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Department of Education,
Science and Training

KNOWLEDGE TRANSFER AND AUSTRALIAN UNIVERSITIES AND PUBLICLY FUNDED RESEARCH AGENCIES

A report to the Department of Education, Science and Training

March 2006

Volumes one and two

KNOWLEDGE TRANSFER AND AUSTRALIAN UNIVERSITIES AND PUBLICLY FUNDED RESEARCH AGENCIES

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March 2006

This document contains both the Report (Volume 1) and the supporting Appendices (Volume 2 - Appendices) that were originally supplied as separate documents.

Contents

Volume one - Report

Volume two - Appendices

Note:

This report has been prepared for the Department of Education, Science and Training. The views expressed are those of PhillipsKPA and are not necessarily the views of the Department of Education, Science and Training or the Australian Government.

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**KNOWLEDGE TRANSFER AND AUSTRALIAN
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**A report to the Department of Education,
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Volume 1

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Contents – Volume 1

Executive Summary	iv
1 Introduction	1
1.1 Background	1
1.2 Project objectives	2
1.3 Approach to the project	3
1.4 Structure of the report	3
2 Defining and scoping knowledge transfer	5
2.1 Positioning knowledge transfer within the operating frameworks of PFRAs and universities	6
2.1.1 PFRAs	6
2.1.2 Universities	7
2.1.3 Positioning knowledge transfer in relation to research and teaching	14
2.1.4 Implications for defining and scoping knowledge transfer	17
2.2 The benefits of knowledge transfer	23
2.2.1 Implications for defining and scoping knowledge transfer	28
2.3 The nature of knowledge transfer	31
2.3.1 Implications for defining and scoping knowledge transfer	33
2.4 Measuring knowledge transfer	34
2.4.1 Implications for defining and scoping knowledge transfer	36
2.5 The gap between definition and scope and policy development	37
3 Public policy support for knowledge transfer	38
3.1 The role of government in supporting knowledge transfer	38
3.2 Policy responses of overseas governments	39
3.2.1 United Kingdom	39
3.2.2 United States	43
3.3 Public policy support for knowledge transfer in Australia	44
3.3.1 Education, Science and Training portfolio	45
3.3.2 Industry, Tourism and Resources portfolio	54
3.3.3 Health and Ageing portfolio	58
3.3.4 Other Australian Government portfolios	60
3.3.5 Other national programmes and knowledge transfer organisations	61
3.3.6 State Governments	61

3.4	Assessing the adequacy of existing programmes supporting knowledge transfer	64
3.4.1	The view of stakeholders	65
3.4.2	Barriers to knowledge transfer	67
3.4.3	Reported gaps in Australian public policy	68
3.4.4	The issues and challenges in developing public policy	69
3.4.5	Our analysis of the gaps in public policy support	72
4	Case studies of knowledge transfer and Australian universities	75
4.1	Knowledge transfer for commercial benefit	77
4.1.1	Aggregated Olive Processing and Research Cluster	77
4.1.2	HPV vaccine	79
4.1.3	Future Materials - Australian Materials Technology Network	81
4.1.4	InQuirion	82
4.1.5	The Small and Medium Enterprise Research Centre	84
4.2	Knowledge transfer for other material, human, social or environmental benefit	85
4.2.1	Australasian Legal Information Institute	85
4.2.2	Human services partnership	87
4.2.3	Northern Adelaide Partnerships	89
4.2.4	Cape York Institute and MULTILIT	92
4.2.5	Capricornia Online	94
4.2.6	Research Institute for Asia and the Pacific	97
4.2.7	Risky Business	99
4.3	Observations	101
	References	105

Contents – Volume 2

Appendix 1: Stakeholders providing input to the project	1
Appendix 2: Summary of stakeholder input	3
Appendix 3: Knowledge transfer for commercial benefit: summary of desktop research findings	6
Benefits of knowledge transfer	6
The nature of knowledge transfer	8
Measuring knowledge transfer	14
Current incentives and barriers to knowledge transfer	18
Appendix 4: Knowledge transfer for material, human, social and environmental benefit: summary of desktop research findings	22
Benefits of knowledge transfer	22
The nature of knowledge transfer	27
Measuring knowledge transfer	37
Current incentives and barriers to knowledge transfer	39
Appendix 5: National research priorities and goals	41
Appendix 6: Existing Australian Government funding programmes supporting knowledge transfer	42
The approach to mapping and tabulating existing programmes	42
Descriptions of existing programmes and the rationale for our mapping decisions	43

Executive Summary

Introduction

The Department of Education, Science and Training (DEST) has commenced an internal examination of the issues relating to knowledge transfer activities and funding as they relate to Australian universities and publicly funded research agencies (PFRAs). The Department commissioned PhillipsKPA to:

- (a) Work with the Department to help develop a clear definition and scope for knowledge transfer activities in Australia.
- (b) Provide the Department with a systematic analysis of current policies, programmes and funding arrangements to determine the extent to which knowledge transfer activities are already supported and promoted in Australia.
- (c) Provide the Department with ten to fifteen case studies drawn from Australian universities.

Following preliminary consultations with the Department, the scope of the project was further clarified by DEST as follows:

- The focus for the project is on knowledge transfer from research or research-related activity.
- It would be helpful for the analytical framework adopted by the project to separately examine knowledge transfer in partnership with industry and business for commercial benefit and knowledge transfer in partnership with other sectors aimed at broader economic, social and environmental benefits.

The definition and scope of knowledge transfer

Universities and PFRAs are knowledge organisations; their core objectives are to generate, acquire and transfer knowledge. These objectives are realised through the full range of functions performed, including research, teaching (or extension activities in the case of PFRAs) and community service or engagement.

Effective knowledge transfer strategies rely on the capacity of institutions to shape their knowledge transfer approaches and activities in partnership with their various communities, and to respond creatively to the distinctive needs of those communities. From this perspective, a 'healthy' system of knowledge transfer should demonstrate considerable diversity in knowledge transfer approaches and activities, both within and across institutions and across disciplines and national research priorities.

It is this diversity that makes knowledge transfer difficult to define in precise terms. It also highlights the risks involved in attempting to over-prescribe the definition of knowledge transfer. We have been conscious of these factors in developing a proposed set of principles and definitions of knowledge transfer. The challenge has been to add clarity to the current discussion and debate to assist in future knowledge transfer policy and programme development whilst not 'straightjacketing' the concept.

For this project, our brief is to focus only on research and research-related knowledge transfer. After considering the literature and the views of Australian stakeholders, however, we have formed the view that the exclusion of teaching from the definition of knowledge transfer risks omitting important aspects of knowledge transfer.

We suggest that DEST give further consideration to those aspects of knowledge transfer that are linked to the teaching and extension missions of universities and PFRAs, for possible inclusion in future knowledge transfer policy frameworks.

For the purposes of this project, we have been asked to adopt the nomenclature of 'knowledge transfer'. Our desktop research has led us to conclude that the emerging preferred language internationally is 'engagement'. Some Australian stakeholders have expressed a strong preference for the language of 'engagement'. Concerns about the 'knowledge transfer' term appear to relate to its:

- historical usage in the knowledge commercialisation domain, thus potentially limiting the scope of the activity it covers; and
- inference of a one-way flow of knowledge, versus a two-way negotiated flow of knowledge for mutual benefit which is usually stressed as a key feature of 'engagement'.

We suggest that DEST give further consideration to the benefits and risks associated with different terminologies before settling on a final language for the purposes of policy development.

Proposed definitions of knowledge transfer

We propose the following definitions of knowledge transfer.

For the purposes of the definitions:

- 'Knowledge' should be interpreted to incorporate knowledge, skills, technologies and other capabilities related to an institution's areas of academic specialisation.

- 'Commercial enterprises' should be interpreted as including the commercial operations of universities and PFRA_s as well commercial enterprises and industry sectors more broadly.

In developing the definitions, we have drawn on the Allen Consulting Group's typology of benefits available from publicly funded research: material, human, social and environmental (Allen Consulting Group, 2005a).

DEFINITIONS OF KNOWLEDGE TRANSFER APPLICABLE TO UNIVERSITIES AND PFRA_s

Knowledge transfer is the process of engaging, for mutual benefit, with business, government or the community to generate, acquire, apply and make accessible the knowledge needed to enhance material, human, social and environmental wellbeing.

Knowledge transfer for commercial benefit is the process of engaging, for mutual benefit, with business or government to generate, acquire, apply and make accessible the knowledge needed to enhance the success of commercial enterprises.

Cognisant of our project brief to focus on research and research-related knowledge transfer, we also propose the following research-specific definitions:

RESEARCH-SPECIFIC DEFINITIONS OF KNOWLEDGE TRANSFER APPLICABLE TO UNIVERSITIES AND PFRA_s

Knowledge transfer is the process of engaging, for mutual benefit, with business, government or the community to plan, conduct, apply and make accessible existing and new research to enhance material, human, social and environmental wellbeing.

Knowledge transfer for commercial benefit is the process of engaging, for mutual benefit, with business or government to plan, conduct, apply and make accessible existing and new research to enhance the success of commercial enterprises.

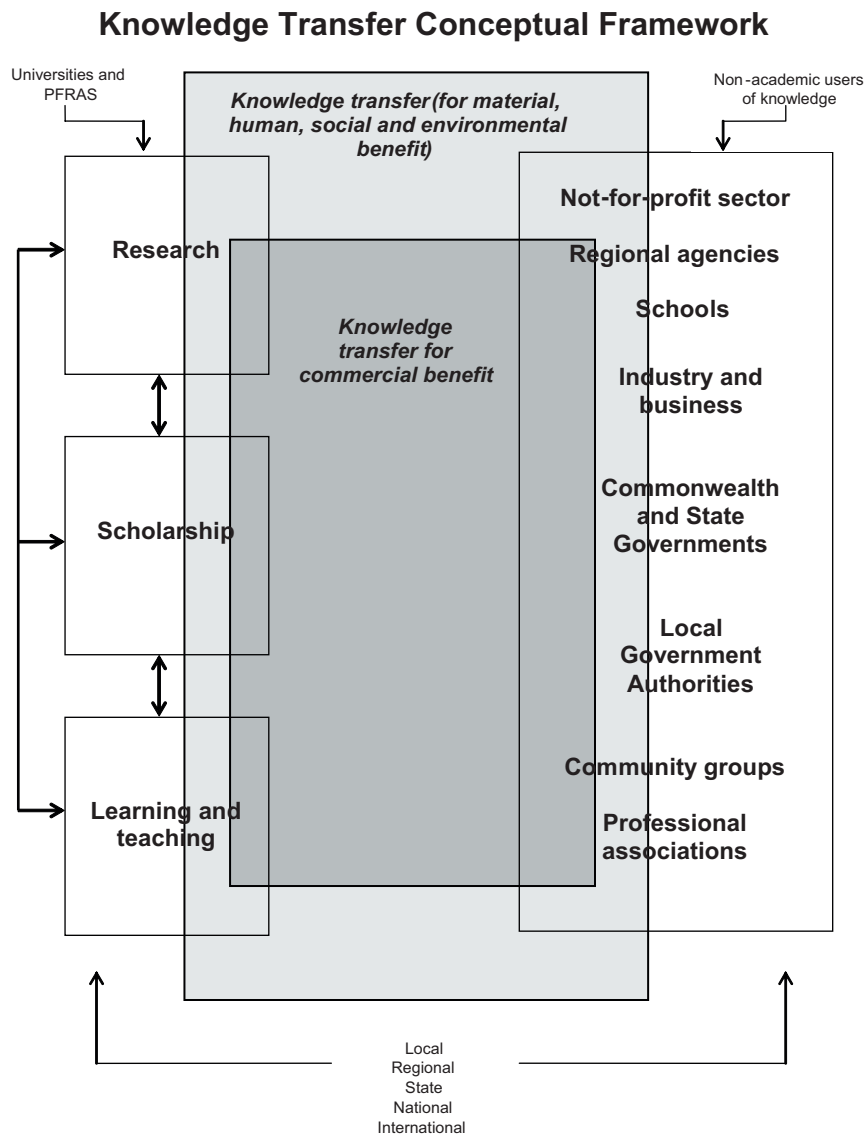
Principles to underpin the definition and scope of knowledge transfer

Based on our desktop research and the views expressed by stakeholders in the consultation phase of this project, we propose nine principles which underpin the proposed definition and scope of knowledge transfer:

1. Knowledge transfer is significantly integrated with the academic domains of research, scholarship and learning and teaching, which are themselves overlapping and integrated.
2. Knowledge transfer requires capabilities, infrastructure and relationships that extend beyond the traditional academic domains of research, scholarship and learning and teaching.
3. Knowledge transfer is distinguished from the traditional academic domains by its requirement for mutually-beneficial engagement with a wide range of non-academic users of knowledge.
4. Knowledge transfer represents a major component of the community's return on public investment in universities and PFRA's and should consequently be valued and actively encouraged across all disciplines and all institutions.
5. Knowledge transfer within Australian publicly funded institutions is ultimately directed towards enhancing Australia's material, human, social and environmental wellbeing.
6. Knowledge transfer for commercial benefit represents a specific sub-set of the broader concept of knowledge transfer which is directed towards enhancing material, human, social and environmental wellbeing.
7. Knowledge transfer for commercial benefit is directed, in the first instance, towards enhancing the success of commercial enterprises.
8. Knowledge transfer occurs through multiple inter-connected and overlapping processes.
9. High quality knowledge transfer activities will be encouraged if valid knowledge transfer performance measurement systems can be developed. If they are to encourage knowledge transfer across all disciplines and all institutions, such systems will need to reflect the diversity of university and PFRA knowledge transfer activities, approaches, partners and outcomes.

Knowledge transfer conceptual framework

Drawing on the above principles, we have developed the following knowledge transfer conceptual framework.



The framework highlights that:

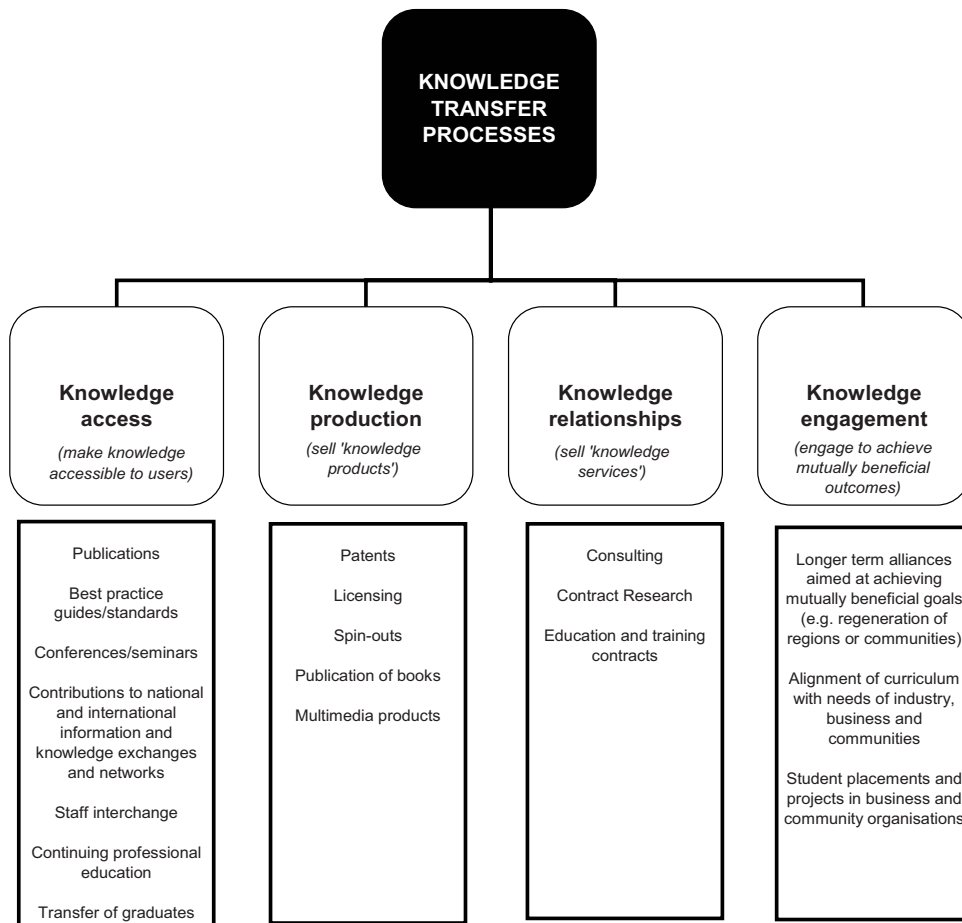
- Knowledge transfer is integrated with the three academic dimensions of research, scholarship and learning and teaching, but also extends beyond them.
- Knowledge transfer involves engagement with a diversity of non-academic users of knowledge.
- Knowledge transfer can occur at local, regional, state, national and international levels.

- Knowledge transfer for commercial benefit represents a sub-set of the broader concept of knowledge transfer for material, human, social and environmental benefit.

Scope of knowledge transfer

As noted in our eighth principle, knowledge transfer occurs through multiple interconnected and overlapping processes. We have drawn on the recent work of Howard Partners (2005), which identified four knowledge transfer processes, to propose the following scope of knowledge transfer. The examples provided under each knowledge transfer process are intended to be indicative rather than comprehensive.

THE SCOPE OF KNOWLEDGE TRANSFER



Adapted from Howard Partners (2005a)

The adequacy of existing public policy support for knowledge transfer

In the report, we provide a summary description of existing public policy programmes supporting knowledge transfer, including those provided through:

- the Education, Science and Training portfolio;
- the Industry, Tourism and Resources portfolio;
- the Health and Ageing portfolio;
- other Australian Government portfolios;
- other national programmes and knowledge transfer organisations; and
- State Governments.

We also briefly describe:

- the views of stakeholders in relation to the adequacy of existing programmes;
- demand-side and supply-side barriers to knowledge transfer; and
- perspectives on current gaps in public policy support for knowledge transfer as described in recent Australian reports.

After considering the above, we have reached a number of conclusions in relation to the adequacy of current support measures.

We have not identified any immediately evident gaps in the structure of funding support for the PFRAs, principally on the basis that their governing Acts specify knowledge transfer as one of their core functions. However, in the course of this project the PFRAs provided us with little evidence beyond what is available on the public record. We therefore hesitate to make a definitive statement about the overall adequacy of funding support for knowledge transfer in PFRAs.

Our mapping of existing programmes demonstrates that current public policies are providing some support to universities in their knowledge transfer activities. We conclude, however, that there is justification for the views of many stakeholders within the higher education system that current funding arrangements and programmes do not support the full range of actual and potential knowledge transfer activities. In particular, funding programmes have focused mainly on knowledge transfer for commercial benefit rather than knowledge transfer for other human, social and environmental benefit.

There is also evidence of unmet demand in some existing higher education programmes, such as the Australian Research Council (ARC) Linkage schemes and the Cooperative Research Centres (CRC) programme.

Recent reports on knowledge transfer and views from stakeholders point to perceived shortfalls in support for commercialisation infrastructure and support in the early stages of the commercialisation process where institutions are most

exposed to the risk of making investments with little or no financial return. However, it is important to place these perceived gaps and shortfalls in perspective. The emphasis of most higher education stakeholders in their input to the project was on the deficit of support for knowledge transfer targeted at human, social and environmental outcomes, rather than any shortfalls in existing support for knowledge transfer for commercial benefit.

There are three types of rationale for government intervention through the provision of public policy support for knowledge transfer. The gaps and shortfalls in existing public policy which we have identified for each type of rationale are summarised below.

1. To achieve cultural change

The major gaps we have identified are:

- Support for capacity building at the institution level – development of the culture, strategies, structures, skills, support mechanisms and policies required to establish knowledge transfer as a function commensurate with research and teaching.
- Support for knowledge transfer capacity building at the system level – for example:
 - establishment of commercialisation ‘centres of excellence’ that provide services across universities and/or PFRAs
 - development of systems to measure knowledge transfer performance
 - development of best practice resources to assist institutions and their non-academic partners.

2. To overcome market failure and instigate demand from users

The major gaps we have identified are:

- Support for the conduct of productive and beneficial knowledge transfer activities and projects with business and community partners which are not in a position to meet the full costs of knowledge services.
- Support for the development of national information resources and intermediary mechanisms that enable business and community, especially the SME sector, to locate sources and sites of knowledge within the university system and negotiate mutually beneficial knowledge transfer partnerships.
- Additional support for the early stages of commercialisation.

- Additional support for existing knowledge transfer programmes experiencing high levels of unmet demand.

We wish to highlight here the importance of demand-side initiatives. The research literature and experience in Australia (e.g. through models such as the Rural R&D Corporations) consistently points to the relative success of knowledge transfer initiatives that are driven by industry or other groups of knowledge users. There is scope for DEST to work with other government portfolios to assess the feasibility of extending these models to other industry sectors and to develop other demand-side models that will facilitate knowledge transfer.

3. To provide pump priming to support start up activities and experimentation in new activities

The major gap we have identified is:

- Support for the initiation and development of new knowledge transfer partnerships of mutual benefit with both commercial and non-commercial partners.

Case studies

The project brief requires us to identify case studies of knowledge transfer activities currently being undertaken in Australian universities.

Through existing sources such as published material and institutions' websites, we quickly identified in excess of 120 case study examples for possible inclusion in the report, excluding those related to CRCs or Research/Technology Parks. We are confident that a comprehensive survey of knowledge transfer activities across all universities would reveal a much larger number of examples. In determining the case studies to include in the report, we sought to provide a diversity of examples demonstrating the range of knowledge transfer activities and processes and the varieties of organisational frameworks adopted by universities to facilitate knowledge transfer. We also sought to present case studies that located knowledge transfer within regional, state, national and international settings.

We have included 12 case studies in the report: five demonstrating knowledge transfer for commercial benefit; and, seven demonstrating knowledge transfer for other material, human, social and environmental benefit.

The case studies are specific examples of knowledge transfer, making what can otherwise be an esoteric concept 'real'. They also lend support to the conclusions we have reached in relation to: the principles that underpin the definition and scope of knowledge transfer; the definition and scope of knowledge transfer; and the assessed gaps in public policy support.

1 Introduction

1.1 Background

In Australia, the issue of a 'knowledge transfer', 'third stream', 'third mission' or 'engagement' role for Australian universities and PFRAs has arisen in the context of the development of a Research Quality Framework (RQF). The Expert Advisory Group charged with proposing possible models for the new RQF noted in its recent Preferred Model report:

The EAG has agreed that activities that involve successful application of the original research of others (eg knowledge diffusion or transfer) and broader activities that stimulate and facilitate knowledge transfer by universities to business and society are not a focus for the RQF. However, the EAG agrees that these types of initiatives are important and could be addressed through the introduction of "Third Stream" funding.

(DEST, 2005b; p. 8)

At an RQF consultation meeting in June 2005, the Minister invited the higher education sector to provide him with views and suggestions on 'third stream' funding. The Minister has indicated that by 'third stream' he is referring to the concept of knowledge transfer.

The issue of university engagement with business and the community has also been raised in other inquiries and forums such as the Building University Diversity initiative and the House of Representatives Science & Innovation Committee's Inquiry into Pathways to Technological Innovation.

In the course of the last six months, a number of key bodies including the Australian Vice-Chancellor's Committee (AVCC), the Innovative Research Universities (IRU Australia) and the Federation of Australian Scientific and Technological Societies (FASTS) have issued statements or conducted forums on this topic. The 2005 Australian Universities' Quality Forum had the theme 'Engaging communities'.

There is considerable discussion and debate emerging in Australia in relation to the need for additional or enhanced public policies and programmes supporting knowledge transfer or the 'third stream'. Three key issues impacting on knowledge transfer policy development have emerged from this debate, including:

- The scope of knowledge transfer – does it encompass knowledge transfer through teaching, as well as through research and research-related activity?
- With respect to research-related knowledge transfer, should it only encompass the transfer of knowledge created through original research, or

should it also encompass the transfer of knowledge acquired through the research of others?

- Should the knowledge transfer policy be focused only on knowledge transfer in partnership with industry and business for 'commercial benefit', or should it be scoped to also encompass knowledge transfer in partnership with government and the wider community aimed at a broader range of economic, social and environmental benefits?

1.2 Project objectives

The Department of Education, Science and Training (DEST) has commenced an internal examination of the issues relating to knowledge transfer activities and funding. The purpose of this project is to assist with this work. The consultants are required to:

- (a) Work with the Department to help develop a clear definition and scope for knowledge transfer activities in Australia.
- (b) Provide the Department with a systematic analysis of current policies, programmes and funding arrangements to determine the extent to which knowledge transfer activities (especially among Australia's universities, but also including PFRAs) are already supported and promoted in Australia. The analysis will include a gap analysis, identifying any areas where there is insufficient or inappropriate support for such activities.
- (c) Provide the Department with ten to fifteen examples and case studies of knowledge transfer activities currently being undertaken in Australian universities, drawing where possible on published material, institutions' websites, etc.

