboratory records, as they are created, by signing and dating notebook entries. An independent witness must not be a co-inventor but should understand the nature of the work. An example of an appropriate witness is a technician who was not involved with the conception of the invention but was involved with its reduction to practice. A co-worker or supervisor who has observed the inventors work but is not a co-inventor is also an appropriate witness.

The second element is to verify the diligence and credibility of the inventor and as such the nature and quality of the record keeping is all important.
Records should be kept of the inventor's conception of the idea and reduction to practice in the laboratory notebooks. This should include dated records of conception of ideas, experimental aims which identify the utility of the invention (where this is not self-evident), discussions and conclusions of experiments. The experiments must follow a diligent course, ie steady, constant and without substantial interruption, as the diligence of the inventor may ultimately be used to determine the owner of the patent. Additionally, corroborating evidence should be carefully kept such as notes of laboratory meetings, diary entries, progress reports, grant applications, draft manuscripts and purchase orders. Failed experiments should also be recorded as these may be useful for demonstrating the non-obviousness of an invention.

In considering particularly the second element for verification of invention date, the quality of the notebook will be critical in demonstrating diligence and credibility of the inventor. Some guidelines are listed below for record keeping practice which will help establish inventor ownership.

Laboratory notebooks should be bound and uniquely numbered with a designated custodian responsible for assigning and cataloguing books.

An index at the front is useful and the notebook pages should be numbered with experiments appearing in chronological order. Where experiments go over more than one page the reference to previous pages should be clearly identified. Pages left blank should be crossed through or identified as intentionally left blank and dated.

All entries should be made in permanent ink in a single colour. Changes or additions should be initialled and dated. Changes should be crossed through such that the original text is legible and no white-out should be used. Result print outs and photographs should be dated and attached in permanent adhesive (no removable tape) and signed and dated across both the added document and underlying page. Results which fade over time should be photocopied or photographed prior to attachment. It is advisable to attach a hard copy of electronic records to the notebook, as electronic records can be altered and are likely to be treated with suspicion.

Each experiment should commence with a stated objective, particularly noting the date on which the idea was formed as well as the date or dates on which the work was commenced and completed and any unusual delays explained. The methods used should be clearly described including all protocols, conditions, equipment used, materials used (including source), yields, characterising data etc. such that they could be repeated by an independent person. Experiment design and calculations used should also be recorded clearly. If a standard method was used it should be fully referenced to the original publication.
The experiment should end with an analysis of experimental results and conclusions, as recognition of success is an important feature of the requirement of reduction to practice.

At the conclusion of the experiment the record should be signed and dated by the inventor and at least one independent witness. Both the recording of the experiment and the signing and witnessing should occur as soon as possible after the completion of the experiments. Any substantial delay in either of these should be accompanied by an explanation for the delay.

The US system of granting patents on the basis of the ‘first to invent’ means that all scientists should ensure their laboratory records perform not just the traditional function of enabling the preparation of peer-reviewed publications and grant applications but also protect the valuable intellectual property rights of the inventor.

Some guidelines for maintaining laboratory notebooks:

1. Use bound laboratory notebooks to which pages cannot be added or deleted (thread sewn into the binding). Do not use spiral notebooks. Each page should be numbered. Each new book should be numbered sequentially.

2. Record each entry in ink, so it is indelible. Never make deletions—make corrections by drawing a line though the entry and dating and initialising the change. Never remove pages or portions of a page for any reason.

3. Sign and date each entry. For example, “Pages _ through _, Name and Date.” If you don’t work on a project for a period of time, indicate it by stating “On vacation...”, “On other projects” etc.

4. Describe in detail the hypothesis, the experimental design, the materials and methods. Include all experiments—even the ones that fail. This shows diligence on your part. Record all results in the notebook, and record your conclusions in narrative form.

5. Be sure to write on every page. If you decide to skip a page (for example, you get to the end of one experiment near the bottom of the page and you want to start at the top of the new page), draw a diagonal line through the skipped lines and sign and date the diagonal line.

6. Permanently affix all labels, printouts etc. in the laboratory notebook with glue. Note – no paper clips or staples, which are temporary measures.
7. Computer generated and stored data are common. Because of the ease of changing computer stored data the courts have not recognised computer stored data as valid evidence unless it was: 1. printed out shortly after the data was created in the system and bound (for example, using hot binders), and 2. signed and dated by the person creating the data (for example, running the machine), and 3. corroborated by a third person. (See more on corroboration, below).

8. Corroborate each entry. This corroboration should occur as part of the review of the person’s laboratory work by the Principal Investigator, or other members of the research team. Each entry should be read by someone who did not perform the work, but who is competent to understand the work. “On this date I read the entries in this notebook from the entry dated _, on page _, to and including the most recent entry above. Name & Date.” In industry, labs routinely have a “notebook corroboration day” each week for lab teams to switch notebooks to read and sign. Corroboration should (ideally) occur each week, as big parts of the project are completed, and the end of the project.

9. If an invention occurs, note it completely, sign and date it, have a corroborator sign and date it, and HAVE a knowledgeable THIRD PERSON WHO is NOT an inventor also read, sign and date the entry.

10. Retain all records in a fireproof safe if they are really worth something to you. Records of invention need to be kept a long time (30 years isn’t unreasonable—given the patent extension for drugs/devices, and/or GATT calculations.) DILIGENCE in working on an invention between conception and reduction to practice is also required so you need to use the notebook to show you kept working (but I won’t go into it here).

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