Following preliminary consultations with the Department, the scope of the project was further clarified by DEST as follows:

- The focus for this project is on knowledge transfer from research or research-related activity. Consideration should be given to the question of whether knowledge transfer should encompass both original research undertaken by the research organisation and research outputs from other research organisations.
- The project should give consideration to the full range of research and research-related knowledge transfer functions undertaken by universities and PFRAs. For policy analysis purposes, however, it would be helpful for the analytical framework adopted by the project to separately examine knowledge transfer in partnership with industry and business for commercial benefit (hereafter also referred to as 'the narrow concept' of

knowledge transfer) and knowledge transfer in partnership with other sectors aimed at broader economic, social and environmental benefits (hereafter referred to as 'the broader concept' of knowledge transfer).

1.3 Approach to the project

The project methodology incorporated three principal components.

Desk Research

The desk research component included:

- an examination of the international and Australian literature in relation to 'third stream', 'knowledge transfer' and 'engagement' and related topics;
- an examination of related public policies and programmes in a number of countries;
- identification of existing Australian knowledge transfer policies and programmes; and
- identification of case studies.

Consultations

We conducted interviews with representatives of a number of peak bodies and relevant Government departments, and also invited written input from university peak bodies, PFRAs and other relevant groups. Appendix 1 provides a list of those consulted.

Analysis and Reporting

The analysis and reporting component included:

- a synthesis, analysis and reporting of the outcomes of the desk research and consultations;
- the development of a set of principles to underpin the definition and scope of knowledge transfer;
- the development of a set of definitions for knowledge transfer; and
- the development of a framework for mapping existing policies and programmes and identifying gaps in support for knowledge transfer and case studies.

1.4 Structure of the report

This report is presented in two volumes:

- The first volume is the main body of the report and addresses the three key objectives of the project
 - the definition and scope of knowledge transfer
 - existing policies, programmes and funding arrangements and the extent to which knowledge transfer activities are already supported and promoted in Australia
 - case studies of knowledge transfer activities.
- The second volume contains a set of appendices which provide background information that informs the discussion in the first volume, including
 - stakeholder views as expressed in consultations and written input to the project
 - summaries of our desktop research findings in relation to both the narrow and broader concepts of knowledge transfer
 - summary descriptions of the existing Australian Government funding programmes that support knowledge transfer.

References are listed in the first volume of the report.

2 Defining and scoping knowledge transfer

Universities and PFRAs are knowledge organisations; their core objectives are to generate, acquire and transfer knowledge. These objectives are realised through the full range of functions performed, including research, teaching (or extension activities in the case of PFRAs) and community service or engagement.

Effective knowledge transfer strategies rely on the capacity of institutions to shape their knowledge transfer approaches and activities in partnership with their various communities, and to respond creatively to the distinctive needs of those communities. From this perspective, a 'healthy' system of knowledge transfer should demonstrate considerable diversity in knowledge transfer approaches and activities, both within and across institutions and across disciplines and national research priorities.

It is this diversity that makes knowledge transfer difficult to define in precise terms. It also highlights the risks involved in attempting to over-prescribe the definition of knowledge transfer or narrowly base policy on a set of selected metrics that, by default, come to represent the definition in the minds of stakeholders. Recent Australian studies, for example, have highlighted that current research commercialisation metrics fail to reflect the diversity of ways within which research-generated knowledge is transferred to industry and business and reinforce a narrow conception of knowledge transfer that risks distorting policies and practices in unhelpful ways (Howard Partners, 2005a).

We have been conscious of these factors in developing a proposed set of principles and definitions of knowledge transfer. The challenge has been to add clarity to the current discussion and debate to assist in future knowledge transfer policy and programme development whilst not 'straightjacketing' the concept. In this regard, it is important to emphasise that while we have sought to achieve some conceptual clarity, the case studies presented later in this report demonstrate that knowledge transfer is a complex and multi-dimensional phenomenon. Some of the distinctions we make in our proposed principles and definitions are conceptually valid as a tool to assist policy analysis and development, however, in the real-world these distinctions become less clear-cut. We will discuss this further throughout the chapter.

In developing principles and definitions, we have drawn on the views of stakeholders as expressed in consultations and written input to the project (see Appendix 2 for a summary) and on extensive desktop research examining international and Australian trends and issues. In particular, we have drawn on recent work by Howard Partners and the Allen Consulting Group on knowledge transfer and the impacts of publicly funded research. In our view, it is important at this early stage in the evolution of public policy relating to knowledge transfer to consolidate and build upon existing frameworks and concepts that have resonated with Australian stakeholders.

As noted in Chapter 1, we have been asked to separately analyse knowledge transfer in partnership with industry and business for commercial benefit and knowledge transfer in partnership with other sectors aimed at broader material, human, social and environmental benefits. Appendices 3 and 4 provide overviews of our desktop research findings in relation to these two aspects of knowledge transfer.

In this chapter, we draw on the material presented in the Appendices to discuss the key issues in relation to defining and scoping knowledge transfer and propose a conceptual framework for knowledge transfer, together with a set of principles and definitions of knowledge transfer. It should be noted that these have been developed with a particular focus on the university sector. However, they are also readily applicable to PFRAs and if necessary, the conceptual framework could be easily modified to align more fully with the *modus operandi* and adopted language of PFRAs.

2.1 Positioning knowledge transfer within the operating frameworks of PFRAs and universities

This project requires an examination of knowledge transfer in Australia as it relates to universities and PFRAs. Knowledge transfer is a key aspect of the operations of both categories of public institutions. Nevertheless, universities and PFRAs operate within different legislative, regulatory and funding frameworks and the place of knowledge transfer within those frameworks is consequently also different.

In the following sections we explore the place of knowledge transfer within the operating frameworks of PFRAs and universities.

2.1.1 PFRAs

The key functions of the Australian PFRA sector are to generate and transfer knowledge and this is reflected in enabling legislation.

The *Science and Industry Act 1949*, governing the Commonwealth Scientific and Industrial Organisation (CSIRO), specifies the following functions:

- (a) *to carry out scientific research for any of the following purposes:*
 - (i) *assisting Australian industry;*
 - (ii) *furthering the interests of the Australian community;*
 - (iii) *contributing to the achievement of Australian national objectives or the performance of the national and international responsibilities of the Commonwealth;*

(iv) any other purpose determined by the Minister;

(b) to encourage or facilitate the application or utilization of the results of such research...

Similarly, the *Australian Institute of Marine Science Act 1972* and the *Australian Nuclear Science and Technology Organisation Act 1987* require these PFRA's to carry out research and development in relation to their specific fields of science and technology and their application and use, and to encourage and facilitate the application and use of the results of research and development.

From the time of their establishment, therefore, each of the Australian PFRA's has been principally focused on the generation of knowledge through applied research and the transfer of that knowledge to industry, government and the community. For this reason, PFRA's (along with CRCs and Rural R&D Corporations) represent the 'leading edge' in Australian knowledge transfer from research. Unlike universities, the role of the PFRA's does not formally extend to teaching, however, 'outreach' or 'extension' activities are central to their *modus operandi* and they also play a critical national role in research training.

The Government, through enabling legislation, has been explicit about the central importance of knowledge transfer to the role of PFRA's and it can be assumed that the funding allocated to each PFRA is intended to not only support research, but to also support knowledge transfer activities.

With respect to the university sector, however, the place of knowledge transfer in the higher education operating framework, and within current funding schemes, is considerably less explicit and clear. As a result, the current national debate in relation to knowledge transfer and its funding tends to be centred on the university sector rather than the PFRA sector. We turn now to a discussion of the place of knowledge transfer within the higher education operating framework.

2.1.2 Universities

There is a significant diversity in the legislation governing Australian universities, both across and within States and Territories. Some of the enabling legislation, for example, is extremely brief in defining the objects or functions of the University:

The object of the University is the advancement of learning and knowledge, including the provision of university education.

(University of Adelaide Act 1971, sect 4a)

In other cases, however, the functions of the University are outlined in considerable detail and these often include specific reference to knowledge transfer responsibilities. The *Griffith University Act 1998* requires the University to: 'to encourage the advancement and development of knowledge, and its application to government, industry, commerce and the community'; and 'disseminate knowledge

and promote scholarship'. The *Royal Melbourne Institute of Technology Act 1992* includes the following two objects of the University:

... the advancement of knowledge and its practical application by research and other means, the dissemination by various means of the outcomes of research and the commercial exploitation of the results of such research...

the maintenance of close interaction with industry and the community and the development of associations or agreements with any other educational, commercial, governmental or other institution...

Other University Acts require institutions to undertake a variety of knowledge transfer functions, including to: address the specific needs of particular regions; address the specific needs of particular community groups, such as Indigenous Australians or groups that have suffered disadvantages in education; and, promote critical enquiry within the general community.

Regardless of the detail, or lack of it, within enabling legislation, knowledge transfer is an important element of all universities' missions, intersecting in a diversity of ways with other elements such as teaching and research. Given this diversity, it is not surprising that different commentators in the area of knowledge transfer or 'engagement' have adopted slightly different conceptual approaches and languages for positioning knowledge transfer within broader academic frameworks.

Through our desk research, and the input received from stakeholders in the course of this project, we have identified five common approaches to the positioning of knowledge transfer within the higher education operating framework. These varying approaches see knowledge transfer as:

1. Community service or outreach
2. The 'third stream'
3. An integrated feature of teaching and research
4. Engagement and engaged scholarship
5. The commercialisation of knowledge.

Each of the approaches is discussed briefly below. The material presented in Appendices 2, 3 and 4 provides further background information.

Community service and outreach

For many years, the academic model adopted in Australia by universities and policy makers alike incorporated the three dimensions of teaching, research and community service. Community service, however, has never achieved an equivalent status to the other two dimensions, in government policy or in university strategic, organisational and policy frameworks.

Community service has often been seen in practice as a separate and predominantly voluntary activity of academic staff that is passively endorsed by institutions, rather than a core activity that requires strategic vision and the deliberate development of institution-wide strategies and priorities. Community service has been loosely defined, but covers activities such as: staff presentations to business and community groups; involvement in government and professional association committees; contributions via public commentary and debate on topical issues; and voluntary service provision in Australia and overseas.

In 1990, Boyer argued:

... all too frequently, service means not doing scholarship but doing good. To be considered scholarship, service activities must be tied directly to one's special field of knowledge and relate to, and flow directly out of, this professional activity. Such service is serious, demanding work, requiring the rigor – and the accountability – traditionally associated with research activities.

(Boyer, 1990; p. 22)

Since that time, the term 'community service' has gradually lost currency in the higher education sector, being replaced by terms such as 'engagement', 'engagement with business and the community' and 'knowledge transfer' (see below). These shifts in language indicate a move away from the traditional conceptions of 'community service' as a one-way transfer of knowledge from individual 'experts' to passive recipients, to an increased emphasis on purposeful two-way institutional partnerships for knowledge exchange of mutual benefit.

There appears to be a common, though not universal, view that the traditional concept of community service does not meet the criteria for the contemporary vision of knowledge transfer or engagement, at least in terms of how it may be represented in public policy and funding programmes. In many respects, traditional community service activities performed by individual academics can be viewed as 'part and parcel' of professional life across all sectors in society.

The 'third stream'

The notion of the 'third stream' originated in the United Kingdom. Within this framework, knowledge transfer is seen as something separate to, or an extension of, the teaching and research missions. The Higher Education Funding Council of England (HEFCE) noted in its 2002 funding guidelines:

Alongside their more traditional roles of teaching and research, higher education institutions (HEIs) and public sector research establishments (PSREs) have

increasingly been adopting a further role as stimulators and facilitators of knowledge transfer to business and society.

(HEFCE, 2005a)

A definition of the 'third stream' developed by the Science and Technology Policy Research Unit (2002) offers a more integrated view of knowledge transfer but emphasises interactions with non-academic environments:

Third stream activities are therefore concerned with the generation, use, application and exploitation of knowledge and other university capabilities outside academic environments. In other words, the Third Stream is about the interactions between universities and the rest of society.

(Science and Technology Policy Research Unit: Molas-Gallart, J. et al, 2002; p. iii)

An integral feature of teaching and research

While the 'third stream' concept has gained some currency internationally, there is a fundamental rethink taking place in the UK about the appropriateness of the 'third stream' nomenclature and its associated concepts:

At the beginning, the 'third stream' was simply defined as anything other than universities' core businesses of teaching and research; that made sense because most institutions focussed on the objective of promoting new functions such as technology licensing or spinouts. However, as institutions delve further into these activities, it has become clear that most third stream activities have (and should have) strong linkages with teaching and/or research, and that it is important to emphasize synergy and integration sooner rather than later. The issue is gradually shifting from how to start such new activities to how best to nest or embed them within the university culture so that they become sustained.

(Hatakenaka, 2005; p. 8)

Accordingly, the objectives of the most recent round of the UK 'third stream' funding programme include:

... extend and embed the capability for effective 'third stream' activity (alongside and integrated with teaching and research) across the entire diverse HE sector.

(HEFCE & OST, 2005a; p. 5)

Sunderland et al (2004) note that some predominant visions of university engagement position engagement as an irreducible and unavoidable element of existing university activities, that 'just happens anyway' in all aspects of academic endeavour.

On the other hand, there is a growing acknowledgement that fundamental shifts in the modes of research and teaching are requiring institutions to develop new capabilities and strategies that extend beyond those they have traditionally adopted. There has been considerable acknowledgement, for example, of a significant growth

in Mode 2 knowledge production which is described as applied, problem-centred, transdisciplinary, demand-driven, network-embedded and not necessarily led by universities (Gibbons et al, 1994). This is in contrast to the traditional Mode 1 knowledge production which is described as pure, disciplinary, expert-led, hierarchical, peer-reviewed and almost entirely university-based.

Similarly, in the teaching domain, there are increasing pressures on universities to better prepare graduates for the realities of the 21st century workplace in close collaboration with industry, business, government and other external groups.

Engagement and engaged scholarship

In academic settings around the world, there is an emerging preference for adoption of the language of 'engagement' and 'engaged scholarship', versus other possible nomenclatures such as 'knowledge transfer' or somewhat dated nomenclatures such as 'community service' (Kellogg Commission on the Future of the State and Land-Grant Universities, 2001; Association of Commonwealth Universities, 2003; Australian Vice-Chancellor's Committee, 2005).

The concepts of engagement and engaged scholarship are closely aligned with the view of knowledge transfer as an integral feature of teaching and research, however, they give a more explicit emphasis to two-way partnership models that involve mutual learning and knowledge exchange:

The publicly engaged institution is fully committed to direct, two-way interaction with communities and other external constituencies through the development, exchange, and application of knowledge, information, and expertise for mutual benefit.

(American Association of State Universities and Colleges, 2002; p. 9)

Good practice in engagement means a relationship involving mutual learning and knowledge exchange, where roles and expectations coincide, and which addresses objectives that are important both locally and institutionally.

A successful engagement generates creative solutions to identified priorities. This is done through the mobilisation of ideas, expertise and processes of learning available in both the university and the community.

(Department of Transport and Regional Services, 2005)

Engagement focusses on universities' application of research, teaching and scholarship in partnership with the needs of business and communities. It can also focus on specific projects designed to generate social and economic benefits within its community of interest. In both cases the outcomes are reflected back into the refinement of university programs to ensure their continued relevance.

(AVCC, 2005)

The concept of the engaged university also emphasises the need for institutions to have the organisational frameworks in place to support engagement. Garlick (2002) offers the following description of the fully engaged university in the context of regional development:

'[It] incorporates regional community objectives throughout its organisation and management practices, its course design and delivery, its research programs, and its resource usage. Its relationship with the regional community is on a whole-of-community basis, rather than with specific interest groups'.

(Garlick, 2002; p.2)

Most descriptions of engagement:

- link it to the full range of academic functions, however they may be described (e.g. teaching, research and scholarship);
- emphasise a diversity of engagement partners, including government, business, the not-for-profit sector, schools, regional bodies and community groups;
- link it to a variety of economic, human, social and environmental objectives;
- highlight that effective engagement requires the matching of institutional strengths and intellectual assets with a range of business, government and community needs, resulting in a wide diversity of engagement activities and outcomes; and
- subsume the commercialisation of knowledge, through partnerships with industry and business, within the broader conception of engagement.

Links to the Boyer framework

Many writers in the field of university engagement turn to the Boyer scholarships model as a foundation. Boyer (1990) argued that universities needed to move beyond an exclusive focus on traditional and narrowly defined research as the first and most essential form of scholarly activity, if they were to respond to the changing nature of society and its knowledge needs. He proposed four interrelated dimensions of scholarship:

- **Discovery** – the pursuit of inquiry and investigation in search of new knowledge.
- **Integration** – making connections within and between the disciplines, and interpreting, synthesising and bringing new insights to bear on original research.
- **Application** – the practical application of knowledge in a dynamic process whereby new understandings emerge from the act of applying knowledge through an ongoing cycle of theory to practice to theory.
- **Teaching** – transmitting, transforming and extending knowledge.

Boyer subsequently expanded his definition to include the scholarship of **engagement**, which refers to those activities within teaching, discovery, integration and application that connect the academy with people and places outside the campus and ultimately direct the work of the academy toward understanding and solving pressing social, civic and ethical problems (Commission on Community-Engaged Scholarship in the Health Professions, 2005).

More recently, the US Kellogg Commission on the Future of the State and Land-Grant Universities (2000) has proposed a simplified framework:

- **Discovery** – research, scholarship, and creative activity that reveal new knowledge, integrate it into existing bodies of disciplinary work, cross-pollinate disciplines, and possibly create something entirely new.
- **Learning** – replacing passive modes of instruction that rely on students' acceptance of material from teachers with a more active process in which students and faculty take responsibility for their own intellectual growth – 'students' are conceived as lifelong learners and 'teachers' are conceived as mentors.
- **Engagement** – productive involvement with communities. Going well beyond most conceptions of community service, which emphasises a one-way transfer of university expertise to the public, the engagement ideal envisions new public/university partnerships defined by mutual respect for what each partner brings to the table.

The commercialisation of knowledge

The conceptualisation of knowledge transfer as the commercialisation of knowledge is reflected in the following definitions:

Knowledge transfer is defined as the process for transferring knowledge and technology to the commercial sector. This may be achieved through commercialisation, such as spin-offs and licensing innovations, or consulting and education activities.

(Knowledge Commercialisation Australasia, 2005)

Within a modern, knowledge driven economy, knowledge transfer is about transferring good ideas, research results and skills between universities, other research organisations, business and the wider community to enable innovative new products and services to be developed.

(UK Office of Science and Technology, 2005)

This conceptual view of knowledge transfer emphasises the role of universities and PFRAs in commercialising their own intellectual property, in contributing to the commercial success of industry and business sectors more broadly and in

facilitating the nation's global economic competitiveness. It also often covers the idea of 'extension' or other education activities aimed at imparting knowledge to industry and business.

2.1.3 Positioning knowledge transfer in relation to research and teaching

A number of the prevalent approaches to positioning knowledge transfer discussed in the previous sections perceive knowledge transfer as integrated with research and teaching. The brief for this project requires us to examine a related question:

- Should the definition of knowledge transfer encompass original research only or both original research and the research of others?

In addition, our review of the literature on the topic of knowledge transfer and views expressed by stakeholders has prompted us to ask a further related question:

- Should the definition of knowledge transfer extend beyond the research dimension to also include a teaching dimension?

The role of original research versus the research of others

The distinction between knowledge transfer related to original research and knowledge transfer related to the research of others, is one of those distinctions we referred to earlier that may be conceptually valid, but somewhat inadequate when it comes to real-world applications. Most researchers would argue that it is extremely difficult to separate the knowledge created through original research and the knowledge acquired through others, particularly when it comes to the application of knowledge.

In its recent study on measuring the impact of publicly funded research, the Allen Consulting Group (2005a) notes the issues and problems associated with establishing a logic that connects research outputs to final outcomes, including 'disentangling the contribution of research performed in Australia from research performed elsewhere when assessing the impact of research' (p. viii).

Moodie (2006) notes that innovation relies as much on the uptake of existing knowledge as it does on the creation of new knowledge:

Knowledge and information abound; it is the capacity to use them productively that is in scarce supply. As distinguished science policy expert Michael Gibbons argues, much innovation – and hence economic development – depends less on original discoveries and more on the timely take-up, modification and marketing of knowledge solutions that already exist but need to be adapted to local environments... This is a radically different orientation to cultivating research esteem that is more often judged by the interests and values of other researchers, not those who may use it.

(Moodie, 2006; p. 38)

In its recent budget submission, FASTS also notes:

A sophisticated economy should not choose between adopting other people's research (fast follower) and doing their own – it must do both. Moreover, these two objectives are not mutually exclusive. A high quality R&D sector provides the skills and capabilities to allow understanding, appreciation and rapid adoption of non-Australian R&D.

(FASTS, 2005; p. 3)

Universities and PFRAs have the infrastructure, capabilities and networks to rapidly acquire newly created knowledge from around the globe and this is one of the key intellectual assets they can offer to Australian industry, government and communities within a knowledge transfer context. It is not surprising, therefore, to note that Section 9 of the *Science and Industry Research Act* governing CSIRO explicitly requires it to not only encourage or facilitate the application or utilisation of the results of its own research, but to also do the same in relation to 'any other scientific research'. The CSIRO Act and the Acts governing the Australian Institute of Marine Science (AIMS) and the Australian Nuclear Science and Technology Organisation (ANSTO) also require these PFRAs to collect, interpret and disseminate information relating to their areas of scientific expertise.

The approach to 'third stream' funding in the United Kingdom also reinforces the point that knowledge transfer can effectively apply to both generated knowledge and acquired knowledge. The Higher Education Funding Council's 2003 funding guidelines specify three broad categories of activities, as follows:

- *activity type 1: research-intensive departments, often world class, carrying out knowledge transfer linked to their research*
- *activity type 2: less research-intensive groups or departments exploiting knowledge which they may generate, acquire and develop; training professional practitioners; and working in communities of practice with companies and other organisations*
- *activity type 3: links with the community, voluntary sector, and public sector bodies which may be undertaken by all types of institution, but are often a key part of the third stream activities of HE colleges.*

(HEFCE and OST, 2003; p. 9)

The UK Higher Education Policy Institute cautions against promoting a concept of knowledge transfer that is only suitable to research-intensive universities noting that the policy goal should be to enhance the economic and social impact of all universities and it is therefore necessary to acknowledge the diversity both across institutions and across disciplines (Hatakenaka, 2005).

In our view, the concept of knowledge transfer should encompass both the knowledge created through original research and the knowledge acquired through the research of others, where value is added to that acquired knowledge for the benefit of users. 'Value adding' can be achieved in a number of ways, including for example: translation of academic research outputs to enable better absorption by non-academic user groups; development of best practice guides and standards

based on a combination of research outputs; and development of new applications of existing technologies.

The role of teaching

For this project, our brief is to focus only on research and research-related knowledge transfer. We have consequently not given focused attention in our desktop research to the issue of teaching-related knowledge transfer. After considering the literature and the views of Australian stakeholders, however, we have formed the view that the exclusion of teaching from the definition of knowledge transfer risks omitting important aspects of knowledge transfer.

For example, there is a view expressed by many Australian stakeholders (AVCC, 2005; Innovative Research Universities, 2005) and international bodies (Association of Commonwealth Universities, 2001) that the definition of 'knowledge transfer' or 'engagement' needs to broadly reflect the concept of transferral of knowledge from universities and PFRA's to outside parties, regardless of whether the knowledge arises from, or is transferred through, research, teaching or scholarship. A recent study undertaken in Victoria, which examined a range of successful university-community partnerships, reinforces this view (Winter et al, 2005).

As discussed earlier, there has been a growing acknowledgement within the UK that the 'third stream' or knowledge transfer is strongly linked with both the research and teaching mission of institutions. The UK *Higher education-business and community interaction survey* captures data on relevant education and continuing professional development activities:

While some third stream activities such as licensing rely heavily on research infrastructure, many business and community partners look to HEIs to provide teaching-related services. Some of these activities, such as student placements, focus on both undergraduates and postgraduates, with the main impact being enhanced employability of the student. In other interactions, an employer may pay for a number of its staff to attend CPD courses (in-house or remote from the employer), the impact being increased effectiveness for the employer. A third group of activities includes courses delivered to the public and benefiting the local community through access to the range of an HEI's teaching and learning resources.

(Department of Employment and Learning et al, 2005)

The concept of teaching-related knowledge transfer is principally based on the view that engagement with business and the community creates a virtuous circle, whereby academics and researchers remain networked and up-to-date with industry and community requirements and then update and enhance curriculum and research training to produce graduates that are more useful to their employers.

A project recently funded under the Collaboration and Structural Reform Fund provides an example of a teaching-related knowledge transfer partnership. Monash University, together with industry partners, the Australian Human Resources Institute and Engineers Australia are working collaboratively to improve outcomes in higher engineering education by creating national engineering capability, sustaining critical technical expertise and embedding innovation in course design.

Other aspects of teaching-related knowledge transfer involve:

- student placements, internships and conduct of projects for business and community groups;
- the operation of public clinics staffed by students, under supervision, in professional areas such as Optometry, Law, Veterinary Science;
- enterprise education; and
- joint university or PFRA and industry supervision of research students.

We also note that the extension or industry training aspects of PFRA's have traditionally been perceived as a major component of their knowledge transfer strategies.

We suggest that DEST give further consideration to those aspects of knowledge transfer that are linked to the teaching and extension missions of universities and PFRA's, for possible inclusion in future knowledge transfer policy frameworks.

2.1.4 Implications for defining and scoping knowledge transfer

The nomenclature of 'knowledge transfer'

For the purposes of this project, we have been asked to adopt the nomenclature of 'knowledge transfer'. As noted above, our desktop research has led us to conclude that the emerging preferred language internationally is 'engagement'. The 'knowledge transfer' nomenclature, on the other hand, appears to have much less currency. Another term that is sometimes employed to convey the two-way nature of knowledge flow is 'knowledge exchange'.

Some Australian stakeholders have expressed a strong preference for the language of 'engagement'. Concerns about the 'knowledge transfer' term appear to relate to its:

- historical usage in the knowledge commercialisation domain, thus potentially limiting the scope of the activity it covers; and
- inference of a one-way flow of knowledge, versus a two-way negotiated flow of knowledge for mutual benefit which is usually stressed as a key feature of 'engagement'.

We are also very conscious that any public policy on this issue needs to 'speak to' non-academic audiences as well as academic ones. The language, definition and scope adopted needs to provide an assurance to groups external to universities and PFRA_s that they have an active (rather than a passive) role to play in knowledge creation, acquisition, application and dissemination. The language adopted, together with associated policy frameworks, will also be important in shaping the orientation and cultures of public institutions. There is a risk, in our view, that the language of 'knowledge transfer' could reinforce old ways of thinking in the midst of radically changing modes and processes of knowledge production, acquisition and diffusion.

Another issue requiring consideration is the extent to which there are benefits or risks associated with the adoption of a language that may leave Australia out of step on the international stage.

We suggest that DEST give further consideration to the benefits and risks associated with different terminologies before settling on a final language for the purposes of policy development.

In keeping with our project brief, however, we have continued to use the terminology of 'knowledge transfer' throughout the report.

Principles

Three key principles to underpin the definition and scoping of knowledge transfer emerge from the discussion in the preceding sections. We present each principle below, along with further explanation of our rationale for proposing it.

- ◆ **Principle 1: Knowledge transfer is significantly integrated with the academic domains of research, scholarship and learning and teaching, which are themselves overlapping and integrated.**

The earlier discussion highlights a strong emerging theme in much of the international and Australian commentary on knowledge transfer or engagement: that is, knowledge transfer is integrated with all aspects of academic endeavour. The case studies presented later in this report demonstrate that many of the success stories in knowledge transfer involve multiple interactions between partners that cut across the academic dimensions of research, scholarship and teaching.

In support of this concept, we also note that the *modus operandi* of PFRA_s is very much about working in collaboration with end users to design, conduct and disseminate research – knowledge transfer is a fundamental component throughout the research process, rather than being a separate 'add-on'.

As discussed earlier, there are various academic models that can be drawn upon for the purposes of describing the relationship between knowledge transfer and traditional academic functions (e.g. Boyer, the Kellogg Foundation). We propose building the conceptual framework for knowledge transfer on a relatively simple academic model incorporating: research; scholarship; and learning and teaching.

We suggest this particular model for three key reasons:

- It is a framework that is widely understood and adopted in Australian higher education.
- This model will be more readily understandable to non-academic audiences than other academic models such as Boyer.
- The identification of 'scholarship' as a distinctive academic element separate from research and learning and teaching emphasises the fact that knowledge transfer is not constrained to knowledge generated through original research.
- The Kellogg Foundation model (Discovery, Learning and Engagement), whilst attractive in its simplicity, understates the extent to which knowledge transfer is integrated with the other academic functions of research, scholarship and teaching. As noted earlier, policy analysts in the UK are questioning the wisdom of the 'third stream' concept for similar reasons. In addition, there have been views expressed in recent Australian higher education policy discussions that the concept of knowledge transfer or engagement is not (as yet) sufficiently defined to warrant specification alongside research and learning and teaching.

In summary, the model we propose as the foundation for the conceptualisation of knowledge transfer includes:

- **Research** – in brief, the generation of new knowledge through original research (Boyer's discovery dimension).
- **Scholarship** – making connections within and between the disciplines, interpreting, synthesising and bringing new insights to bear on original research, developing new applications of existing knowledge and technologies and linking theory and practice through application (Boyer's integration and application dimensions).
- **Learning and teaching** – enabling access to knowledge (modern technologies and the changing nature of knowledge diffusion are driving a shift from the traditional notion of the expert teacher delivering knowledge to the notion of the teacher as mentor and facilitator of learning) (Boyer's teaching dimension).

All academic models that have been adopted in Australia and overseas emphasise the important inter-linkages between the academic dimensions of the model. This topic generated considerable debate in Australia throughout recent national higher education review processes, where the possibility of teaching-only higher education institutions was raised and widely rejected. There is a consensus view that teaching, research and scholarship are strongly inter-related, with each informing the other.

- ◆ **Principle 2: Knowledge transfer requires capabilities, infrastructure and relationships that extend beyond the traditional academic domains of research, scholarship and learning and teaching.**

While knowledge transfer is widely conceived to be significantly integrated with research, scholarship and teaching, Australian stakeholders and the international literature also emphasise that effective knowledge transfer requires additional capabilities, infrastructure and, most importantly, relationships that extend beyond those required for 'traditional' academic functions.

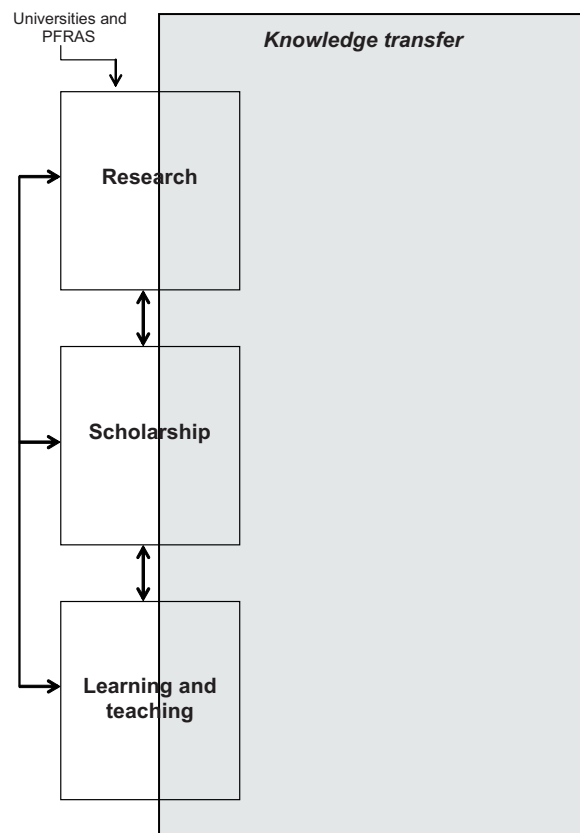
This has been particularly evident in recent years in the area of research commercialisation, where universities and PFRA's have adjusted management structures, added new organisational support functions and created commercialisation companies to support knowledge transfer. The number of staff employed in university research commercialisation companies, for example, has almost doubled from 58 in 2000 to 104 in 2002 (reported from the National Survey of Research Commercialisation in IRU Australia's written input to the project). Adjustments have also been made within PFRA's: the CSIRO National Flagships programme, for example, has recently been introduced to facilitate stronger partnerships between CSIRO and export industries.

There has also been an increasing acknowledgement of the need to adjust organisational arrangements to give greater support and status to knowledge transfer more broadly. For example, a number of institutions such as Griffith University, the University of Melbourne, Charles Darwin University, Murdoch University and Deakin University have created executive portfolios with responsibility for community partnerships, engagement and rural and regional development, and have pursued the development of strategic plans to focus their efforts. Many universities have also invested in organisational units to support community engagement (e.g. University of South Australia, Victoria University, University of Ballarat).

A key issue raised by stakeholders in the course of this project is the need for institutions to have the capabilities and capacity to invest in the initiation, building and maintenance of enduring knowledge transfer partnerships that will deliver mutual benefits over the longer term.

On the basis of Principles 1 and 2, we propose the following first component of our proposed conceptual framework for knowledge transfer. (Note: We will progressively add to this framework as we proceed through this chapter of the report.) The diagram is intended to be descriptive, and as such is not meant to reflect the relative scale of various aspects of knowledge transfer.

Knowledge Transfer Conceptual Framework (1)



The framework highlights that knowledge transfer is integrated with the three academic dimensions of research, scholarship and learning and teaching, but also extends beyond them.

While we have been asked to focus on research and research-related knowledge transfer in this project, we have included learning and teaching in the framework for completeness. For a research-related model of knowledge transfer, the learning and teaching box could be omitted.

- ◆ **Principle 3: Knowledge transfer is distinguished from the traditional academic domains by its requirement for mutually-beneficial engagement with a wide range of non-academic users of knowledge.**

The literature on knowledge transfer and engagement emphasises that knowledge transfer occurs most effectively through mutually beneficial two-way partnerships where goals are deliberately and mutually determined and knowledge is generated, acquired, applied and accessed in order to achieve those goals. Partnerships can range from legally binding contractual arrangements to less formal arrangements for working collaboratively, including loose networks. Some knowledge transfer activities, however, do not require partnerships as such, relying instead on broader and less formal aspects of university and PFRA engagement with their communities.

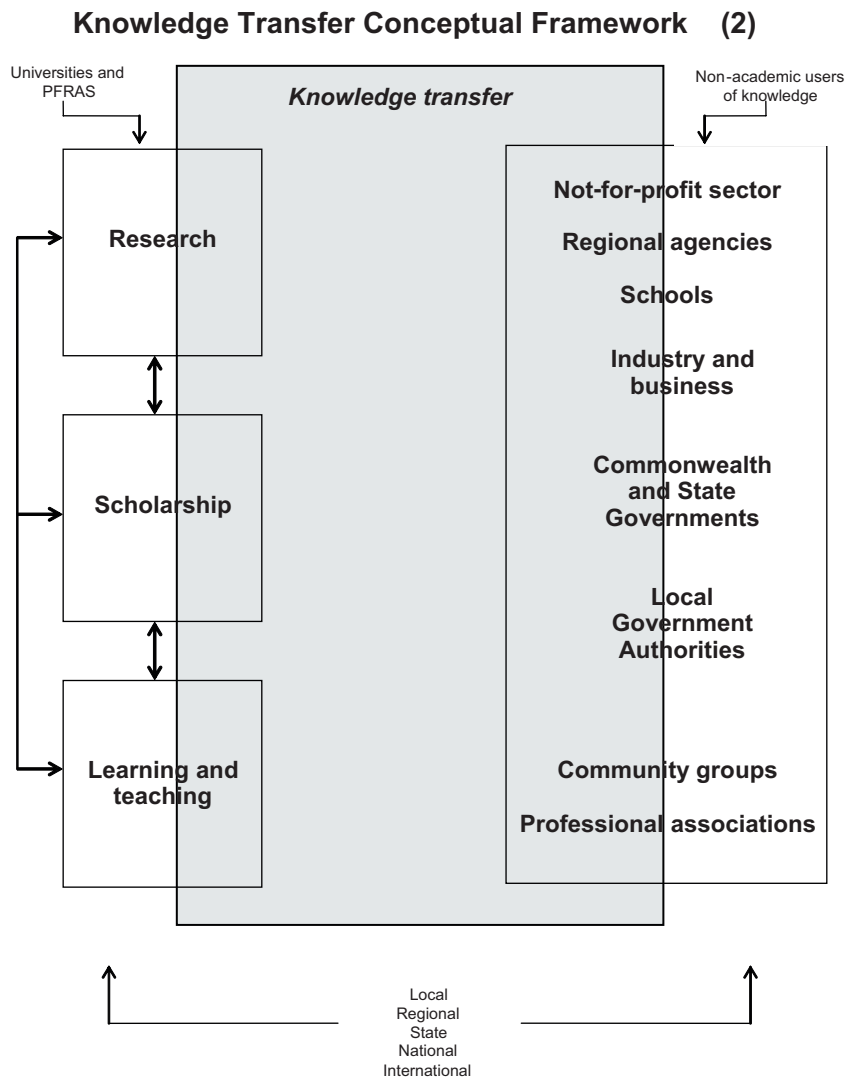
As noted earlier, there is considerable commentary in the literature around the concept that knowledge transfer should not be conceived as a one-way proposition. The benefits to universities and PFRA's of engagement with business and the community are as rich as the benefits to external partners. Institutions can not maintain their relevance or currency without active interaction with the external world.

Knowledge transfer partnerships can be:

- local, regional, state, national and international
- based on contractual or non-contractual arrangements
- single partner or multiple partner arrangements, involving
 - industry and business including
 - individual enterprises
 - industry associations
 - industry networks or clusters
 - investors
 - governments at all levels
 - regional agencies and bodies
 - not-for-profit and volunteer organisations
 - professional associations
 - public and private schools and other education providers.

In discussions on knowledge transfer, considerable emphasis is often given to the important role played by universities within their immediate regions (be they urban or rural regions). There are undoubtedly important benefits to be derived from universities working closely with their local stakeholders. It is important to note, however, that successful knowledge transfer partnerships will be built on shared goals and a careful matching of institutional strengths, capabilities and interests with the needs of various communities. In many instances, this match may not be located in the institution's immediate physical vicinity, but may be found elsewhere in the state, country or the world.

A second set of components can now be added to our proposed conceptual framework.



The extended framework highlights the diversity of the non-academic user groups that engage with universities and PFRAs for purposes of knowledge exchange, and within each group there are many different organisations with contrasting knowledge needs and innovative capacities. It also reflects the fact that knowledge transfer activities and partnerships can occur at local, regional, state, national and international levels.

2.2 The benefits of knowledge transfer

Knowledge transfer as a return on investment

The public purse invests significant amounts of money in public higher education and research institutions. In many respects, knowledge transfer can be viewed as a key public return on that investment, unlocking the knowledge generated and acquired by institutions for the benefit of business and the community.

The Australian Government has promoted the concept of institutional diversity, encouraging institutions to establish priorities and pursue distinctive missions tailored to their particular context, strengths and capabilities. Holland (2005) argues that the concept of engagement has been instrumental in fostering institutional diversity in the United States by providing a new vision for excellence in higher education that is not so narrowly focused on the research-intensive university model:

By focusing on the alignment of academic strengths with the critical issues of their surrounding communities, these universities developed a more specific teaching and research agenda that improved their performance as measured by student learning, retention, research productivity, and improved political and financial support from community leaders and public funders. The more specific topical and purposeful focus generated by an engagement and community involvement agenda tends to give these institutions a clear sense of mission, academic values and a vision for excellence that they previously lacked.

(Holland, 2005; p. 14)

The individual research, teaching and disciplinary strengths of institutions will clearly impact on the nature of their knowledge transfer activities. Institutions, or groups within institutions, with strengths in pure science and technology research, for example, will engage in different ways and with different audiences than institutions or groups with scholarship-based strengths in social sciences policy and practice. The expectations on institutions located in rural and regional settings will be different again, due to the paucity of institutional capacity in the region:

Apart from local government authorities, tertiary education institutions represent the only organisational entity with the independence, critical mass, skills, information and networks consistently represented in many of the regions...

(Garlick, 2002; p. 3)

Moreover, the findings of our desktop research, as presented in Appendices 3 and 4, highlight the inter-disciplinary nature of innovation. For example:

Innovation is not simply technological advance. Choosing the best business model or social structure is sometimes more important than being the first to discover or invent. Similarly, scientific skills must be combined with the humanities, economics, sociology and law. Responsible Partners recognise this transdisciplinary nature of innovation and organise themselves accordingly.

(European Commission and others, 2005; p. 7)

It is in the national interest to ensure that the public investment in universities and PFRA_s leads to meaningful knowledge transfer through engagement with all sectors of society. This should be the case for all institutions and all disciplines, and care needs to be exercised to ensure that public policy measures encourage and facilitate a sector-wide commitment to knowledge transfer.

The narrow and broader concepts of knowledge transfer

A key issue in the knowledge transfer debate, not unrelated to the above discussion, has concerned the appropriate public policy emphasis to be placed on knowledge transfer for commercial benefit (the narrow concept) versus knowledge transfer for material, human, social and environmental benefit (the broader concept).

Much of the Australian public policy analysis and development with regard to knowledge transfer has, to date, focused on the commercial application of university and PFRA research in partnership with industry and business. This is evident in the substantial number of inquiries and reports commissioned by the Australian Government over the last few years and the emphasis placed on measuring research commercialisation outputs such as patenting and licensing activities, spin-off company formation and the level of industry and business investment in research. A range of funding programmes has also been introduced to support this type of knowledge transfer.

Both overseas and in Australia, however, there has been a growing consensus among publicly funded institutions and governments that this concept of knowledge transfer is too narrow and fails to reflect the diversity of knowledge transfer pathways, objectives and partners evident in the higher education and PFRA sectors. In particular, it is seen as downplaying the critical role of institutions in enhancing material, human, social and environmental wellbeing¹ through mechanisms that are not immediately targeted at commercial outcomes. This broader field of activity, however, has been much less researched, there has been relatively little policy analysis and development, and there are fewer national funding programmes of relevance (this is discussed further in Chapter 3).

Appendices 3 and 4 summarise the findings of our desktop research on the identified and perceived benefits of the narrow and broader definitions of knowledge transfer.

The key feature which distinguishes knowledge transfer for commercial benefit from the broader concept of knowledge transfer is the primary outcome sought through the knowledge transfer: commercial, typically 'private', benefits (which often will have secondary 'public' benefits) versus 'public' benefits (which may be realised through commercial mechanisms or may have secondary commercial benefits for the research organisation or its partners)². The first type of knowledge transfer typically requires collaborative partnerships between industry/business and universities/PFRAs, while the latter type typically requires collaborative partnerships with a broader range of community groups and organisations, particularly the not-for-profit sectors. Both types will also often require collaborative partnerships with governments at all levels.

¹ We explain the basis for this choice of words further below.

² We recognise that the terms 'private' and 'public' benefit carry a particular meaning in economic theory. We are using the terms loosely here to assist in differentiating between the two types of knowledge transfer we have been asked to investigate in this project.

It is important to emphasise, however, that many valuable knowledge transfer partnerships and activities will involve a mixture of outcomes, some resulting in 'private' benefits and some resulting in 'public' benefits. The distinction between knowledge transfer for commercial benefit and knowledge transfer more broadly is in many respects an artificial one.

A recent Howard Partners report, which has been well received nationally, emphasises that knowledge transfer for commercial benefit has been narrowly conceived in Australia to date (Howard Partners, 2005a). The emphasis has been on universities and PFRA's selling or licensing the results of research in the form of commodified knowledge and thus generating commercial returns for the institutions themselves. The report demonstrates, however, that this emphasis has failed to acknowledge the plurality and the complexity of the channels and mechanisms through which universities and PFRA's generate commercial benefits for industry and business more broadly.

Benefits

There has been considerable work undertaken in Australia and overseas to explore the benefits derived from public research and associated knowledge transfer. A recent Canadian study, for example, found that even a one per cent improvement in literacy levels could increase Canada's GDP by more than \$19 billion a year (Coulombe et al, 2004, quoted in Association of Universities and Colleges of Canada, 2005).

A recent Australian study conservatively estimates that for every \$1 spent by the Australian Government on the CRC programme, GDP is cumulatively \$0.60 higher than it would have been had that \$1 instead been allocated to general Government expenditure (Allen Consulting Group, 2005b).

A 2003 study by Access Economics concluded that the likely returns on investment in Australian health R&D are extraordinarily high with annual rates of return up to \$5 for every \$1 spent on R&D. The same study found an 8-year gain in life expectancy as well as improved wellness over 1960-99 (Access Economics, 2003).

The Allen Consulting Group report on measuring the impact of publicly funded research concluded that the spectrum of areas that research can generate benefits within is wide:

Existing approaches to measuring the impacts of publicly funded research have tended to focus primarily on the impacts of this research within the academic community. When impacts beyond academic impacts are measured, the greatest focus has been placed on measuring the economic impacts of research through direct commercialisation of publicly funded research, adoption of knowledge by industry and through skills formation improving labour productivity.

To more fully capture the impacts of public research it is necessary to ask 'what does society value?' and 'does publicly funded research contribute to these dimensions of what society values?'

(Allen Consulting Group, 2005a; p. vii)

The study provides a typology of benefits available from publicly funded research, as reproduced below.

Typology of Benefits Available from Publicly Funded Research

Material dimension	Human dimension	Environmental dimension	Social dimension
Quality and quantity of goods and services available to society	Physical health Mental health Quality of inner life Ability to access pleasurable experiences	Extent of biodiversity Quality of air Quality of land Quality of inland waters Quality of seas	Levels of social attachment Freedom from crime Political rights Political engagement

(Allen Consulting Group, 2005a; p. 24)

Not surprisingly, there are clear parallels between this typology and the Australian Government's national research priorities and goals. In our estimation, over half of the Australian Government's national research goals are primarily concerned with non-commercial outcomes, though they may have flow-on impacts in the commercial domain (e.g. Water – a critical resource; Ageing well, ageing productively; Understanding our region and the world) (see Appendix 5). This lends considerable support to the importance of the broader concept of knowledge transfer.

The Allen Consulting typology also mirrors the thinking evident in recent OECD and World Bank policy analyses, which differentiate between different forms of capital and their impacts on wealth and human wellbeing more broadly (OECD, 2001; World Bank, 2006)³:

- produced capital;
- natural capital; and
- intangible capital, including
 - human capital
 - social capital
 - governance.

Wealth estimates prepared by the World Bank in a very recent analysis of the wealth of 120 nations suggest that the predominant form of wealth worldwide is in the form of intangible capital, representing 80 per cent of wealth in high-income OECD countries (World Bank, 2006), suggesting that investment in building human and social capital is critical to wealth creation. The World Bank also suggests it is vital to efficiently invest the rents from the exploitation of natural resources if a sustained level of income generation is to be achieved.

³ The Australian Bureau of Statistics also utilises this framework (see Australian Bureau of Statistics, 2002, *Measuring Australia's Progress*).

We note in Appendix 4 that governments, both in Australia and overseas, are increasingly emphasising the importance of human and social capital within regional, State and national policy frameworks.

In addition, the Australian Treasury has developed a wellbeing framework to underpin analysis and advice across the full range of its public policy responsibilities (Parkinson, 2004). While the wellbeing framework differs in its structure to the Allen Consulting or international frameworks, there is some overlap in underlying principles. It recognises, for example, that wellbeing frameworks need to extend beyond conventional welfare economic models that assume the level of income or consumption is the most important determinant of wellbeing.

Advocates of the broader concept of knowledge transfer argue that universities and PFRA's have a vital role to play, through knowledge transfer, in building human and social capital and sustaining natural capital.

2.2.1 Implications for defining and scoping knowledge transfer

Principles

Emerging from the above discussion, we propose the following principles to guide the definition and scoping of knowledge transfer. Where necessary, we provide some additional explanation of each principle.

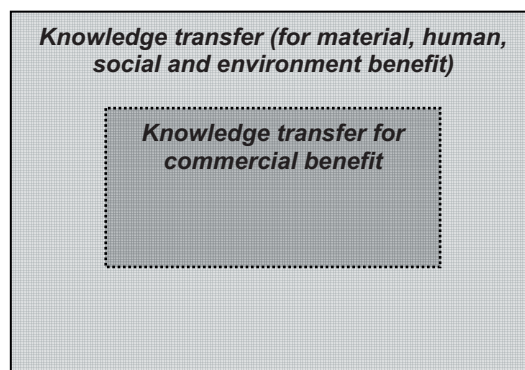
- ◆ **Principle 4: Knowledge transfer represents a major component of the community's return on public investment in universities and PFRA's and should consequently be valued and actively encouraged across all disciplines and all institutions.**
- ◆ **Principle 5: Knowledge transfer within Australian publicly funded institutions is ultimately directed towards enhancing Australia's material, human, social and environmental wellbeing.**

We propose the broad adoption of the Allen Consulting typology of the benefits of publicly funded research as a framework for the purposes of defining knowledge transfer. As noted earlier, the typology is a close reflection of the frameworks adopted by the OECD, the World Bank and the ABS for measuring the wealth and wellbeing of nations. In our view, however, the Allen Consulting terminology will have more appeal to both university and PFRA stakeholders and external groups than the 'capital' language adopted by those organisations.

- ◆ **Principle 6: Knowledge transfer for commercial benefit represents a specific sub-set of the broader concept of knowledge transfer which is directed towards enhancing material, human, social and environmental wellbeing.**

The 'material' dimension of the Allen Consulting typology is concerned with the 'quality and quantity of goods and services available to society' and consequently largely reflects the commercial application of knowledge. In addition, the broader concept of knowledge transfer or engagement, as it is described in Australian and international settings, typically subsumes the concept of knowledge transfer in partnership with industry and business to achieve commercial outcomes.

In our proposed definition and scoping of knowledge transfer, we have conceptualised knowledge transfer for commercial benefit as a specific sub-set of the broader concept of knowledge transfer which is directed towards enhancing material, human, social and environmental wellbeing. This is illustrated in the following diagram.



- ◆ **Principle 7: Knowledge transfer for commercial benefit is directed, in the first instance, towards enhancing the success of commercial enterprises.**

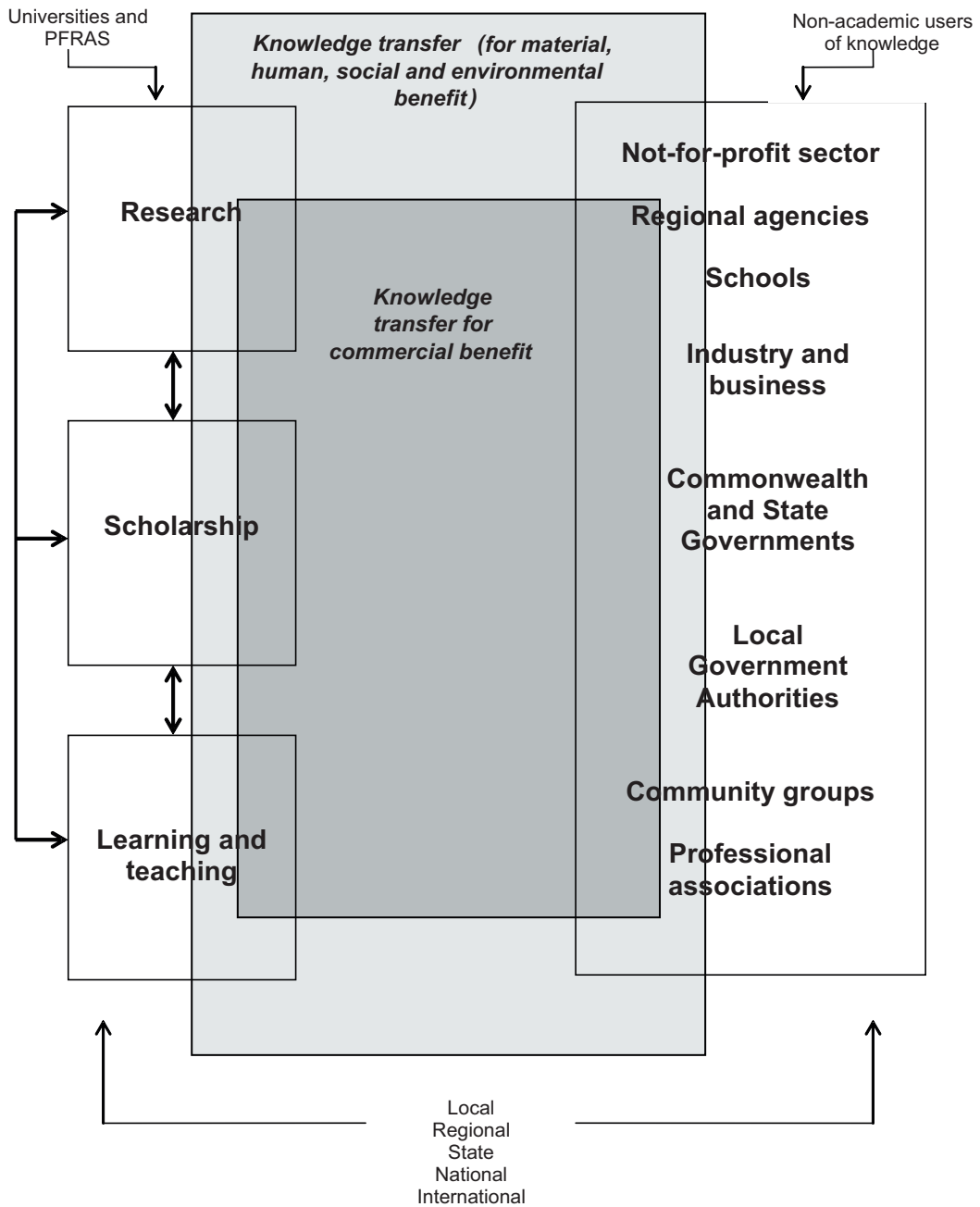
While knowledge transfer for commercial benefit can eventually lead to broader benefits for society - as reflected in employment rates, personal income levels and so on - its immediate objective is to enhance the success of commercial enterprises through the commercialisation of knowledge.

The commercial enterprises referred to in the above principle are intended to include:

- the commercial arms or companies of universities and PFRAs; and
- commercial enterprises and industry sectors more broadly.

Our proposed knowledge transfer conceptual framework can now be completed as follows:

Knowledge Transfer Conceptual Framework



We also propose the following narrow and broad definitions of knowledge transfer, drawing on the Allen Consulting Group typology.

For the purposes of the definitions:

- 'Knowledge' should be interpreted as incorporating knowledge, skills, technologies and other capabilities related to an institution's areas of academic specialisation.
- 'Commercial enterprises' should be interpreted as including the commercial operations of universities and PFRAs as well commercial enterprises and industry sectors more broadly.

DEFINITIONS OF KNOWLEDGE TRANSFER APPLICABLE TO UNIVERSITIES AND PFRAs

Knowledge transfer is the process of engaging, for mutual benefit, with business, government or the community to generate, acquire, apply and make accessible the knowledge needed to enhance material, human, social and environmental wellbeing.

Knowledge transfer for commercial benefit is the process of engaging, for mutual benefit, with business or government to generate, acquire, apply and make accessible the knowledge needed to enhance the success of commercial enterprises.

Cognisant of our project brief to focus on research and research-related knowledge transfer, we also propose the following research-specific definitions:

RESEARCH-SPECIFIC DEFINITIONS OF KNOWLEDGE TRANSFER APPLICABLE TO UNIVERSITIES AND PFRAs

Knowledge transfer is the process of engaging, for mutual benefit, with business, government or the community to plan, conduct, apply and make accessible existing and new research to enhance material, human, social and environmental wellbeing.

Knowledge transfer for commercial benefit is the process of engaging, for mutual benefit, with business or government to plan, conduct, apply and make accessible existing and new research to enhance the success of commercial enterprises.

2.3 The nature of knowledge transfer

The Howard Partners report referred to earlier proposes a comprehensive framework for understanding research commercialisation and knowledge transfer.

It argues that universities and research organisations generate useful commercial benefits via four research commercialisation processes, which are summarised in the following table.

Models of knowledge transfer and commercial relationships

Research commercialisation process	Generating benefits...	Commercialisation objective
Knowledge diffusion (most applicable to commodity-based industries such as agriculture and mining)	... by encouraging the broad industry-wide adoption of research findings	Focus is on adoption. Cover costs through industry contributions
Knowledge production (the 'standard' research model – most applicable to the life sciences)	... by selling or licensing the results of research in the form of commodified knowledge	Make money from sale of 'knowledge products' – patents, multimedia, spin-outs, fee-paying students
Knowledge relationships (most applicable to natural sciences/engineering plus social sciences and business/law)	... by providing services such as consultancy that indirectly exploit broad intellectual property platforms, focusing on cooperation, collaboration, joint ventures and partnerships	Make money from sale of 'knowledge services' – consulting, contract research, industrial teaching
Knowledge engagement (most applicable at the level of the institution)	... as a by-product of shared interests and concerns that transcend the boundaries of the university <i>per se</i>	Business development: mutual long term benefit; base for creating wealth.

While the framework was developed specifically with reference to knowledge transfer for commercial benefit, it applies equally well to the broader concept of knowledge transfer. Even the 'knowledge production' process has applicability to the broader concept of knowledge transfer. For example, in some specific instances, knowledge targeted at human or social wellbeing benefits may be most effectively absorbed by the community through marketed products (the CSIRO Total Wellbeing Diet publication⁴ and the Triple P: Positive Parenting Program⁵ are examples of this). We believe the framework is helpful for the purposes of defining and scoping knowledge transfer and analysing gaps in public policy (see Chapter 3).

⁴ See <http://www.csiro.au/csiro/channel/pchaj,,.html>

⁵ See http://www.pfsc.uq.edu.au/02_ppp/ppp.html

It is important to highlight that the case studies presented in Chapter 4 demonstrate that, in the real world, knowledge transfer partnerships will often incorporate a number of these processes which inter-connect and overlap with each other in various ways.

The Howard Partners report presents a typology of knowledge products and services to represent the outputs that are subsumed in the knowledge transfer processes (see Appendix 3). Other reports have also put forward various frameworks or metrics aimed at capturing the range of knowledge transfer activities or outputs applicable to universities and PFRAS (Molas-Gallart et al, 2002; Coordination Committee on Science and Technology Working Group, 2005; Allen Consulting Group, 2005a) (see Appendices 3 and 4). These can be drawn upon for the purposes of identifying a range of activities that may legitimately be included within the scope of knowledge transfer.

2.3.1 Implications for defining and scoping knowledge transfer

Emerging from the above discussion, we propose the following further principle to guide the definition and scoping of knowledge transfer.

- ◆ **Principle 8: Knowledge transfer occurs through multiple inter-connected and overlapping processes.**

In addition, for the purposes of scoping knowledge transfer, we propose an adaptation of the Howard Partners framework of knowledge transfer processes (see diagram below).

We note that for two of the four knowledge processes defined by Howard Partners, 'knowledge diffusion' and 'knowledge production', the research organisation is deemed to have sufficient information and "does not want to hear others' opinions, ideas or inputs" (Howard Partners, 2005a; p. 23). We understand how this description may be helpful in differentiating these two processes from others, however, our view would be that effective knowledge transfer will always involve some level of engagement with user groups to understand their context, absorptive capacity and knowledge needs, even if this is only to 'road test' the useability of draft materials before releasing them for wider consumption.

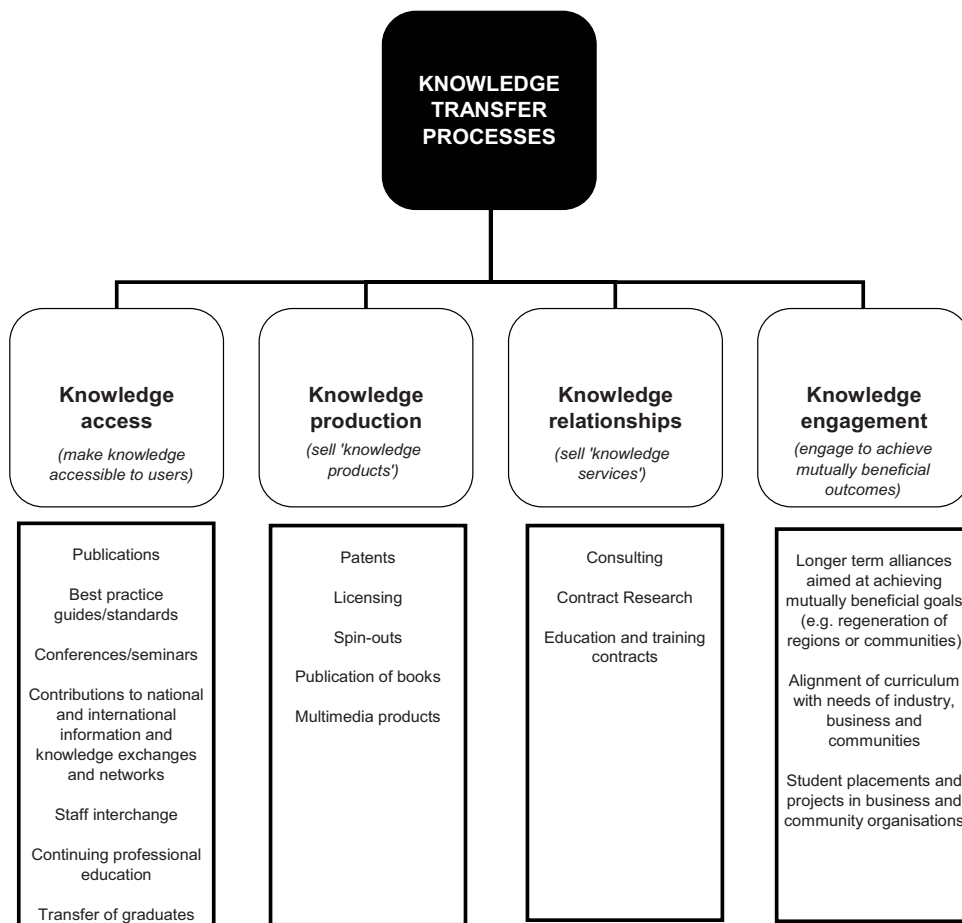
Moreover, to maintain consistency with our proposed academic framework and definitions of knowledge transfer, we have adapted the Howard Partners framework by changing 'knowledge diffusion' to 'knowledge access'. This is for two reasons:

- The terminology of 'knowledge diffusion' and the Howard Partners explanation of the concept suggests a one-way flow of knowledge, when our definition of knowledge transfer emphasises the importance of engagement for mutual benefit.
- The terminology 'knowledge access' better reflects the points we made earlier about the changing nature of learning and teaching and the impact of modern technologies on knowledge dissemination approaches.

In the following diagram, we also draw on the Howard Partners report and other desktop research findings presented in Appendices 3 and 4, to provide examples of the kinds of knowledge transfer activity that typically will apply for each knowledge transfer process. The examples provided under each knowledge transfer process are intended to be indicative rather than comprehensive.

Also, it is important to highlight that the same category of activity can fit under different processes depending on the circumstances. For example, the production, publication and dissemination of a best practice guide could occur as an extension to a publicly funded research project ('knowledge diffusion'), or could be developed under contract from a government department or business or community organisation partner ('knowledge relationship'). Also, as noted earlier, any given knowledge transfer partnership may involve one or more of the knowledge transfer processes.

THE SCOPE OF KNOWLEDGE TRANSFER



Adapted from Howard Partners (2005a)

2.4 Measuring knowledge transfer

In Appendices 3 and 4, we provide a summary of our desktop research findings in relation to the measurement of knowledge transfer activities and outcomes.

One aspect of knowledge transfer that has received concentrated attention internationally and in Australia concerns the measurement of research commercialisation and technology transfer. The OECD has played a particularly strong role in defining and providing international comparative data on a range of metrics (OECD 2005b; OECD 2005c). The Association of University Technology Managers in the United States has also been influential with its annual Licensing Survey (AUTM, 2005).

The 'standard' measures of research commercialisation, however, are increasingly being judged as inadequate for the purpose of measuring the extent and effectiveness of knowledge transfer effort or innovation capacity (Howard Partners, 2005; Australian Treasury, 2005). In particular, Howard Partners has argued convincingly that current metrics focus on the 'knowledge production' process and provide almost no acknowledgement of the other processes that are critical to effective knowledge transfer. The authors argue that 'It does not follow that just because data are available, they are going to be useful in assessing performance' (p. x). Moreover, the report argues for:

...separate approaches to performance measures and performance indicators. Performance measurement is undertaken on the basis of assessment of overall program performance, having regard to purpose, resources, processes, impacts and effects. This involves using a range of program evaluation methodologies and techniques.

(Howard Partners, 2005a; p.x)

The authors suggest that universities and PFRAs should be encouraged to develop measurement and indicator profiles that are representative, and indicative, of their distinctive missions and strategies.

Attempts to measure the broader concept of knowledge transfer (i.e. knowledge transfer for other material, human, social and environmental benefit) are even less well developed than those for knowledge transfer for commercial benefit. Consistent with the views expressed by Howard Partners, Hatakenaka (2005) cautions against the simplistic use of performance metrics for 'the third stream' or knowledge transfer more broadly:

The most fundamental reason for not using such simple metrics at this stage in the development of third stream activities is that the approach would not be likely to help inculcate the culture change that needs to pervade the institution. In fact there is a risk of the very reverse: encouraging the establishment of separate 'third stream' units focused on meeting the metrics, which would shield the academic community from the very culture changes that need to be made.

(Hatakenaka, 2005; p. 4)

Nevertheless, considerable work has also been progressing overseas in the area of measurement and assessment of 'engagement' or knowledge transfer (Molas-Gallart et al, 2002; Committee on Institutional Cooperation, 2005; The Higher Learning Commission, 2003). Holland (2005) reports that the Carnegie Foundation will shortly be revising its influential *Carnegie Classification of Institutions of Higher Education* to include measures of 'engagement'. This scheme will be voluntary

during the pilot phase, with the intention of identifying a few measurable indicators that all institutions could collect and report.

A number of stakeholders providing input to this project, including the AVCC, argue that it would indeed be possible to develop broad indicators of university knowledge transfer activity and its outcomes. Some Australian universities have already begun exploring approaches to the measurement of 'community engagement' (Adams et al, 2005). We also note that the Australian Universities Quality Agency assesses the quality of community engagement activities in its audits of Australian universities, where this is identified as an element in the auditee institutions' mission.

Recent trends in Australian research and higher education policy have favoured a shift to performance-based funding approaches that rely on quantitative metrics. The current status of knowledge transfer measurement systems, however, would suggest that considerable further work is needed to develop a set of metrics that would have credibility and the widespread endorsement of stakeholders.

There may, however, be a fundamental limit to how comprehensive any knowledge transfer measurement system can be. If institutions are genuinely responsive to the needs of non-academic users of knowledge and their respective communities, then knowledge transfer initiatives will be uniquely shaped according to those needs, the academic strengths of the institution and the nature of the participating academic disciplines. The case studies presented in Chapter 4 demonstrate the diversity of partners, approaches, processes and outcomes inherent to the knowledge transfer domain, highlighting the need for considerable caution in identifying a restricted set of metrics to measure knowledge transfer. There is a very real risk that, on the ground, policies and practices will be distorted in unhelpful ways in order to maximise performance as measured. Attempts to identify a range of metrics that would capture the full diversity of knowledge transfer activity and outcomes, however, could lead to an unsustainably resource-intensive and intrusive measurement effort.

On the other hand, if knowledge transfer can't be measured, it also can't be readily recognised and rewarded, and it will always be considered secondary to teaching and research by governments, institutions and individual academics.

For this reason, we suggest there would be value in DEST investing in the exploration and development of valid approaches to assessing knowledge transfer performance at the system, institution and individual staff member levels. These approaches may or may not involve a substantial reliance on quantitative metrics.

2.4.1 Implications for defining and scoping knowledge transfer

We propose a final principle to underpin the definition and scoping of knowledge transfer:

- ◆ **Principle 9: High quality knowledge transfer activities will be encouraged if valid knowledge transfer performance measurement systems can be developed. If they are to encourage knowledge transfer**

across all disciplines and all institutions, such systems will need to reflect the diversity of university and PFRA knowledge transfer activities, approaches, partners and outcomes.

2.5 The gap between definition and scope and policy development

This project has been commissioned by DEST to assist it in examining the issues relating to knowledge transfer activities and funding. The issues that are currently attracting most debate and discussion in Australia concern the perceived need for additional public funding to support knowledge transfer and the desirable design of any possible funding programme or programmes.

In proposing the principles, definition and scope of knowledge transfer presented above, we are acutely aware that they do not, in themselves, provide direct pointers to the appropriate design of funding programmes.

The first key public policy question is: what attitudes, behaviours, supporting structures and kinds of activities should be encouraged? The definition and scope of knowledge transfer that we have developed should partly answer this question.

The second key public policy question is: how adequate and appropriate are existing funding programmes and other public policy measures in terms of encouraging those attitudes, behaviours, supporting structures and activities? Our analysis of existing policies and programmes in the following chapter assists in answering this policy question (though stops short of evaluating the effectiveness of existing programmes – such an exercise would be beyond our project brief).

The third key public policy question is: where there are identified gaps, how should funding programmes be designed to create incentives or limit barriers to the adoption of desirable attitudes, behaviours, supporting structures and activities? Our project brief does not extend to canvassing or recommending the design of possible funding programmes.

3 Public policy support for knowledge transfer

3.1 *The role of government in supporting knowledge transfer*

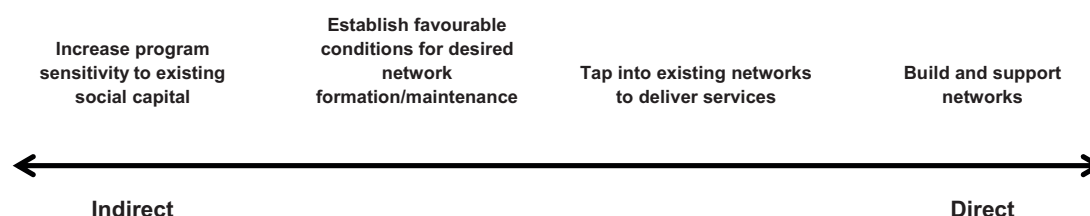
The emphasis in recent public policy, both in Australia and overseas, on knowledge transfer for commercial benefit has been grounded in the increasing recognition of the importance of innovation to global economic performance.

According to the OECD (1999a), innovative capacity depends on the complex interaction between:

- the success of public policy in creating favourable conditions for innovation;
- the level and range of capabilities (including absorptive capacity and innovation culture) at the individual company or organisation level; and
- the efficiency and effectiveness of networking and clustering arrangements within the sector and beyond to other sectors and knowledge-producing agents such as universities and PFRA_s.

An OECD National Innovation Systems project (Little, 2001) developed a typology that describes the range of policy themes pursued by governments in the promotion of innovation, including: addressing market failures; building an innovation culture; enhancing knowledge diffusion; promoting networking and clustering; and, leveraging research and development.

These concepts about the roles of government in supporting innovation in the commercial sectors are also applicable to the broader concepts of supporting innovation and improved performance across other sectors of society. For example, the Canadian policy research initiative on social capital (Canadian Policy Research Initiative, 2005) emphasises the role of government in building social capital and outlines several options for government involvement:



Effective functioning networks are a key driver of knowledge transfer in both the commercial and non-commercial domains.

Of more direct significance for this project, Hatakenaka (2005) argues that there are three types of rationale for government intervention through funding programmes to support knowledge transfer or in his language 'third stream' activities:

- To **achieve cultural change** (the internalisation of the value of knowledge transfer across the institution and the development of supportive institutional policies, practices and organisational structures).

Without public money, all that universities can do is to undertake third stream activities which can be paid for by external stakeholders. Third stream activities are then equated with income generating activities for the institutions – and little room is left for instilling the higher order values about achieving an impact on the economy and on society.

(Hatakenaka, 2005; p.17)

- To **overcome market failure** and instigate demand from user communities who are unable or unwilling to pay for knowledge transfer services (e.g. small to medium enterprises are often the target of public subsidy).
- To **provide pump priming** to support start up activities and experimentation in new activities responding to newly discovered needs of users.

3.2 Policy responses of overseas governments

In this section, we briefly outline the knowledge transfer policy responses of selected overseas governments.

3.2.1 United Kingdom

England

Official acknowledgement of the 'third stream' in England dates back to 1999, when the Higher Education Reach Out to Business and the Community (HEROBC) scheme was first introduced by the HEFCE in collaboration with the Office of Science and Technology. Following on from the HEROBC scheme, the Higher Education Innovation Fund (HEIF) was introduced in 2002.

The HEIF was established as a partnership between the Department of Trade and Industry/Office of Science and Technology and the HEFCE. The first two rounds of funding under HEIF, awarded on the basis of competitive bid, committed £265 million over the years 2002-03 to 2005-06. These rounds placed a particular emphasis on supporting institutions in building their own capacity to engage with business and the community.

The second round also included funding, of up to £500,000 per year for five years, for new centres of knowledge exchange activity that were to be exemplars of good practice in interactions between less research-intensive university departments and business. It also incorporated a number of previous funding programmes supported

by the Office of Science and Technology⁶ to provide a single stream of knowledge transfer funding:

Support for knowledge transfer will be through a single stream of funding, allowing HEIs to play a greater role in targeting available resources at their identified priority areas – be it capacity building, seed funding, entrepreneurship education, or other social and economic activities.

(HEFCE and OST, 2003; p. 6)

While the HEIF has represented a significant fund, it is small in comparison to the annual research funding to universities of approximately £1.8 billion in 2003-04, representing roughly six per cent of the annual research allocation (Lambert, 2003).

The HEFCE recently released a summary evaluation of the first round of HEIF funding which concluded that:

The profile and credibility of third stream activity, and the targeting of outputs and outcomes, have been much improved within higher education institutions and their business and community partners. Third stream activity is now firmly embedded within institutions, and the sector is strongly committed to continuing to develop this as a core activity of HE, in order to further contribute to the society and economy.

(HEFCE and OST, 2006; p.7)

In recognition of the importance of university knowledge transfer to the UK's innovation performance, the Government has now committed to a permanent 'third stream' funding programme. £238 million will be provided for the two-year period 2006-08. This includes up to £20 million as continuation funding for the successful Centres for Knowledge Exchange (CKEs) which were initiated in 2004 under HEIF 2 (HEFCE and OST, 2005a; p. 3).

The HEFCE has now also adopted the Lambert Review proposals that 'third stream' funding should be allocated in a way that provides universities with greater certainty about future funding levels and reduces the administrative burden associated with repeated bidding rounds.

From 2006-07, 75 per cent of the HEIF funding will be allocated by formula, with the remaining 25 per cent allocated on a competitive basis to:

⁶ Science Enterprise Challenge to establish a network of centres in UK universities, specialising in the teaching and practice of commercialisation and entrepreneurialism in the field of science and technology, and University Challenge Fund to provide seed funds to assist the transformation of good research into good business.

... encourage extension of the boundaries of effective knowledge transfer and exchange. It will generate new, cutting-edge knowledge transfer practices and socio-economic benefits, building on HEIF 1 and HEIF 2 and learning from international good practice. We want to make sure these opportunities are not lost in our determination to move to a more predictable system for core third stream funding.

(HEFCE and OST, 2005a; p. 6)

The funding formula includes the following metrics:

- academic staff numbers (as a measure of potential and capacity) (45 per cent of funding);
- external income (as a measure of the value placed on interaction with the institution by demand-side partners) (45 per cent of funding); and
- activities not best measured by income (10 per cent of funding)⁷.

The allocation of formula funding is contingent on institutions providing acceptable high level plans for their 'third stream' activity. The importance of inter-university collaboration has been stressed through all HEIF funding rounds, as has the importance of strong links with Regional Development Agencies and regional economic development priorities.

Initiatives supported under the HEIF cover a diverse array of activities, including licensing, spinouts, awareness raising, extension services to local communities, work based placement and enterprise education. While the majority of funded projects in round two of the HEIF were aimed at knowledge transfer partnerships with industry and business for commercial outcomes, there are examples of funded projects targeted at the social and civic arena. For example, the University of Central Lancashire and the University of Portsmouth were jointly funded to establish an anti-crime network for those involved in detecting, reducing and preventing crime in both the public and private sectors (HEFCE, 2004).

A number of other English Government agencies also offer funding programmes in support of knowledge transfer or 'third stream' activities. For example:

- The **Cambridge-MIT Institute**, a collaborative alliance between the University of Cambridge and the Massachusetts Institute of Technology (MIT) to undertake integrated joint education and research initiatives that will improve entrepreneurship, productivity, and competitiveness in the UK (funded through the Science budget).
- **Knowledge Transfer Partnerships** which enable higher education institutions to apply their knowledge and expertise to important business

⁷ This includes measures of: dedicated third stream staff, SME engagement, sandwich student placements and engagement with non-commercial (including social and civic organisations).

problems. Each Partnership involves an institution, company partners and a recently qualified graduate recruited as the KTP Associate (funded by the Department of Trade and Industry).

Scotland

The Scottish Funding Council introduced a Knowledge Transfer Grant (KTG) in 2001-02 to support knowledge transfer activities in Scottish higher education institutions.

The aim of the Council's formulaic KTG, which is otherwise allocated non-prescriptively, is to increase the scale and rate of exploitation of the outputs from higher education research, knowledge, skills, expertise or ideas, particularly where this is likely to generate economic, educational, social, healthcare or cultural benefits for Scotland.

(Scottish Funding Council, 2005)

The budget for the Knowledge Transfer Grant has been increased by 31.6% to £12.5 million for the academic year 2005-06, to support a significant increase in the transfer of ideas from higher education institutions to business in Scotland.

As in England, higher education institutions can also access other funding programmes to support knowledge transfer. For example, Scottish Enterprise offers a Proof of Concept Programme.

Wales

In partnership with the Welsh Development Agency and the Welsh National Assembly, the Higher Education Funding Council for Wales offers a number of project-based funding programmes targeted at higher education institutions supporting business and public sector agencies. These include:

- Centres of Expertise for Technology and Industrial Collaboration;
- Wales Spinout Programme which encourages the development of new 'spinout' businesses from Welsh universities and colleges;
- Colleges and Businesses in Partnership, supporting collaboration between SMEs and higher education institutions; and
- Knowledge Exploitation Fund, providing financial assistance for institutional culture change and capacity building, skills development and training, and commercialisation and knowledge transfer. The Fund includes a number of sub-programmes:
 - Patent and Proof of Concept Fund
 - Collaborative Industrial Research Projects
 - Technology Transfer Networks
 - Technology Transfer Centres.

3.2.2 United States

The US has been a world leader in technology transfer and the commercialisation of research. The 1980 Bayh-Dole Act was a landmark piece of legislation in the United States which resulted in a significant increase in technology transfer effort across American universities and research institutions. It created a uniform patent policy among the many federal agencies funding research, and allowed universities and other publicly funded research agencies to retain ownership of inventions made under federally funded research. In return, universities were expected to file for patent protection and to ensure commercialisation upon licensing.

Hatakenaka (2005) reports that the current high levels of university and business collaboration in the US can be attributed to two types of *demand-side* funding for subsidising collaboration which have been in place in the US since the late 1970s (and earlier if the extensive government funding for agricultural extension is taken into account):

- National Science Foundation programmatic support under its flagship programmes for establishing centres for university-industry collaborative research – many States complemented and replicated such programmes with their own funds. By 1990, there were over 1,000 such centres.
- Small Business Innovation Research and Small Business Technology Transfer grants which were established in 1982 and 1992 respectively to promote research activities in small businesses.

One example of the policy response of the US Government to the increased emphasis on 'public engagement' is the Office of University Partnerships (OUP), which was established in 1994:

... in an effort to encourage and expand the growing number of partnerships formed between colleges and universities and their communities. OUP recognizes the crucial role these collaborations and partnerships play in addressing local problems and revitalizing our nation's communities. Additionally, colleges and universities are making future generations aware of these issues by integrating partnership activities into their academic studies and student activities.

(Office of University Partnerships, 2005)

The OUP operates a number of funding programmes to support its objectives, including the Community Outreach Partnership Centre programme, which provides four years of financial support to community partnerships at higher education institutions.

A scan of the websites of State higher education agencies reveals a widespread acknowledgement of the importance of community engagement and civic responsibility in State higher education plans, but little evidence of dedicated policies or funding programmes, with some programmes that do exist funded federally. Examples of programmes include:

- teacher quality grants – supporting professional development partnerships between universities and school districts;
- campus community collaborations grants – supporting partnerships between community-based organisations and universities; and
- community service-learning grants – supporting the placement of students in community organisations.

3.3 *Public policy support for knowledge transfer in Australia*

In this section, we provide a summary description of existing public policy programmes supporting knowledge transfer, including those provided through:

- the Education, Science and Training portfolio;
- the Industry, Tourism and Resources portfolio;
- the Health and Ageing portfolio;
- other Australian Government portfolios;
- other national programmes and knowledge transfer organisations; and
- State Governments.

We have not attempted to cover programmes provided through local government authorities. Local governments are more likely to provide support through individual projects or service contracts than ongoing programmes of support.

For the key Australian Government portfolios that support knowledge transfer (i.e. Education, Science and Training; Industry, Tourism and Resources; and Health and Ageing), we have:

- Provided a description of each key relevant programme in Appendix 6.
- Mapped and tabulated selected features of the programme for the purposes of analysing the:
 - target audiences of the programme
 - primary focus of the programme - knowledge transfer for commercial benefit or knowledge transfer for other material, human, social or environmental benefit (or both)
 - knowledge transfer processes supported through the programme.

In relation to knowledge transfer processes, it is important to highlight that programme guidelines are not always sufficiently explicit to enable a straightforward assessment of which processes are supported, and some degree of subjective judgement has been applied. Our approach to mapping and tabulating each programme, and our rationale for our mapping decisions, are outlined in Appendix 6.

3.3.1 Education, Science and Training portfolio

Australian Government funding programmes and initiatives of relevance to knowledge transfer within this portfolio include a number of core funding arrangements, the proposed Accessibility Framework and a range of specific programmes. These are discussed below.

Core funding arrangements

Core funding arrangements include:

- higher education block funding for research training, research and research infrastructure;
- higher education learning and teaching grants; and
- PFRA funding.

Higher education block funding for research training, research and research infrastructure

The Research Training Scheme (RTS) provides block research funding, on a calendar year basis, to eligible higher education providers to support research training for students undertaking Doctorate and Masters Degrees by research. The objectives of the RTS are to:

- enhance the quality of research training provision in Australia;
- improve the responsiveness of higher education providers (HEPs) to the needs of their research students;
- encourage HEPs to develop their own research training profiles;
- ensure the relevance of research degree programmes to labour market requirements; and
- improve the efficiency and effectiveness of research training.

In 2005 the RTS mechanism returned 75% of higher education providers' previous year's allocations and allocated the remaining 25% according to providers' relative success in a performance index comprising research income (40%), higher degree by research completions (50%) and research publications (10%). The total funding allocated by the Australian Government in 2005 to Australian universities through the RTS equalled A\$552 million.

The Institutional Grants Scheme (IGS) provides block research funding, on a calendar year basis, to eligible higher education providers to support research and

research training activities. The IGS may be used to fund any activity related to research and higher education providers have discretion in the way they spend their IGS funds. The current IGS allocation mechanism reflects providers' relative success in a performance index comprising research income (60%), Commonwealth funded research student load (30%) and research publications (10%). The total funding allocated by the Australian Government in 2005 to Australian universities through the IGS equalled A\$291 million.

The Research Infrastructure Block Grants (RIBG) scheme provides block grants, on a calendar year basis, to eligible higher education providers to enhance the development and maintenance of research infrastructure.

The research block funding schemes provide considerable support for functions and activities with knowledge transfer dimensions, particularly:

- research training and the transfer of knowledge through graduate placement in industry and other organisations;
- academic publications; and
- the conduct of research under contract from industry, business, government and other agencies (income derived from contract research is counted in the block funding formulas).

The proposed Research Quality Framework (RQF), if implemented, will provide a new mechanism for allocating a portion of the block funds. The previous Minister for Education, Science and Training indicated in his foreword to The Preferred Model paper that the RQF would be used to allocate all of the IGS funding and at least 50 per cent of the RTS funding. It is not proposed that it be applied to the RIBG.

The Preferred Model for the RQF put forward for comment by the Expert Advisory Group (EAG) in September 2005, proposes a five point rating scale for research quality and a three point rating scale for research impact. The proposed use of an impact rating has generated some controversy within the higher education sector. The controversy is centred around issues such as:

- Should quality and impact be treated separately or is impact an important measure of quality?
- What should the relative weighting be for quality and impact?
- Does the impact component of the RQF represent, by default, a 'third stream' or knowledge transfer funding component?

The final report of the RQF EAG is currently being considered by the Minister. The report is therefore not in public domain and hence we can not comment on the proposals contained within it.

The RQF, if and when it is implemented, will provide a mechanism for determining, based on past performance, how the block funding will be allocated. 'Past performance' will be judged in terms of academic quality and impact. For a number of reasons, we do not concur with the views being expressed by some stakeholders

that the 'impact' component of the RQF represents a pseudo 'third stream' or knowledge transfer component:

- The RQF assessment of the quality and impact of research will not capture the wide scope of knowledge transfer activities and outcomes across the university and PFRA sectors. The AVCC notes:

... all university income for research counts towards the allocation of competitive research block funding. However the income must meet the prescribed definition of research, which not all useful engagement activity will do...

(AVCC, 2005; p.6)

The case studies presented in Chapter 4 lend strong support to this view. While only representing a small sample of knowledge transfer activities, the case studies provide an indication of the diversity of valuable knowledge transfer activities, approaches, partners and outcomes within the higher education sector.

For individual institutions, a proven track record in *some* forms of knowledge transfer will presumably lead to higher impact ratings in the RQF and enhanced block funding outcomes, however, the RQF is not designed to capture the full range of knowledge transfer activities. This was the point being made by the EAG when it suggested that the concept of 'third stream' funding be considered.

- Our proposed definition of knowledge transfer encompasses knowledge generated through original research and the research of others – the RQF will presumably assess the quality and impact of original research only. We have also highlighted the issue of the role of learning and teaching in knowledge transfer.
- Our proposed definition highlights that while knowledge transfer is heavily integrated with research, it requires additional capabilities, infrastructure and relationships to be realised. A key issue raised by the higher education sector in the course of this project is the need for 'pump priming' funding to support the initiation and building of enduring knowledge transfer partnerships that will in the future lead to higher impact outcomes.

Our conclusion is that research block funding provides support for some forms of knowledge transfer. Under the current formula mechanisms, the funding supports activities such as the production of research graduates and academic publications and research undertaken in collaboration with industry and government. Under the proposed RQF, the funding will reflect proven research performance in terms of peer assessments of quality and impact.

However, knowledge transfer is not explicitly stated as a core objective of any of the research block funding schemes. In addition, the case studies presented in Chapter 4 demonstrate the range of knowledge transfer activities that would not be covered by either existing or proposed distribution mechanisms for research block funding.

Higher education learning and teaching grants

From 2005, higher education providers are funded under the Commonwealth Grant Scheme each year to deliver a specified number of Commonwealth supported undergraduate and postgraduate non-research places. Since 2005, the distribution of Commonwealth supported load has been set out in funding agreements negotiated with individual higher education providers. Each place is classified under a funding cluster which determines the level of Commonwealth support it receives.

Universities regularly engage with external bodies in the design and delivery of their programmes of study, especially in the professional areas where accreditation by professional bodies is a requirement (e.g. Engineering) or where student work experience is a compulsory component (e.g. Teaching). Institutions currently draw on the funding provided through the Commonwealth Grant Scheme to support these types of arrangements that have often been in place over a long period of time.

Our desktop research and the input provided by stakeholders in the course of this project, however, highlight that institutions are responding to increasing demands for greater engagement with industry, business and the community in the design and delivery of academic programmes.

We also note that the indicators adopted for the allocation of the Learning and Teaching Performance Fund do not include any measures targeting teaching-related knowledge transfer (e.g. CPE, education and training services contracts with industry, government or community, curriculum alignment).

PFRA funding

As noted in section 2.1.1., the governing Acts of PFRAs have always made the requirement for knowledge transfer quite explicit, and the *modus operandi* of PFRAs has consequently been shaped by a strong emphasis on collaboration with government agencies, business and the community.

This infers that the Government funding allocated to the PFRAs is intended to cover their knowledge transfer activities. It is beyond the scope of this project to make any judgements about the extent to which current funding levels support an optimal level of knowledge transfer. However, we note that the PFRAs invited to provide input to this project did not come forward with any strong views about inadequacies in current support for knowledge transfer.

In their input to the project, one PFRA did note that it is constrained from gaining additional funding through many major Australian research funding programmes, such as most of the ARC programmes.

Accessibility framework

There has been an increasing interest internationally in the concept of open access to the findings of publicly funded research:

Open access means a return to the core values of scholarship – the free exchange of scholarly information with the objectives of publicly registering claim to intellectual property and of contributing to the advancement of scholarly endeavour by preventing

duplication of effort and establishing a knowledge base on which others can build. In other words, maximising the impact of research effort. After so long in the realm of restricted access, the academy appears to be taking back control in the area of scholarly communication.

(UK Joint Information Systems Committee (JISC) and the Open Society Institute, 2004; p.10)

A number of international agencies, overseas governments and higher education peak bodies have recently taken significant policy decisions aimed at opening up access to the findings of public research, including the OECD, the United Kingdom, the US, Germany and Italy (DEST, 2006).

The Government's 2004 *Backing Australia's Ability* package included the proposal to develop an Accessibility Framework to improve access to research information, outputs and infrastructure. The Government is keen to ensure that, through the establishment and linkage of electronic digital repositories, national scholarly output and research data derived from Australian Government funding will be available to researchers and the wider community, subject to agreed ways to safeguard the privacy of participants and the protection of confidential information and commercially sensitive data.

The Framework will embrace a range of e-Research environments that are emerging from the changing innovative practices of scientists and scholars in all disciplines. It will be largely based on existing investments in research infrastructure, which are laying the foundations for e-research in which advanced computational, collaborative data acquisition and management services are available to researchers through high-performance networks.

To date, the Government has provided \$33.7 million in funding from the Systematic Infrastructure Initiative (SII) for projects to build the technical information infrastructure to support the creation, dissemination of and access to knowledge, the use of digital assets and their management. These projects have been recommended to the Minister by the Australian Research Information Infrastructure Committee (ARIIC). Four of these projects are working on the development of open access institutional repositories.

Through the provision of accessibility infrastructure, the Accessibility Framework has the potential to provide significant support to universities and PFRA's in their knowledge transfer activities. Enhanced open access approaches will certainly facilitate the sharing of knowledge between researchers and will provide the possibility of greater access for non-academic users of knowledge. Our desktop research, however, suggests that effective knowledge transfer usually requires the intervention of knowledge intermediaries who are able to translate and contextualise academic knowledge to make it 'useable' by non-academic communities.

A recent study on knowledge exchange networks reported in Appendix 3 (Howard Partners, 2005b) emphasises the importance of the human interface in networks, noting that paradoxically the greater opportunity for the transfer of knowledge through the Internet, the greater is the need for skilled facilitators, trusted advisers and 'honest brokers' who can bridge the cultures and interests of the parties to an exchange.

Funding programmes specifically targeted at knowledge transfer

The following programmes which may be used to support knowledge transfer are administered by the Education, Science and Training portfolio:

- Cooperative Research Centres (CRC) programme;
- Collaboration and Structural Reform (CASR) Fund;
- Australian School Innovation in Science, Technology and Mathematics (ASISTM) programme;
- Australian Research Council (ARC) Linkage schemes, including:
 - Linkage projects
 - Research Centres
 - Research Networks
- CSIRO National Research Flagships initiative.

The table presented over the following two pages summarises the relevant features of these programmes.

Programmes administered by the Education, Science and Training portfolio (continued)

Program	Government Funding	Research Sector participants	Who can apply?	No. Funded	Targeted non-academic users of knowledge	Commercial benefit the primary focus?	Other material, human, social or environmental benefit the primary focus?	Knowledge Transfer Processes (adapted from Howard Partners)	Level of Demand			
								Knowledge access	Knowledge production	Knowledge re'ships	Knowledge engagement	
ARC Linkage Projects (1)	\$112.2m over 5 years (in two rounds announced in 2005)(2)	Units and partner research organisations	Units and other eligible research organisations	380 projects in 36 administering universities (in two rounds announced in 2005)	Private sector; private non-profits; government non-research organisations	Yes (for some projects)	Yes (for some projects)	◆	◆	◆	◆	ARC reports significant and increasing unmet demand (177 proposals funded from 434 submitted in 2005 Round 1; 203 proposals funded from 442 proposals in 2004 Round 2)
ARC Centres of Excellence	\$250m in two rounds of 5 year duration (2003 to 2007 and 2005 to 2010); max \$3m per year each (2)	Units	Units	12 administering universities	End-users of research	Yes (for some Centres)	Yes (for some Centres)	◆	◆	◆	◆	In 2004-05, there were 11 successful applications from 97 proposals
ARC Special Research Centres	\$14.6m in 2005 (2)	Units	Units	7 administering universities	End-users of research	Yes (for some Centres)	Yes (for some Centres)	◆	◆	◆	◆	No further rounds are being offered
ARC Co-Funded Centres	\$232.4m over 9 years for ASSC and NICTA; \$10m over 5 years for ACPFG (3)	Units, PFRA's	Not applicable	3	Private sector	Yes (for some Centres)	Yes (for some Centres)	◆	◆	◆	◆	Not applicable

◆ = primary emphasis of programme
◇ = secondary emphasis of programme

(1) Excludes proposals funded only for Australian Postgraduate Awards Industry.
(2) Excludes contributions from partner organisations.
(3) Excludes contributions from partner organisations and from other Australian Government agencies.

Knowledge access: make knowledge accessible to users
Knowledge production: 'sell' knowledge through patents, licensing or spin-off companies
Knowledge relationships: 'sell' knowledge services such as consulting, contract research and education and training services
Knowledge engagement: Form longer-term alliances of mutual benefit

Programmes administered by the Education, Science and Training portfolio (continued)

Program	Government Funding	Research Sector participants	Who can apply?	No. Funded	Targeted non-academic users of knowledge	Commercial benefit the primary focus?	Other material, human, social or environmental benefit the primary focus?	Knowledge Transfer Processes (adapted from Howard Partners)	Level of Demand
ARC Research Networks	\$42 million over five years from 2004/05 (avg of \$8.4 million per annum); max of \$500,000 per year	Unis	Unis	11 administering universities (3416 individual participants)	End users of research	Yes (for some networks)	Yes (for some networks)	<p>Knowledge access: ◆</p> <p>Knowledge production: ◆</p> <p>Knowledge rel'ships: ◆</p> <p>Knowledge engagement: ◆</p>	In 2004/05, there were 24 successful applications from 84 proposals
CSIRO National Flagships initiative	\$305 million over seven years from 2004/05 (plus redirected CSIRO funds of approx \$62 million per year)	CSIRO/Unis/Other PFRA's	Not applicable	Six flagships have been selected	Private sector, international partners	Yes (for some flagships)	Yes (for some flagships)	<p>Knowledge access: ◆</p> <p>Knowledge production: ◆</p> <p>Knowledge rel'ships: ◆</p> <p>Knowledge engagement: ◆</p>	Not applicable

◆ = primary emphasis of programme
◇ = secondary emphasis of programme

Knowledge access: make knowledge accessible to users
Knowledge production: 'sell' knowledge through patents, licensing or spin-off companies
Knowledge relationships: 'sell' knowledge services such as consulting, contract research and education and training services
Knowledge engagement: Form longer-term alliances of mutual benefit

Key points of note include:

- With the exception of the ASISTM programme, all programmes cover both knowledge transfer for commercial benefit and knowledge transfer for other material, human, social and environmental benefit. In terms of the balance of funding, however, there is an emphasis on knowledge transfer for commercial benefit.
- The CRC Programme, which has been seen both here and overseas as one of Australia's success stories in knowledge transfer, addresses both knowledge transfer for commercial benefit and knowledge transfer for other material, human, social and environmental benefit. It also spans all four of the knowledge transfer processes.
- This is also the case for the ARC Linkage schemes, which according to the ARC, are experiencing high unmet demand.

Most of the programmes are principally supply-led in nature, with universities and/or PFRA's being the organisations that apply for funding, though a number require collaborative partners from outside the research sector. Only one programme (ASISTM) is principally demand-led in nature, with schools typically being the project initiators, though universities and other bodies are also free to initiate proposals.

While this is the case, it is important to acknowledge that funding programmes such as the CRC and ARC Linkage programmes do play a key role in overcoming market failures by encouraging non-academic partners to invest in research and knowledge transfer. In the case of ARC Linkage Projects, for example, the ratio of partner organisation funding to ARC funding in 2005 was 1.5.

3.3.2 Industry, Tourism and Resources portfolio

The following programmes which may be used to support knowledge transfer are administered by the Industry, Tourism and Resources portfolio:

- Pre-Seed Fund (PSF);
- Innovation Investment Fund (IIF);
- Commercialising Emerging Technologies (COMET);
- Renewable Energy Development Initiative (REDI);
- Renewable Energy Equity Fund (REEF); and
- Commercial Ready.

The table presented over the following pages provides a summary of the relevant features of these programmes.

Programmes administered by the Industry, Tourism and Resources portfolio

Program	Government Funding	Research Sector participants	Who can apply?	No. Funded	Targeted non-academic users of knowledge	Commercial benefit the primary focus?	Other material, human, social or environmental benefit the primary focus?	Knowledge Transfer Processes (adapted from Howard Partners)	Level of Demand
Pre-Seed Fund (PSF)	\$72.7 million over ten years (avg of \$7.3 million per annum); max of \$1 million per project	Unis, PFRAs (through companies or projects)	Research sector	17 (in 2004/05)	Investors	Yes (beneficiaries are unis/PFRAs or their spin-off companies)	No	◆	25 successful applications from 1,100 proposals since inception
Innovation Investment Fund (IIF)	\$220.7 million over 10 years (avg of \$22 million per annum)	Unis, PFRAs (through companies only)	Research sector; small companies in a broad range of technologies including life science, information and communication	31 (in 2004/05)	Investors	Yes (beneficiaries include spin-off companies of unis/PFRAs)	No	◆	74 companies invested in since inception
Commercialising Emerging Technologies (COMET)	\$170 million over 12 years (avg of \$14.2 million per annum); max of \$120,000 per project	Unis, PFRAs (through companies only) (10% of grants targeted at the research sector)	Research sector, small new companies across all industry sectors (mostly in manufacturing and property and business services)	283 (in 2004/05)	Small business	Yes (beneficiaries can include spin-off companies of unis/PFRAs)	No	◆	127 successful applications from 155 proposals in 2004/05

◆ = primary emphasis of programme
 ◇ = secondary emphasis of programme

Knowledge access: make knowledge accessible to users
 Knowledge production: 'sell' knowledge through patents, licensing or spin-off companies
 Knowledge relationships: 'sell' knowledge services such as consulting, contract research and education and training services
 Knowledge engagement: Form longer-term alliances of mutual benefit

Programmes administered by the Industry, Tourism and Resources portfolio (continued)

Program	Government Funding	Research Sector participants	Who can apply?	No. Funded	Targeted non-academic users of knowledge	Commercial benefit the primary focus?	Other material, human, social or environmental benefit the primary focus?	Knowledge Transfer Processes (adapted from Howard Partners) Knowledge access Knowledge production Knowledge relationships Knowledge engagement	Level of Demand
Renewable Energy Equity Fund (REEF)	\$17.7 million over ten years (avg of \$1.77 million per annum); max of \$2.26 million per project	Unis, PFRAs	Research sector, renewable energy sector	5 (in 2004/05)	Investors	Yes (beneficiaries can include unis/PFRAs or their spin-off companies)	No	◆	10 companies invested in since inception
Renewable Energy Development Initiative (REDI)	\$100 million over 7 years (avg of \$14.3 million per annum); max of \$5 million per project	Unis, PFRAs (through companies only - eligibility criteria apply)	Non-tax exempt companies or wholly or majority owned Commonwealth and State Government bodies that otherwise meet criteria	10 (in first round announced in Dec 2005)	Business sector	Yes (beneficiaries can include spin-off companies of unis/PFRAs)	No	◆	10 successful applications from Round 1 with grant value of \$23 million and total project value of approximately \$60 million
Commercial Ready	\$1.07 billion over 7 years (avg of \$200 million per annum for five years from 2006/07); max of \$5 million per project over three years	Unis, PFRAs (through companies only)	SME business sector	25 (in 2004/05); aims to assist 1,700 SMEs over 7 years)	SME business sector	Yes (beneficiaries can include spin-off companies of unis/PFRAs)	No	◆ ◇	196 applications assessed, with 129 supported from 1/10/04 to 31/12/05

◆ = primary emphasis of programme
 ◇ = secondary emphasis of programme

Knowledge access: make knowledge accessible to users
 Knowledge production: 'self' knowledge through patents, licensing or spin-off companies
 Knowledge relationships: 'self' knowledge services such as consulting, contract research and education and training services
 Knowledge engagement: Form longer-term alliances of mutual benefit

Key points of note include:

- All programmes have a primary focus on knowledge transfer for commercial benefit and a primary emphasis on the 'knowledge production' process.
- The programmes fall into two categories:
 1. Supply-side programmes targeted at universities and PFRAs to support them in commercialising their IP (Pre-Seed Fund).
 2. Demand-side programmes targeted at SMEs in a range of sectors to assist in accelerating commercialisation – universities and PFRAs can seek funding but only through spin-off or commercial companies. A number of these programmes also create incentives for SMEs to seek R&D services from universities and PFRAs (Commercial Ready, COMET).

In its written input to the project, the Group of Eight universities commented that many of the commercialisation programmes offered through the Industry, Tourism and Resources portfolio focus on assisting private sector companies, with strict eligibility restrictions placed on companies associated with a university or PFRA. Representatives of the Department of Industry, Tourism and Resources (DITR) consulted for this project agreed with the observation that most programmes are targeted at private enterprise and put the view that there was scope to do more in terms of encouraging the private sector to commercialise ideas through knowledge transfer from universities and PFRAs.

TechFast

In addition, the Australian Government has provided through the Department of Industry, Tourism and Resources \$2.5 million in funding to the Australian Institute for Commercialisation (AIC) to support the pilot TechFast programme (due to be completed in June 2006) (see more detail in Appendix 6).

TechFast provides an intermediary mechanism to enable the linkage of SME knowledge needs with university and PFRA expertise. It is intended to help established, well performing technology-based SMEs accelerate into larger, sustainable, fast growing businesses that will make a significant contribution to economic growth and development. This will be achieved through fast tracking the adoption by SMEs of external technologies sourced from research organisations.

TechFast is a demand-side programme with a primary focus on knowledge transfer for commercial benefit. It has a primary emphasis on 'knowledge access', with secondary emphases on 'knowledge relationships' and 'knowledge production'.

3.3.3 Health and Ageing portfolio

The following programmes which may be used to support knowledge transfer are administered by the Health and Ageing portfolio through the NHMRC:

- Development Grants;
- Centres of Clinical Research Excellence; and
- Health Services Research Program Grants.

The table presented on the following page provides a summary of the relevant features of these programmes.

Key points of note include:

- The number of projects funded under the programmes is quite small, although funding levels and timeframes can be quite large.
- One programme is targeted at commercialisation, and the others are targeted at knowledge access in clinical, policy and health service delivery settings.
- Representatives of the NHMRC consulted for this project emphasised that most of the NHMRC programmes are targeted at knowledge generation, rather than knowledge transfer.

Programmes administered by the Health and Ageing portfolio

Program	Government Funding	Research Sector participants	Who can apply?	No. Funded	Targeted non-academic users of knowledge	Commercial benefit the primary focus?	Other material, human, social or environmental benefit the primary focus?	Knowledge access	Knowledge Transfer Processes (adapted from Howard Partners)	Level of Demand
NHMRC Development Grants	A total of \$4.56 million was allocated in the Jan and Sept 2005 rounds; max funding of \$200,000 for one year	Unis, PFRAs	Research sector	14 (for commencement in July 2004)	Commercial sector	Yes	No	◆	◆	10 successful grants from 38 applications (January 2005); 10 successful grants from 29 applications (September 2005)
NHMRC Centres of Clinical Research Excellence	\$14 million allocated for grants commencing in 2005	Unis, PFRAs	Research sector	6 (in 2007 round)	Health Clinicians	No	Yes	◆	◆	7 successful grants from 61 applications
NHMRC Health Services Research Program Grant	\$50 million for five rounds of funding from 2005 (avg of \$10 million per round); individual projects in first round attracted between \$3.2 and \$4.5 million	Unis, PFRAs	Research sector	3 (in first round)	Policy makers, health service providers and citizens	No	Yes	◆	◇	3 successful applications from 26 expressions of interest and 7 short-listed proposals (first round)

◆ = primary emphasis of programme
 ◇ = secondary emphasis of programme

Knowledge access: make knowledge accessible to users
 Knowledge production: 'sell' knowledge through patents, licensing or spin-off companies
 Knowledge relationships: 'sell' knowledge services such as consulting, contract research and education and training services
 Knowledge engagement: Form longer-term alliances of mutual benefit

3.3.4 Other Australian Government portfolios

In addition to the above key Australian Government portfolios, universities and PFRA's access funding, that may include knowledge transfer components, from a range of other Government portfolios, most notably: Agriculture, Fisheries and Forestry; Defence; and Transport and Regional Services. It is beyond the scope of this project to map these programmes in any detail.

In any discussion of knowledge transfer in Australia, however, it is important to highlight the success, as judged both here and overseas, of the Rural R&D Corporation (RDC) model. The legislated objectives for the RDC model focus on expanding Australia's rural R&D effort, improving its efficiency and effectiveness by investing in high priority areas, and enhancing industry's international competitiveness through more effective uptake of research results. Central to the RDC Model is an alliance between industry and Government to pursue R&D to advance the interests of industry as well as those of the wider public.

The rural industry-based RDCs are generally funded on the basis of the Government matching, dollar-for-dollar, industry R&D levies up to a maximum of 0.5% of the industry's gross value of production. A few RDCs (e.g. the Land and Water Resources RDC and the Rural Industries RDC) receive substantial government funding in recognition of the broad public interest in energy and environmental issues, and the need to pursue generic rural R&D and support new and emerging rural industries.

The Government's dollar-for-dollar matching contribution is designed to provide an incentive for the primary sector to increase its R&D funding and to become more involved in R&D priority setting and the adoption of outcomes, and also recognises that activities funded by the RDC generate a mix of public and private benefits.

Each RDC uses its funds as it sees fit in pursuit of its objectives and priorities. The majority of the funds are used for research, which may be commissioned by the RDC or be allocated to projects proposed by researchers. Each RDC places a strong emphasis on education, technology transfer and communications. In addition to extensive programmes of publications, events, supporting resources and so on, some RDCs employ professional managers who act as knowledge brokers to promote the transfer and uptake of knowledge arising from the research and to act as a communication link between the researchers and industry.

The RDCs also seek to build research capacity by investing in human resource development through scholarships and fellowships on the research side and through education of users on the industry side.

The success of the RDC model is often attributed to its strong demand-side nature, with industry both funding and managing the programme. In our consultations for this project, the issue of whether the RDC model could effectively be extended to

other appropriate industry sectors was raised as an issue that could be considered by Government.

3.3.5 Other national programmes and knowledge transfer organisations

There are a range of other programmes and organisations that support knowledge transfer with respect to Australian universities and PFRAs, for example:

- InnovationXchange - the Australian Industry InnovationXchange Network (IXC) is an industry-led not-for-profit company which provides a secure, managed environment for the connection of insights and opportunities between firms, universities and governments through the deployment of an Intermediary Service.
- Knowledge Commercialisation Australasia (KCA) - the purpose of KCA is to assist in the development and maintenance of skills associated with knowledge transfer from public sector organisations and to promote the activities of its public sector members in government, industry and commercial forums.
- Australian Institute for Commercialisation (AIC) - a national, not-for-profit company dedicated to enhancing Australia's ability to commercialise its research and development (R&D) in the global marketplace.

A number of these programmes and organisations were initiated with the funding support of the Australian and State Governments.

3.3.6 State Governments

All State Governments in Australia have some form of active relationship with the higher education industry within the State. However the nature of that relationship varies greatly, reflecting differences in the scale of the States and fundamental differences in approach to the role of the State in higher education.

All State Governments have moved to some degree beyond their minimal legal responsibilities for accreditation and registration functions in higher education. With the increasing importance of knowledge-based industries to State economies, a number of State Governments have moved to adopt a stronger and more strategic orientation to their higher education sectors. There are consequently new models emerging for defining the relationship between State Governments and universities.

This has occurred in the context of a clear trend toward more comprehensive strategies, including substantial investment, designed to enhance the development of the knowledge economy. At a minimum this involves measures intended to create favourable conditions for innovation, but in many cases it also involves direct funding of infrastructure, the purchase of specific services and the funding of targeted initiatives.

It is beyond the scope of this project to provide a comprehensive overview of State Government policies, strategies and funding programmes of relevance to knowledge transfer. There are also no readily available sources of information relating to the extent to which universities and PFRA's access State funding in support of knowledge transfer. However, we provide below a brief overview of relevant developments in a sample of States.

Queensland

Since 1998, the Queensland State Government has been pursuing its high profile 'Smart State' strategy. This is arguably the most comprehensive and sustained State Government strategy to develop the knowledge economy. The State Government's relationship with the higher education sector in Queensland is located within the context of the Smart State strategy. The Smart State strategy was recently reviewed and renewed for the period 2005 to 2015 (Queensland Government, 2005).

Key points of note include:

- Development of 'smart sector' strategies in partnership with industry, business, education and research providers. These industry-specific strategies 'will integrate education, research, technology adoption, sustainability, infrastructure and export issues'.
- Operational funding for collaborative projects and research programmes that are strategically important to Queensland.
- Investment in strategic alliances and networks.
- Support for highly innovative projects in the early stages of commercialisation.
- The substantial investment in innovation infrastructure, which has been used effectively to leverage funding from other sources and to attract leading edge industries and research teams. The latest initiatives include an Innovation Building Fund (\$128 million over 4 years) and an increase to \$40 million in the Smart State Research Facilities Fund.
- Funding to attract and retain top researchers and PhD students.

While it is difficult to make definitive, causal links between the Smart State strategy and economic performance, the Queensland State Government points to evidence of improved and above-average economic growth, labour productivity and export performance since the introduction of the strategy.

Tasmania

The University of Tasmania and the State Government initially entered into a landmark agreement in 2000. The agreement was subsequently renewed in 2005, establishing a framework to further strengthen the well-developed links between the two parties (Tasmania Department of Premier and Cabinet, 2006).

The new agreement aims to achieve:

- more collaboration and co-investment on research;
- growth in the State's intellectual capital as the basis for achieving long term economic and social development;
- joint promotion nationally and internationally of expertise, innovation and services;
- closer collaboration on strategic planning and public policy development, as well as workforce planning and training;
- increased innovation and commercialisation;
- greater cooperation and co-investment in infrastructure development; and
- development of Tasmania's cultural capital.

Northern Territory

In response to *The Economic Development Strategy for the Northern Territory*, Charles Darwin University and the Northern Territory (NT) Government signed a landmark Partnership Agreement in June 2003, with the aim of combining expertise and resources to foster NT development (Charles Darwin University, 2006). As part of the Partnership Agreement, the University and Government agreed to undertake a rigorous and ongoing assessment of Government, University and Territory needs and growth areas, target the use of human, financial and infrastructure resources, and cooperate on the development of specific project areas or 'Schedules'. The Schedules have covered a range of State development issues, including: 'Supporting the Energy Industry'; 'Enhancing Teacher Capability in ICTs'; 'Achieving Economic and Social Gain from Desert Knowledge'; 'Indigenous Youth Leadership Development Program'; and 'Producing Graduates in Hard to Recruit Areas'.

Victoria

In October 2002, the Victorian Minister for Education and Training released a Ministerial Statement on future directions for higher education, *Knowledge and Skills for the Innovation Economy*, emphasising that:

The future development of our higher education system requires an agreed vision and a commitment to a new partnership between State and Commonwealth Governments and our universities.

(Victorian Department of Education and Training, 2002; p.18)

The Statement expressed the Government's willingness to support the higher education sector to the extent that it can without absorbing costs that should rest

with the Commonwealth. The Ministerial Statement also outlined proposals for new arrangements, including:

- State Government partnership agreements with each public university;
- establishment of a Ministerial Higher Education Roundtable including key Ministers, Department Secretaries and Vice-Chancellors; and
- establishment of a committee of senior representatives from all State Government portfolios to coordinate engagement with the higher education sector.

The Ministerial Statement documents that the new partnership agreements would, amongst other things:

- *Reflect university missions and priorities and provide a framework within which State Government priorities will be negotiated by individual agencies.*
- *Determine ways in which State Government resources can support universities in developing their community and industry engagement.*
- *Incorporate long-term strategies for asset disposal and acquisition where State Government involvement is required.*
- *Identify areas in which State Government assistance, cooperation and advocacy will assist universities' accomplishment of missions and strategies.*

(Victorian Department of Education, 2002)

The Victorian Government recently commissioned a survey of universities: *Australian Universities as Sites of Citizenship and Civic Responsibility (Victoria)*. The report of the survey findings concludes that university-community engagement initiatives have been important in delivering social and economic benefits to local and regional communities (Winter et al, 2005).

3.4 Assessing the adequacy of existing programmes supporting knowledge transfer

The project brief requires us to provide a gap analysis, identifying any areas where there is insufficient or inappropriate support for knowledge transfer activities. Our gap analysis has been informed by:

- the views of stakeholders;
- identified barriers to knowledge transfer; and
- reported gaps in support for knowledge transfer.

3.4.1 The view of stakeholders

As evidenced by the input provided to this project (see Appendix 2), there is a broad consensus among higher education peak bodies that:

- existing programmes provide some support for knowledge transfer activities;
- these programmes largely focus on knowledge transfer for commercial benefit; and
- there is no general support for universities' role in responding to the needs of business and the community more broadly and initiating, building and maintaining longer term knowledge transfer partnerships.

The views expressed by the majority of higher education stakeholders are reflected in the following quote from the written input provided to the project by IRU Australia:

The IRU Australia acknowledges that some specific engagement activities are supported through existing funding programmes. However demands for new services are constantly emerging which requires universities to provide [services] on a small scale as external funding is unlikely to be sourced. There are instances where university products and services are unsustainable beyond an initial funding period as many user communities (and SMEs) are unable to pay the full cost of services even though economic and public benefits are obvious. Continuation of services by universities often becomes financially unviable leading to the termination of many excellent projects; reinforcing the culture within academia that engagement is not 'core business'. This is compounded in regional locations where the cost of delivery of higher education is far greater.

The IRU Australia therefore argues that engagement or knowledge transfer funding should provide support and incentive for universities to develop their capacity to utilise the knowledge and skills of staff and students through the formation of sustainable partnerships – both of a commercial and non-commercial nature leading to a range of economic, social, cultural and environmental benefits.

There is a common call for the introduction of a dedicated block grant programme, based on broad indicators of university engagement activity, to support institutional knowledge transfer capacity building. Some stakeholders, however, put forward the view that a combination of block funding and competitive project-based funding was desirable in order to promote more innovative knowledge transfer partnerships that capitalise on excellence and respond to local, regional and national priorities.

The key funding gaps identified by stakeholders included:

- Funding to support the formation of sustainable knowledge transfer partnerships between universities, business and the community to achieve material, human, social and environmental benefits.

- Support for 'public good' engagement projects, which have clear economic or social benefits, but for which there is no ready funding source.
- Funding to support SMEs in engaging with universities.

While the majority of university stakeholders consulted suggest that current funding support for research commercialisation is adequate, when compared with funding support for other forms of knowledge transfer, the Group of Eight universities and other stakeholders argue that significant funding gaps also exist in the commercialisation domain. In particular, the identified gaps relate to support for:

1. The high costs involved in establishing and maintaining commercialisation offices, and protecting and commercialising IP, especially given the time lags in achieving commercial returns.
2. The transition from discovery research to proof of concept.

With respect to the first gap, a number of stakeholders highlighted the significant difficulties experienced by universities in recruiting and funding specialist research commercialisation personnel. There was some support for the concept of establishing commercialisation 'centres of excellence' that would service multiple universities and/or PFRA's. By way of example, it was reported that the German government had invested A\$84 million in 2001 in 20 technology transfer offices to provide research commercialisation services, on a regional basis, to 245 collaborating universities and research institutes. This concept builds on recent developments where institutions in Australia have partnered to establish joint commercialisation agencies or have sub-contracted their commercialisation function to another institution.

With respect to the second gap, we noted earlier that representatives of DITR put the view there was scope to do more in terms of encouraging the private sector to commercialise ideas through knowledge transfer from universities and PFRA's.

While there is a majority view that dedicated funding support for knowledge transfer is desirable, a small minority of stakeholders put alternative views, including:

- The majority of universities should not be encouraged to pursue the commercialisation of research – it is not core business and consequently they lack the necessary culture and expertise.
- Preference should be given to boosting funding levels in existing proven knowledge transfer programmes, such as the CRC Programme and the ARC Linkage programme.
- The major market failure concerns the lack of easy access by industry and business, especially SMEs, to the sources of expertise and knowledge available in universities and PFRA's.

- The need for a focus on demand-side incentives, versus supply-side incentives.

3.4.2 Barriers to knowledge transfer

In Appendices 3 and 4 we outline the incentives and barriers to knowledge transfer with respect to knowledge transfer for commercial benefit and knowledge transfer for other material, human, social and environmental benefit.

In summary, the identified barriers to knowledge transfer include:

Demand-side barriers

- Features of the Australian industry structure, including relative lack of high technology industries, high number of SMEs and their fragmentation and dispersion, relatively low levels of business investment in R&D.
- Resistance to 'purchasing' knowledge arising from publicly funded research and lack of capacity to pay, or pay the full cost, of knowledge services.
- Lack of a 'single entry' point into the higher education and research systems to identify sources of relevant knowledge.
- Lack of intermediary mechanisms to link non-academic users with sources of knowledge and expertise within the research and higher education systems (particularly relevant to SMEs).
- Lack of cohesiveness of community groups and relevant agencies in terms of capacity to define issues and problems and work together with universities and PFRAs towards solutions.

Supply-side barriers

- Funding constraints in general and associated pressures on academic staff time.
- Cultural issues, including:
 - visibility of knowledge transfer or 'engagement' in organisational structures, strategic plans and policies
 - workload and promotion policies that give insufficient emphasis to knowledge transfer or 'engagement'.
- Skill and other capacity issues including:
 - capacity and flexibility to offer competitive salary packages for commercialisation staff and to dedicate staff resources to the 'engagement' agenda
 - commercialisation skills and knowledge of academic staff.

- Resourcing issues including:
 - access to capital to support IP protection and early stage commercialisation
 - lack of critical mass to justify investment in commercialisation
 - balancing the risks and benefits of commercialisation, given the often low and delayed returns from commercialisation activity.
- Governance issues including:
 - inconsistencies in State and Territory IP laws and in IP policies between institutions
 - delays in decision-making in universities
 - State Government requirements in relation to commercialisation activity.

Where appropriate, public policy measures should aim to remove both demand-side and supply-side barriers to knowledge transfer.

3.4.3 Reported gaps in Australian public policy

Recent studies and forums in Australia have pointed to a number of perceived gaps in public policy in relation to university and PFRA knowledge transfer.

The Howard Partners report on knowledge transfer (Howard Partners, 2005a) noted that current Australian Government support for science and innovation covers all four of the identified knowledge transfer commercialisation processes. It went on to argue, however, that commercialisation processes do not fully capture the scope of university 'engagement' activities as such activities 'extend beyond research and its commercialisation to all forms of engagement which link universities to society and the economy' (p. 62). It is argued that 'there are no public programmes in Australia that specifically provide support for these activities' (p. 63).

With respect to knowledge exchange networks, Howard Partners also argue that:

Future work in the area of university-business-government relations should give a priority to building practical, efficient and effective institutions of engagement as a foundation for the networks that are needed to underpin Australia's national innovation system. We need to ensure that the structures for collaboration such as partnership, alliances and joint ventures are capable of delivering value for all stakeholders, and at the same time ensuring that core institutional values are preserved.

(Howard Partners, 2005b; p. 3)

With respect to research commercialisation, the Allen Consulting Group (2004) notes:

The threshold issue is that optimisation of university research commercialisation outcomes requires endorsement by universities and Governments of the commercialisation of research as a core activity alongside teaching and research. This necessitates Government funding models that recognise the risks and time it takes to be successful in research commercialisation, appropriate cultures, employment, recognition and reward systems in universities and capacity building, given the additional demands this places on universities and academics.

(Allen Consulting Group, 2004; p. x)

The Allen Consulting Group has also put forward the view that the Government should increase funding for proven existing programmes that target university engagement with external stakeholders, such as the CRC Programme, rather than create new 'third stream' funding programmes (Allen Consulting Group, 2005b). The case studies presented in Chapter 4, however, demonstrate the diversity of valuable knowledge transfer activity that occurs outside the formal structures of CRCs and other programmes.

3.4.4 The issues and challenges in developing public policy

There is a complex range of issues and challenges to be considered in the development of a public policy response to the knowledge transfer agenda. One significant issue, the measurement of knowledge transfer activities and outcomes, was discussed in Chapter 2. Four additional key issues are briefly discussed below.

The commercialisation of knowledge generated by publicly funded institutions

While it is appropriate for public policy to ensure that the return on public investment in research and higher education is realised through effective knowledge transfer, there are also acknowledged tensions between the push to commercialise knowledge generated through publicly funded research and the increasing emphasis being given to open access and open innovation.

It was argued by some stakeholders consulted for this project that the current public policy emphasis on research commercialisation encourages institutions to place a narrow interpretation on what constitutes knowledge transfer, and that knowledge was at risk of being 'locked away' rather than transferred for wider application. These issues are concisely expressed by the UK Higher Education Policy Institute which argues that the overarching policy objective of the 'third stream' or knowledge transfer should be to instill economic and social impact as 'values' within universities (Hatakenaka, 2005):

Without that, third stream activities risk being seen as no more than income generating opportunities and institutions would simply maximize their own revenues rather than worry about the wider economic and social impacts. In contrast, some of the best US universities have a culture that means they would choose 'openness' over patenting if that was a more effective route for generating public benefits...

(Hatakenaka, 2005: p. 3)

The Harvard University Corporation, for example, has adopted a number of principles governing commercial activities, including:

Educational and research activities of Harvard should be motivated, and be perceived to be motivated, by the pursuit of knowledge, and not financial reward.

Any agreement with an outside entity or other commercial activity should be structured to protect basic values of the University, such as freedom and openness of inquiry...

Exclusive agreements and agreements which involve holding equity in an outside entity will raise special concerns.

(Harvard University, 2001)

The issue of commercialisation has also attracted recent media comment in Australia, with claims that CSIRO policies are restricting open access to publicly funded science research outcomes (Roberts, 2006).

There are also public policy risks, particularly with regard to competitive neutrality, in the allocation of public funds to support universities in their commercialisation objectives. When universities and PFRA's seek to commercialise their IP, they are also exposed to a range of financial risks. Some stakeholders argue that universities are not well equipped to manage these risks or realise commercial opportunities. There has also been an increasing recognition in Australia that the push to commercialisation is increasingly exposing institutions to financial risks that, in the worst case scenario, could result in compromises in the quality of publicly funded core teaching and research functions.

Public policy needs to walk a fine line between creating incentives for exploiting knowledge with potential commercial value and facilitating the wide uptake of knowledge for national benefit.

Building the culture to support knowledge transfer

A key theme emerging from our desktop research and discussions with stakeholders concerns the importance of building institutional cultures that value and embrace knowledge transfer or 'engagement' across all fields of academic expertise.

This theme is reflected in our fourth principle to guide the definition of knowledge transfer:

Principle 4: Knowledge transfer represents a major component of the community's return on public investment in universities and PFRAs and should consequently be valued and actively encouraged across all disciplines and all institutions.

Some stakeholders consulted in this project cautioned that a definition of knowledge transfer or the adoption of public policy perceived as being non-inclusive would create significant barriers to building engagement-focused institutional cultures. We tend to agree.

Federal and State roles in supporting knowledge transfer

As noted earlier, it is beyond the scope of this project to assess the extent to which State and Territory Governments are supporting universities and PFRAs in their knowledge transfer activities. There are a number of factors, however, that point to their role in 'creating favourable conditions' for and supporting knowledge transfer:

- While public funding responsibility for universities and PFRAs principally rests with the Australian Government, we noted earlier that in some States and Territories the role of knowledge transfer in State and regional economic and social development has been actively acknowledged and encouraged through a range of support mechanisms.
- Most Australian universities are established by State or Territory legislation, and in some instances, it is that legislation which commits them to specific knowledge transfer and community engagement objectives.
- A number of the national research priorities also have direct relevance to State and Territory constitutional responsibilities (e.g. health delivery) and it is self evident that the States and Territories have a lot to gain from effective knowledge transfer.

This role of State and Territory Governments in supporting knowledge transfer requires consideration in the development of a national policy on knowledge transfer.

Balance between demand-side and supply-side incentives

Our desk-top research and the input received from stakeholders during the course of this project have highlighted the importance of considering both demand-side and supply-side incentives when developing public policy in relation to knowledge transfer.

The Howard Partners (2005b) study on knowledge exchange networks, for example, found that networks sponsored and supported through industry associations were more effective than networks supported by universities and research organisations and others. The success of the Rural R&D Corporation model is attributed to the fact that the RDCs are owned and managed by the rural industries they support.

Stakeholders have reported on the difficulties in partnering with SMEs and there is a growing recognition that intermediary mechanisms, such as networks, are required to enable knowledge transfer to this sector. The TechFast pilot programme, which is demand-led, is perceived by some stakeholders to be achieving considerable success in this regard. Other examples of intermediary mechanisms include InnovationXchange and the Australian Materials Technology Network (one of the case studies presented in Chapter 4).

The ASISTM programme is also principally demand-led in nature. It encourages schools to locate knowledge and expertise in universities, research and science organisations with the aim of enhancing learning and teaching in science, technology and mathematics.

It is also critical, however, to create incentives for knowledge transfer on the supply side of the equation. To be fully responsive to demand from industry, government and the community, institutions need to have in place supporting cultures, structures and systems and need to have the requisite capacity to adopt a strategic approach and to dedicate resources to effective knowledge transfer strategies and priorities.

Public policy should aim to achieve an appropriate balance between the creation of demand-side and supply-side incentives.

3.4.5 Our analysis of the gaps in public policy support

We have not identified any immediately evident gaps in the structure of funding support for the PFRAs, principally on the basis that their governing Acts specify knowledge transfer as one of their core functions. However, in the course of this project the PFRAs provided us with little evidence beyond what is available on the public record. We therefore hesitate to make a definitive statement about the overall adequacy of funding support for knowledge transfer in PFRAs. It was beyond the scope of this project to investigate this issue in any further detail.

Our mapping of existing programmes demonstrates that current public policies are providing some support to universities in their knowledge transfer activities. The key questions for this report include:

- Do existing programmes cover the full range of knowledge transfer activities that deserve support (i.e. are there gaps)?
- Are existing programmes covering the level of demand (i.e. are there shortfalls)?

With respect to the former, we conclude that there is justification for the views of many stakeholders within the higher education system that current funding arrangements and programmes do not support the full range of actual and potential knowledge transfer activities. In particular, funding programmes have focused mainly on knowledge transfer for commercial benefit rather than knowledge transfer for other human, social and environmental benefit.

There is also evidence of unmet demand in some existing higher education programmes, such as the ARC Linkage schemes and the CRC programme.

The level of demand for the Pre Seed Fund has also been extraordinarily high, with 1,100 proposals and only a two per cent success rate since its inception. There has been no formal evaluation of the PSF at this early stage of its implementation, and there is no publicly available information about the viability of investment proposals. It is consequently difficult to judge if the low success rate of proposals is due to deficiencies in the proposals themselves or inadequate capacity within the programme to fund all worthy proposals.

Recent reports on knowledge transfer and views from stakeholders point to perceived shortfalls in support for commercialisation infrastructure and support in the early stages of the commercialisation process where institutions are most exposed to the risk of making investments with little or no financial return. However, it is important to place these perceived gaps and shortfalls in perspective. The emphasis of most higher education stakeholders in their input to the project was on the deficit of support for knowledge transfer targeted at human, social and environmental outcomes, rather than any shortfalls in existing support for knowledge transfer for commercial benefit.

We noted early in this chapter that Hatakenaka (2005) put forward three types of rationale for government intervention through funding programmes to support knowledge transfer. The gaps and shortfalls in existing public policy which we have identified fit comfortably within this framework, and are described in summary under the headings of each type of rationale.

1. To achieve cultural change

The major gaps we have identified are:

- Support for capacity building at the institution level – development of the culture, strategies, structures, skills, support mechanisms and policies required to establish knowledge transfer as a function commensurate with research and teaching.
- Support for knowledge transfer capacity building at the system level – for example:
 - establishment of commercialisation ‘centres of excellence’ that provide services across universities and/or PFRAs
 - development of systems to measure knowledge transfer performance
 - development of best practice resources to assist institutions and their non-academic partners.

2. To overcome market failure and instigate demand from users

The major gaps we have identified are:

- Support for the conduct of productive and beneficial knowledge transfer activities and projects with business and community partners which are not in a position to meet the full costs of knowledge services.
- Support for the development of national information resources and intermediary mechanisms that enable business and community, especially the SME sector⁸, to locate sources and sites of knowledge within the university system and negotiate mutually beneficial knowledge transfer partnerships.
- Additional support for the early stages of commercialisation.
- Additional support for existing knowledge transfer programmes experiencing high levels of unmet demand.

We wish to highlight here the importance of demand-side initiatives. The research literature and experience in Australia (e.g. through models such as the Rural R&D Corporations) consistently points to the relative success of knowledge transfer initiatives that are driven by industry or other groups of knowledge users. There is scope for DEST to work with other government portfolios to assess the feasibility of extending these models to other industry sectors and to develop other demand-side models that will facilitate knowledge transfer.

3. To provide pump priming to support start up activities and experimentation in new activities

The major gap we have identified is:

- Support for the initiation and development of new knowledge transfer partnerships of mutual benefit with both commercial and non-commercial partners.

In presenting our assessment of the gaps and shortfalls in support for knowledge transfer, we note that many of the existing programmes were introduced only recently in the *Backing Australia's Ability* packages and have not yet been subject to evaluation. Future evaluations may identify issues relating to the effectiveness of existing programmes and may also shed further light on the extent to which existing programmes provide support and promote knowledge transfer.

⁸ Examples of intermediary mechanisms include TechFast, InnovationXchange and the Australian Materials Technology Network.

4 Case studies of knowledge transfer and Australian universities

The project brief requires us to identify case studies of knowledge transfer activities currently being undertaken in Australian universities. The brief does not ask for case studies drawn from PFRAs. As requested by DEST, we have relied where possible on published material, institutions' websites and other available sources to identify and describe case studies. In addition, when inviting stakeholder written input to the project, we also requested information about case studies that demonstrated the respondent's views on the definition and scope of knowledge transfer.

The selected case studies

Through these sources, we quickly identified in excess of 120 case study examples for possible inclusion in the report⁹. Griffith University alone lists over 70 relevant projects on its Office of Community Partnerships website¹⁰. While most other universities have not adopted such a systematic approach to documenting their knowledge transfer activities, we are confident that a comprehensive survey of knowledge transfer activities across all universities would reveal a much larger number of examples than we have identified.

In determining the case studies to include in the report, we sought to provide a diversity of examples demonstrating the range of knowledge transfer activities and processes and the varieties of organisational frameworks adopted by universities to facilitate knowledge transfer. We also sought to present case studies that located knowledge transfer within regional, state, national and international settings.

We have structured the presentation of the case studies under the two categories of knowledge transfer: that is, knowledge transfer for commercial benefit and knowledge transfer for other material, human, social or environmental benefit. As we have noted earlier in the report, there has been considerable work undertaken in recent years to research and document case studies of knowledge transfer for commercial benefit (e.g. National Survey of Research Commercialisation), and we have consequently given a slightly greater emphasis to providing examples of knowledge transfer for other material, human, social and environmental benefit.

By definition, the case studies presented are of knowledge transfer activities and partnerships that are operational and, in many instances, have received some form of government funding. There are of course other attempts at knowledge transfer that have failed or have not been sustained, often because of inadequate resources. This is a key point which emerged from stakeholder input to the project. The case

⁹ Excluding case studies in relation to CRCs and Research/Technology Parks.

¹⁰ See <http://www3.griffith.edu.au/01/ocp/>.

studies demonstrate what can be achieved through knowledge transfer when 'favourable conditions' exist.

Types of knowledge transfer case study not included

There are some important examples of knowledge transfer that we have chosen not to include. Universities are key players in initiatives and arrangements that are at the leading edge in terms of knowledge transfer in Australia, most notably CRCs and Research/Technology Parks. We have chosen not to include case studies in these areas as there has been extensive scrutiny and reporting of these developments over recent years, and in our view it would not add much to the public policy debate to revisit them here.

We have also not included some key intermediary mechanisms, such as InnovationXchange and the pilot TechFast. Whilst programmes of this nature have a key role to play in facilitating knowledge transfer, and in our view, deserve to be included in the overall public policy landscape as it applies to knowledge transfer, they represent enablers of knowledge transfer rather than actual knowledge transfer activities.

Finally, we have not provided any examples with the specific purpose of demonstrating knowledge transfer as it relates to learning and teaching. Many of the case studies, however, highlight that effective knowledge transfer partnerships often incorporate both research and learning and teaching elements. In researching possible case studies, we noted many examples of knowledge transfer that are specifically targeted at educational objectives. For example:

- University of Tasmania's community education programmes offered through its Cradle Coast Campus.
- Griffith University's EcoCentre - aimed at promoting sustainable ways of living and working across local and national communities through the development and delivery of collaborative environmental education programmes.
- University of Newcastle's Science and Engineering Challenge - aimed at encouraging more students to take up science, mathematics and engineering subjects at high school.
- The University of Technology, Sydney Shopfront - a gateway for not-for-profit community groups to access the University and seek student support in undertaking projects under academic supervision.
- Australian Catholic University's revised Bachelor of Education degree - the new degree entails 70 hours with a community organisation to embed a social justice ethic within the curriculum.

We provide descriptions of 12 case studies in the following section of the report. For each case study, we have identified the sources from which we have sourced or

reproduced information (sometimes verbatim). Finally, we present some observations about the case studies and their relationship to the principles and definitions of knowledge transfer outlined in Chapter 2.

4.1 Knowledge transfer for commercial benefit

4.1.1 Aggregated Olive Processing and Research Cluster

Sources

Information on this case study was reproduced and/or sourced from documentation provided by IRU Australia and the Australian Universities' Community Engagement Alliance (AUCEA) in their written inputs to this project.

Description

Through its independent relationships with three separate companies and groups, La Trobe University has made a significant contribution to the development of a local olive oil processing cluster that has established a \$33,000 per annum R&D fund to seed fund business-university collaborative research.

The three major groups partnering with La Trobe University are:

- **Alfa Laval** - one of the world's largest suppliers of separation equipment for milk, vegetable oils, starch, wine, beer, chemicals, vaccines, latex, mineral oils, industrial fluids, and waste water.
- **OlivOz** - OlivOz Limited was formed to service the processing requirements for the members of the CVOGA (Central Victorian Olive Growers Association), numbering approximately 160 local olive growers, and to locally produce high quality extra virgin olive oil under the common brand name of Latitude 37.
- **Corporazione Dei Mastri Oleari**, International School of Oil Masters (ISOM), which is collaborating with La Trobe University in education and research.

The partnership won a Business Higher Education Round Table award in 2005 for the best collaboration with a regional focus.

Australia imports \$148 million of olive oil per year, \$34 million of which is extra virgin olive oil (Australian Olive Association, 2004). Olives are currently grown in central Victoria and exported from the region for value adding in Melbourne and Wagga Wagga, New South Wales. While OlivOz Limited saw the potential to enhance and grow the local industry through the development of a processing capability, it was concerned about exposing itself to initial financial risk, particularly given the small business profile in the local olive industry.

Through its ongoing relationship with Alfa Laval, La Trobe University was offered, for R&D purposes, an olive oil processing plant valued at \$180,000. In keeping with

its commitment to support the economic development of the region, the University looked for opportunities to place the machine in Bendigo to optimise its potential value to the local industry and to foster mutually beneficial partnerships.

Partnership negotiations took place over a six month period, culminating in the formation of a partnership between OlivOz and Alfa Laval. At no capital cost to the growers, Alfa Laval has now provided an olive processing machine on a one year lease to OlivOz (with the option of renewal/upgrades). The partnership has provided OlivOz a low-risk entry into the oil processing business, with key partners available to share expertise and R&D capacity. It provides growers with access to a state of the art olive oil processing machine located on site for their use and the development of a competitive olive oil industry in the region. This collaboration has resulted in both synergies and operational relationships between stakeholders at all levels. These include Government agencies, education providers, research bodies and industry players.

Proceeds from the lease agreement are contributed to research, development and training programmes. An R&D Steering Committee has been established and Terms of Reference set for the development of projects to meet the needs of the industry and ensure alignment with academic expertise. The partnership will result in an annual contribution of \$33,000 by the cluster towards the research and development fund. This fund will be used to leverage research grants and is expected to double within one year.

In addition, the partnership is anticipated to provide teaching and student placement opportunities in: marketing; cooperative business models; supply chain; food technology; and, agribusiness management. Achievements to date of the partnership include the development and delivery of tailored olive oil courses, concentrating on grove management, pruning, oil blending, processing and oil tasting.

The University's connections through Matri Oleari have provided access to international experts in the olive industry and links to international oil buyers. They also provide university academic staff with links to international universities for research and development purposes. Linkages have been brokered between growers, leading international experts and practitioners.

The benefits deriving from the partnership, for each key member, are considerable including:

- For OlivOz – improved commercial returns, greater market demand for Latitude 37 and R&D to improve growing, processing and marketing.
- For Alfa Laval – market opportunities with increased demand for larger scale production and R&D to improve processing and marketing, new business and cluster models.

- For La Trobe University – funded R&D and training programmes and opportunities to develop and commercialise new oils testing intellectual property.

Since the negotiation and implementation stages of this project, participants in the group have recognised the potential for opportunities not only in processing but also the marketing of product, export potential and linkages of value between different industry players.

The building of capacity in the local olive industry has provided a feeling of worth within the community and an excitement and passion about an industry that is growing and developing; an industry which the region has the capacity to lead nationally.

The project to establish the partnership was undertaken without any direct Government funding.

4.1.2 HPV vaccine

Sources

The information for this case study was reproduced and/or sourced from the *National Survey of Research Commercialisation Years 2001 and 2002* and written input to the project provided by UniQuest Pty Limited.

Description

A new vaccine created by University of Queensland (UQ) researchers is a major breakthrough in the struggle against Human Papillomavirus-related cancer, including cervical cancer, which kills about 250,000 women each year.

Most cervical cancer results from infection with the Human Papillomavirus (HPV) and is the second leading cause of cancer among women. The HPV vaccine, which prevents the virus that causes genital warts and cervical cancer, was developed by immunologist Professor Ian Frazer, in conjunction with biotechnology company CSL Limited and pharmaceutical giant Merck. Professor Frazer and the late Dr Jian Zhou made a discovery at UQ more than 15 years ago that has led to the development of the vaccine.

The technology that lies behind the vaccine – the ability to make a particular protein fold up naturally and produce the virus-like particles that form the basis of the vaccine – has been described by one Australian medical expert as ‘potentially one of Australia’s most important medical discoveries’.

The high risk papillomaviruses type 16 and type 18 that cause 70 per cent of cervical cancer are sexually transmitted. The virus, which infects the neck of the womb, mostly clears after a year or two, but in some cases the infection remains. Persisting infection changes the cells of the neck of the womb to increase the risk that they will

become cancerous, and about one in 100 infections will give rise to a cancer over 10 to 20 years.

The vaccine created by Professor Frazer is a conventional one, designed to prevent infection with high risk papillomavirus by inducing antibodies against the virus, which mediate its destruction. The vaccination is administered before the papillomavirus infection occurs, because once infection is established, it is unlikely to have any effect.

Professor Frazer and his team began work on the vaccine in 1986, with a National Health and Medical Research Council grant of \$200,000 over three years. For Professor Frazer, the research began with an interest in how the virus worked, and the vaccine to prevent HPV and cervical cancer 'was almost a chance observation along the way'.

Biotechnology company CSL, which was seeking new human vaccine opportunities, entered into a research collaboration with Professor Frazer in 1991, providing funds to help advance his work on VLPs of human papillomavirus.

In 1995, CSL negotiated an exclusive worldwide licence from the University of Queensland's commercialisation company, UniQuest, which gave CSL the right to exploit and commercialise the intellectual property created by the research collaboration, including the work on virus-like particles and their application in an HPV prophylactic vaccine.

On publication of the key patent application, Merck approached CSL expressing an interest in working with them to further develop and commercialise the vaccine. Merck entered into an exclusive worldwide licence with CSL to develop a vaccine based on the VLP technology. CSL has been granted patents in both the US and Europe.

The vaccine has now completed Phase III clinical trials and is expected to be on the market in the US, Europe and Australia in 2006. It is predicted to be Australia's first 'blockbuster' commercial product where commercial royalty payments will be returned to the country.

Professor Frazer was named Australian of the Year in 2006. Despite the predicted commercial success of the vaccine, Professor Frazer recently stated:

The vaccine was developed to help women in those countries where there are no cervical cancer screening programs – basically sub-Saharan Africa, South-east Asia and South America. The vaccine was not developed to make money, it was developed to save lives.

(The Weekend Australian, January 21-22 2006, p.7)

The HPV vaccine has its origins with basic research funded by the NHMRC 20 years ago, though its applications to the prevention of cervical cancer were not apparent at that time. The commercial potential of the research was recognised by CSL about

five years later and this facilitated the development of knowledge transfer partnerships with CSL and Merck.

4.1.3 Future Materials - Australian Materials Technology Network

Sources

The information for this case study was reproduced and/or sourced from Howard Partners (2005b) and the Network website (<http://www.future.org.au/index.html>).

Description

Worldwide experience has shown that advances in materials technology are often critical to the competitive advantage for many of today's manufacturing industries. However, many companies, especially small to medium sized enterprises, often miss out on opportunities for advancement because they simply don't have the structures and people in place to monitor the many rapidly evolving technologies available.

Future Materials has been established to ensure Australian companies have access to a national materials technology network comparable to those available in the USA, Japan and Europe. In these countries it has long been the norm for engineering and technology based companies to have close working ties with universities and research institutions.

Future Materials is the marketing name for the Australian Materials Technology Network. Through the Network, Australian companies have access to services and equipment previously difficult to attain. These include:

- materials characterization and evaluation;
- problem solving, such as investigating contaminants and materials failures;
- studies and testing on coatings, thin films and surface modifications;
- expert and independent opinion in litigation and IP matters; and
- collaborative research aiding the development of new products and processes.

The network supports a comprehensive Capabilities Database that enables companies and governments to source expertise. It publishes six email circulated newsletters a year which inform subscribers and members of research news from Australia and overseas. The network has held successful seminars and workshops on subjects such as IP and Materials, TIG Welding, Nanomaterials, Nanotechnology, Plastics and Polymers and the potential of R&D clusters.

The Network is an un-incorporated, not-for-profit, joint venture whose founding partners include the Institute of Materials Engineering Australasia and a number of Australian universities and a TAFE institute, including:

- The University of Queensland - Brisbane Surface Analysis Facility
- University of NSW - School of Chemical Sciences
- Australian National University - Centre for Science and Engineering of Materials
- Monash University - Centre for Advanced Materials Technology
- Ian Wark Research Institute - University of South Australia
- Central TAFE - Advanced Manufacturing Technologies Centre.

The network's research partners include a number of additional universities including: University of Western Sydney; Griffith University; Queensland University of Technology; University of Southern Queensland; and, University of Newcastle.

Future Materials initially received seed funding from the Australian Government through AusIndustry. Future Materials now has over 1000 subscribers and over 80 corporate members. The network also has a number of industry sponsors.

4.1.4 InQuirion

Sources

The information for this case study was reproduced and/or sourced from the *National Survey of Research Commercialisation Years 2001 and 2002*. It has not been updated to reflect developments since that time.

Description

The vast torrent of data being carried by the Internet has created unprecedented demands on information management systems – and an Australian technology is meeting the challenge by processing up to two billion documents every four seconds.

Known as TeraText, the technology is a suite of data-mining software products capable of handling huge volumes of text and building text-intensive applications. Already extensively employed within the defence intelligence sector in both Australia and the United States, TeraText has been specifically designed to fill the gap created when the growth of the Internet led to the advent of new database standards for text such as XML. Unlike traditional database applications, TeraText has been designed to search, transform, deliver and store text using these new standards.

An alliance between RMIT spin-off company InQuirion Pty Ltd and United States-based IT giant Science Applications International Corporation (SAIC) is delivering

these management solutions to the defence intelligence community on two continents.

TeraText today represents the culmination of more than 10 years of research and development, initially sparked in the late 80s when the Australian Research Council funded a Centre for Knowledge-Based Systems at RMIT and the University of Melbourne. The work on TeraText then continued within RMIT at the RMIT Multimedia Database Systems Research Centre.

The commercialisation of TeraText began as far back as 1993, through the formation of a strategic alliance with the Melbourne-based system integration company, Ferntree Computer Corporation (which was later acquired by GE Capital IT). Under the alliance, Ferntree was responsible for marketing the product in Australia while RMIT continued the R&D.

Initial customers included the CSIRO, the Australian Tax Office, the Tasmanian State Government and the Australian Research Council.

In 2001, InQuirion was formed to take the commercialisation to the next step. Half-owned by RMIT and half-owned by some of the 30 or so software developers who are employed at its Melbourne base, its client list has now expanded to include Standards Australia, the Department of Defence, Tenix Defence Systems, the National Library of Australia and State Governments in Victoria and New South Wales, among others.

TeraText's ability to support XML (and initially its predecessor SGML) along with the information retrieval standard for managing large volumes of information across distributed networks, also caught the attention of defence intelligence organisations in the United States and resulted in the United States Department of Defence becoming a client.

In late 2001, in a bid to further its exposure in the lucrative North American market, InQuirion signed an agreement with the Fortune 500 company SAIC, the second largest supplier of IT to the United States Government, in a deal expected to bring tens of millions of dollars to Australia. Under the deal, Californian-based SAIC has the exclusive rights to distribute TeraText in North America through its division TeraText Solutions while InQuirion will retain the intellectual property in Australia and continue to develop and research the products. Clients in North America include numerous organisations with defence intelligence.

Following the success of the strategic alliance with SAIC, InQuirion is pursuing similar partnerships in Europe and Asia.

In Australia, meanwhile, R&D continues.

InQuirion has its origins in research funded by the ARC in the late 80s, and through its strategic alliance with an industry partner, the University was able to commence the commercialisation of the IP generated by that research.

4.1.5 The Small and Medium Enterprise Research Centre

Sources

Information for this case study was reproduced and/or sourced from material provided by the New Generation Universities and the Director of the Small and Medium Enterprise Research Centre (SMERC).

Description

SMERC was established in 1995 as a research centre of the Faculty of Business and Law within Edith Cowan University with the aim of promoting and encouraging research into small and medium enterprises across all disciplines in the Faculty. SMERC is now located within the School of Management.

The Centre harnesses the diversity of skills and experience of faculty staff in the area of small and medium enterprise (SME) research along with areas of teaching and consulting expertise.

The mission of the Centre is to be a relevant conduit between academia, business and the wider community through applied research and its key aims are to:

- disseminate relevant research to the small business and academic communities through publications, seminars and teaching;
- raise the SME research profile in the academic, professional and practitioner communities; and
- engage with the local community and develop on-going relationships and research partnerships.

The current focus of the Centre is to work closely with all tiers of government and private enterprise to generate income for conducting applied research. External partners of the Centre currently include: the WA Department of Education and Training; City of Gosnells; Grape & Wine Research and Development Corporation; Swan Catchment Council; City of Swan; City of Wanneroo; and South West Group.

The value add to the community and region is the benefit of better business enterprises, improved government understanding of the sector and their ability to transfer that knowledge to other regions, increased business and employment opportunities, and increased community engagement. From this engagement research networks are developed at the Centre.

Projects are currently being conducted in the areas of on-line training, home-based business, human resource management for SMEs and the development of a framework for business opportunities for older people.

Previous projects include:

- Assisting local business to recruit and manage young workers;

- Business Expansion Opportunities in Malaga;
- CBD Enhancement Research Project;
- Thematic Business Clusters: Collaboration in the East Wanneroo Metropolitan Region;
- Environmental Scan for North Metro Local Learning and Employment Partnerships; and
- Smart Business Incubators.

The University has funded the establishment of the Centre and continues to fund the part-time Director position and to partially fund a Post Doctoral Research Fellow position. All other positions are self-funded by the Centre. Contract staff are also employed on a project by project basis. The Centre has recently attracted an ARC Linkage Grant to investigate on-line training and SMEs in partnership with the Department of Education and Training.

4.2 Knowledge transfer for other material, human, social or environmental benefit

4.2.1 Australasian Legal Information Institute

Sources

Information for this case study was reproduced and/or sourced from the Australasian Legal Information Institute (AustLII) website (<http://www.austlii.edu.au/>) and the ARC Annual Report 2001/02.

Description

The Australasian Legal Information Institute (AustLII), operated jointly by the Faculties of Law at the University of Technology, Sydney (UTS) and the University of New South Wales (UNSW), provides free internet access to Australasian legal materials. AustLII's broad public policy agenda is to improve access to justice through better access to information. AustLII is one of many organisations aiming to ensure that some part of cyberspace is public space, where no one is denied use of resources because of financial considerations. Its aim is to create a public law library on the internet, which caters for both professionals with legal training and the general public.

To that end, it has become one of the largest sources of legal materials on the net, with over 20 gigabytes of raw text materials and over 4 million searchable documents. AustLII is used by over 20,000 people each working day. Usage statistics indicate that users span the whole community, including educational institutions (about 30%), the legal profession and business (25%), community organisations (15%), government (10%), and overseas (20%).

AustLII maintains its own collections of primary materials: legislation and court judgements ("case law") and a growing collection of law journals. The AustLII collection contains full-text databases of most Australian court judgements ("case law") and legislation. Current databases include Commonwealth, State and Territory legislation and regulations, most federal courts (High Court, Federal Court, Family Court, AAT) and most State courts and tribunals. AustLII also includes a number of more specialised (subject specific) databases as well as the most comprehensive index to Australian law on the Net.

AustLII also maintains collections of secondary legal materials created by public bodies for purposes of public access (e.g. law reform and royal commission reports; "plain English" guides to the law; commentaries and summaries on the law).

In addition to helping public bodies publish their legal information on the web, the Institute also provides a large index of other legal web sites from around the world (the WorldLII Catalog), which is fully searchable and well organised.

AustLII's leadership of the global consortium of free-access legal information providers, via its operation of the World Legal Information Institute (WorldLII) and assistance in developing new Commonwealth and Asian components of that network, ensures access by Australian researchers, practitioners and the public to high quality international legal information. Australia's interests are furthered by increased transparency of regional legal systems.

The ARC Annual Report 2001-02 reports:

AustLII has assisted academic institutions in the United Kingdom, Ireland, Canada, Hong Kong and the Pacific Islands to build their own Legal Information Institutes (LIIs), using AustLII's software and expertise. This global partnership has now resulted in the creation of WorldLII, the World Legal Information Institute (www.worldlii.org), the largest free access law resource on the Internet. With Asian Development Bank support, AustLII staff have also been training lawyers in developing countries in the use of the Internet for legal research, in countries where a law library is an impossible luxury.

(Australian Research Council, 2002; p.56)

The Institute has won a number of awards and its website has been consistently rated as the number one website in Australia, as measured by the number of unique visitors, for the categories of 'business and finance – legal' and 'education – reference'.

AustLII commenced operations on 1 January 1995 with seed funding of \$110,000 provided by the then Department of Employment, Education and Training (DEET) through its Research Infrastructure Equipment and Facilities Program and supplementary funding of \$50,000 provided by each of the two host Universities.

AustLII's 2005 budget was \$1,270,000, more than half of which was provided by its stakeholders, plus \$611,000 provided by the Australian Research Council (ARC) under its Linkage Infrastructure Equipment and Facilities (LIEF) Fund, in which

AustLII's stakeholders were industry partners. The Institute's partners in 2005 include the two host universities, two legal publishers, four Government agencies, ten Courts and Tribunals, and eight organisations from the legal profession, who together provided \$660,000 in funding to support AustLII's provision of free access to legal materials. For the first time in 2005, leading law firms and other legal profession organisations have provided funding support. Similarly, many Courts and Tribunals whose decisions are the most heavily accessed on AustLII are now assisting AustLII financially to provide its services, in addition to efficiently providing it with their decisions.

4.2.2 Human services partnership

Sources

Information for this case study was reproduced and/or sourced from the Deakin University website (<http://www.deakin.edu.au/dhs/>).

Description

The formal partnership between Deakin University and the Department of Human Services (DHS) (Barwon – South Western Region) was established in 1998 with a joint commitment to protect the health and wellbeing of regional and rural Victorians. The Barwon-South Western Region is one of nine DHS regions in Victoria. It extends from Lara to the South Australian border, covering 29,637 square kilometres and nine local government areas.

The collaboration has been actively pursued over the past eight years, following the identification of regional and rural public health needs, recognition of the potential mutual benefits to each organisation, and a desire to respond by building capacity to meet identified needs. A shared geographic region and similar professional and academic interests, as well as the need to operate within a shared environment of broader reform, has stimulated and directed the development of the collaboration. It is a partnership that seeks to bring together the knowledge, experience and resources of the DHS (Barwon – South Western Region) and Deakin University for the benefit of the people living in the region, as well as for the mutual benefit of both organisations.

The partnership involves the Deakin University Faculty of Health and Behavioural Sciences - there are four schools: Nursing, Psychology, Health and Social Development, and Exercise and Nutrition Sciences. Given Deakin University's areas of academic specialisation, the partnership is able to focus on a wide range of public health areas.

The formal partnership is based on agreed terms of reference, and provides a unique and sustainable model of collaborative activity that effectively builds public health capacity.

The partnership has a number of components, as briefly described below.

1. Collaborative research projects in four categories:

- a. Nutrition
- b. Health, housing and aged care
- c. Community services
- d. Performance and quality improvement.

2. Public health forums

The forums are conducted throughout the year in both Geelong and Warrnambool, and open to the public free of charge. They aim to enhance the health of people living in the region by promoting professional development and knowledge, and by improving the lay public's awareness and knowledge of health matters.

3. Regional nutrition strategy and Regional Nutrition Network

The strategy brings together health care professionals with an interest in nutrition and physical activity from across the region. It is supported by a regional nutrition network that gives direction to the strategy and facilitates collaboration. The network has now grown to include over 65 members mainly from the Barwon South-West Region but it also has professionals from Melbourne and neighbouring regions who have connections to the work that is developing in the Barwon SW Region.

4. Development of community resources

Parent to Parent: Raising Your Child with Special Needs (an online guide including an extensive listing of the resources available within the region and at the State and national levels).

The Wellness Guide for Carers produced from the Older Carers' Health and Wellbeing Research Project (an online guide including an extensive listing of the resources available within the region and at the State and national levels).

5. The Sentinel Site for Obesity Prevention

The Sentinel Site for Obesity Prevention grew out of the urgent need to build the evidence on effective strategies for reducing the growing epidemic of obesity among children and adolescents.

By focusing funding, training programmes, research expertise and other resources into a defined geographical region, programmes can be developed and the evidence gathered about effectiveness and sustainability before they are rolled out into other regions. This Sentinel Site project will be important

not only for the Barwon-South Western region of Victoria but will be a leading programme of its type in Australia and internationally. Internationally, this project is also very important, with the World Health Organisation and the International Obesity Task Force both advocating this approach to obesity prevention.

In 2004, the World Health Organisation officially designated the Faculty of Health and Behavioural Sciences at Deakin University as a 'WHO Collaborating Centre for Obesity Prevention and Related Research and Training', facilitating the University's access to international networks, resources and knowledge.

6. Student experience

The partnership provides the opportunity for students to obtain first-hand dynamic field experience. Students who are undertaking social work degrees, undergraduate and postgraduate psychology degrees, including doctoral studies and public policy degrees are all able to undertake field experience at the DHS.

The partnership was initially funded 'in kind' by both organisations. After about 6 months, the University funded a part time coordinator position, and has continued to do so. The DHS has contributed to the salary of partnership personnel in the last 18 months. Specific projects funded by DHS are contracted through standard government competitive tendering processes.

In 2003, Deakin University and the DHS entered into a separate partnership agreement for the Eastern Metropolitan Region. Information about this partnership is available at <http://www.deakin.edu.au/hbs/partnerships/dhsdu/>.

4.2.3 Northern Adelaide Partnerships

Sources

Information for this case study was reproduced and/or sourced from the University of South Australia website (<http://www.unisa.edu.au/unap/default.asp>), Elliott et al (2005), and the Australian Universities Quality Agency (AUQA) Good Practice Database (http://www.auqa.edu.au/gp/search/detail.php?gp_id=1962).

Description

The University of South Australia (UniSA) has responsibility under the *University of South Australia Act 1990* to provide programmes for disadvantaged groups within the community. The University aspires to build the capacity and resilience of the communities in which it works through innovative, collaborative and enterprising activities.

The Northern Adelaide area, significantly disadvantaged according to national indicators, was one of eight communities included in the 2001 Commonwealth 'Sustainable Regions' programme. The area was also targeted by the State

Government for a strategic 'whole-of-government' approach through a Northern Partnership of industry, education and employment. An 'Office of the North' (2002) was established and later, the Northern Adelaide Economic Development Alliance (NAEDA) representing business, unions, government and non-government organisations. A parallel committee, Northern Futures, focuses on youth 12 - 25 years with education a major issue.

In 2002, the University audited its community engagement activities in Northern Adelaide and found them to be numerous, diverse and highly regarded, but largely uncoordinated. As a major employer and a provider of higher education with a campus in Northern Adelaide (Mawson Lakes), the University decided to collaborate to achieve its community engagement mission in a more focused and more sustainable way. The result was University of South Australia Northern Adelaide Partnerships (UNAP) - a model which incorporates the best practice characteristics of community engagement identified by the University.

UNAP simultaneously pursues University and community goals by assisting the establishment of sustainable projects and activities designed to:

1. Increase participation in education
2. Enhance professional skills by providing life-long learning opportunities for professionals who reside and work in the community
3. Reduce skills shortages by promoting life-long learning and providing programmes that address employer needs
4. Improve social resources and build social capital.

UNAP has three full-time staff located at the Mawson Lakes campus in Northern Adelaide. Organisationally, it is located within the Vice-Chancellor's Office. The Director of UNAP reports to the Pro Vice Chancellor of Organisational Strategy and Change who represents the University on NAEDA.

Examples of the projects undertaken under UNAP include:

- 1. Middle Schooling**

The aim of this partnership between UniSA, the Department of Education and Children's Services and North Adelaide public secondary schools is to increase school retention rates by working collaboratively to further develop and promote appropriate methodology and curriculum in the middle years.

A formal Memorandum of Understanding has been developed and an ARC Linkage Grant has been won to fund collaborative research.

2. Health and Wellbeing

UniSA has signed a Memorandum of Understanding with 13 North Adelaide agencies and service providers, including local government authorities, government departments and not-for-profit community groups based on the mutually beneficial vision: "To improve the health and wellbeing of the Northern Adelaide community through harnessing the collaborative capacities of Northern Adelaide service providers and the UniSA."

3. Libraries for Learning Partnership

This partnership involves UniSA, local government authorities, the Department of Education and Children's Services, local TAFE campuses and the Public Libraries Automated Information Network. It is aimed at enabling the development of a community of lifelong learners in Northern Adelaide and fostering the information literacy of the community to enhance life choices, democracy and economic development.

4. Student projects and practicums

The University is partnering with a number of Northern Adelaide agencies to coordinate UniSA health and allied health practicum placements, particularly to address skills shortages in the northern Adelaide area. The community will benefit by having students providing services that may not have previously been available or were hard to access in the area. In addition, UniSA is partnering with Northern Adelaide schools to facilitate the conduct of mutually beneficial student projects.

5. Education and training pathways and skill shortages

UniSA is working with government departments, industry associations, TAFE Institutes and the Office of the North to map education and training pathways, identify gaps in education and training provision and address skill shortages. In particular, the University has progressed collaborations in the fields of advance manufacturing and health.

The University has contributed significant funding (\$250,000 per annum for three years), made a long term commitment of dedicated resources (the UNAP unit), University senior management has provided leadership and demonstrated commitment to the concept, and encouraged and supported input from individual staff throughout the University.

4.2.4 Cape York Institute and MULTILIT

Sources

Information for this case study was reproduced and/or sourced from the Cape York Institute website (<http://www.cyi.org.au/default.aspx>), the MULTILIT website (<http://www.multilit.com.au/index.php>), and written input to the project provided by IRU Australia.

Description

This case study draws together two separate but related knowledge transfer initiatives of Griffith University and Macquarie University. We are presenting them as an integrated case study to demonstrate the ways in which separate knowledge transfer activities can result in synergistic outcomes and benefits. The two knowledge transfer initiatives are:

- The Cape York Institute for Policy and Leadership; and
- MULTILIT – Making up Lost Time in Literacy.

Cape York Institute for Policy and Leadership

The Cape York Institute (CYI) is a public policy organisation that champions reform in Indigenous economic and social policies. The Institute was launched in July 2004 and is based in Cairns. The Institute is a partnership of the people of Cape York, the Commonwealth and Queensland Governments, and Griffith University.

The CYI is a unique organisation in that it strives to sit at the nexus of academia, community development, and advocacy. It is guided by the Cape York Agenda that has been articulated by Cape York leaders: *to enable the people of Cape York to have the capabilities to choose a life that they have reason to value*. To achieve that end goal, CYI's work must support the economic and social development of Cape York. As a result, it endeavours to be rigorous, driven, and yet practical in the work it undertakes.

The Institute has three, mutually supporting elements:

- **Think Tank**---The Think Tank drives the reform agenda and other activities of the Institute, and ensures that these meet the needs of stakeholders. The Think Tank is responsible for the Institute's overall liaison and engagement with the communities, government, and broader public through visits, retreats, workshops, seminars, and conferences.
- **Policy Research**—The Institute undertakes short-to-medium-term policy/research projects across a wide range of economic and social policy issues, including welfare, health, governance, education, economic development, land and housing, substance abuse, and social order. The current emphasis is on: pioneering new welfare arrangements; identifying

and addressing the prerequisites for economic viability in Cape York communities; and assisting communities to develop a community vision through a 'Good Governance' programme.

- **Youth and Leadership** – The Institute is dedicated to developing and supporting current and future leaders by building leadership capabilities. Key programmes include: Higher Expectations, supporting the attendance of Indigenous secondary students at boarding schools; Youth Talent Development, supporting tertiary studies of Cape York students; and, A Leadership Academy to build personal and professional skills for effective leadership in Cape York.

The Institute was formally established by the Vice-Chancellor of Griffith University in accordance with the University's 'Academic Centres Policy'. The Griffith Council has approved the Institute's Charter, Board Constitution and Governance and Management Protocols.

The Institute's Director is Noel Pearson, an Indigenous leader and activist from the community of Hopevale. The Institute has a majority-Indigenous appointed board, chaired by Professor Marcia Langton. In addition to the Director, other *ex officio* members of the Board include: the Secretary, DEST; Director-General, Education Queensland; and, Vice-Chancellor, Griffith University.

The Australian and Queensland Governments have each committed \$2.5 million to the Institute over five years, with Griffith University providing substantial in-kind support as the project sponsor. This funding is supplemented with fee-for-research and private and corporate philanthropy.

MULTILIT – Making Up Lost Time in Literacy

Established in 1996, MULTILIT (Making Up Lost Time In Literacy) comprises multiple initiatives to teach low progress readers effectively. MULTILIT was designed by Professor Kevin Wheldall and his team from Macquarie University Special Education Centre (MUSEC)¹¹. The MULTILIT programme was researched, developed and trialed over several years.

The MULTILIT initiative comprises:

- ongoing research and development;
- assessments and educational programmes;
- professional training;
- resource production and sales; and

¹¹ MULTILIT represents only one of MUSEC's knowledge transfer initiatives. It also runs a school for children with special learning needs from Kindergarten to Year 6 and coordinates an Early Intervention Network for professionals, service providers and parents supporting children, aged birth to six years, who are at educational risk.

- consultancies and partnerships to provide outreach services.

MULTILIT assessments and educational programmes are offered at The MULTILIT Centre located in North Ryde, Sydney and through outreach programmes. MULTILIT professional training and resource sales are also administered at this location.

MULTILIT operates within Access Macquarie Limited (AccessMQ), the commercial, research, consultancy, training and commercialisation company of Macquarie University. Most MULTILIT services and resources are offered on a full commercial basis, however, MULTILIT is also committed to undertaking community projects where support funding is available.

For example, the successful Schoolwise Program accommodates two intakes of 36 disadvantaged students per year who are at-risk of school failure. The Schoolwise Program has been operating successfully for ten years and is based at the Exodus Foundation in Sydney.

Now the Cape York Institute and MULTILIT are working together on a plan to break the cycle of disadvantage experienced in the Cape York community of Coen by establishing a tutorial centre to improve the literacy of Indigenous students. Coen is a township about 500 kilometres from Cairns via a dirt road.

The Institute received government funding for one year and it contracted MULTILIT to establish and run the centre. All staff working in the Coen MULTILIT Tutorial Centre are employed by the University's consultancy company Access Macquarie and have relocated from Sydney for the duration of the project.

A preliminary trial of the MULTILIT programme was conducted in 2005. It achieved very encouraging results, with children who were nearly four years behind national literacy levels for their age progressing over a year on average in both reading and spelling skills after just six months of the programme. The partners are now working on a joint proposal for further government funding.

4.2.5 Capricornia Online

Sources

The information for this case study was reproduced and/or sourced from Garlick and Pryor (2002) and a case study published by the Department of Communications, Information Technology and the Arts (DCITA) (2005c).

Description

Capricornia Online is a community online initiative in the Rockhampton district of Queensland and incorporates:

- The Communities on the Internet Academy (COIN), which provides ICT training; and

- Capricornia Online, which provides a virtual space where online communities of interest can develop.

The project is a partnership between Rockhampton City Council and CQU. Under the arrangement, the Council meets wages costs while CQU provides the venue for the COIN Academy, meets equipment costs and provides access to research expertise and international networks. The research function operating at COIN is based on participative action research and ethnographic methodologies which aim to determine the factors affecting the adoption of a community informatics approach in this setting and compare these with findings in other locations. CQU has a range of formal and informal relationships with community informatics researchers and Community Informatics projects both in Australia and across a number of overseas countries including the UK, Netherlands, Malaysia, the US, Canada and India.

Capricornia Online was initiated in August 2002 to give effect to the 'social appropriation of technology' philosophy. In addressing the digital divide, this involves the need to progress beyond access to appropriating technology for social and community purposes.

Up to now, the low ICT skill level of the community compared to the national average has been the main barrier to the broader community role and impact of Capricornia Online. COIN provides a training programme, offered principally through community groups, where local residents are able to develop their ICT skills. This can expand the range of economic and social opportunities available to them in general terms and also equips them to apply these skills in the community setting via Capricornia Online.

Some 220 individuals and not-for-profit groups have signed up to Capricornia Online, including about 40 organisations and community groups. The focus up to now has been on developing the Capricornia Online model, with recruitment of a larger number of users seen as the next stage in the development process.

Volunteers and mentors from across the community and community groups have had a key role in the development of Capricornia Online. A key lesson from the initiative is that champions from across the community need to be drawn in as leaders so the Capricornia Online model can extend further into the community.

A number of community networks have already been established including:

- **The Multicultural Corner**

The Multicultural Corner has developed as an online community to promote dialogue with and between various ethnic groups in the district, so that cultural understanding increases and Rockhampton is helped to develop as an inclusive community.

- **Voices**

Voices is a community forum where community dialogue is fostered on a range of matters of interest to the community. It originated as a discussion forum for displaced workers who had become unemployed when the local meatworks shut down.

Other networks include 'Living History' and 'Fishing the Fitzroy'.

The COIN and Capricornia Online experience suggests that social and cultural barriers, rather than a lack of technology, are the main barriers to ICT usage and its social appropriation.

Garlick and Pryor (2002) reported, as early as 2002, on the benefits derived from the COIN Academy and the CQU and Rockhampton City Council partnership including:

- increased home usage of ICT in the region;
- a strengthened relationship between the two partners;
- extension and strengthening of CQU links with international networks and other universities undertaking community-based informatics initiatives;
- the production of numerous academic publications based on the initiative and emerging policy and practice issues; and
- greater recognition by the Council and the regional development body of the need to develop and implement strategies relating to ICT capacity and skills and new age library/community centre facilities.

DCITA (2005) reports:

Having a guiding vision plays a key role in sustaining leadership and inspiring entrepreneurial action. The leadership role of Central Queensland University Faculty of Informatics and Communication brought a vision which has guided the initiative through all stages.

(DCITA, 2005; p. 3)

The University's vision was guided by its knowledge of community-based informatics drawn from its own applied research and its international research alliances.

Capricornia Online was initiated by a staff member of the then Faculty of Informatics and Communication at Central Queensland University (CQU) and commenced with a grant from the Family Community Network Initiative of the Department of Family and Community Services (FACS) to conduct the COIN Academy project.

4.2.6 Research Institute for Asia and the Pacific

Sources

The information for this case study was reproduced and/or sourced from the Research Institute for Asia and the Pacific (RIAP) website and RIAP Annual Reports (<http://www.riap.usyd.edu.au/>).

Description

RIAP is a multi-disciplinary international projects agency within the University of Sydney. Established in 1987, its major consultancy activities are geared towards developing international collaborative ventures that contribute to the building of institutional and human resource capacities; and promotion of network linkages between Australia and Asia Pacific region.

It provides a number of knowledge transfer services, including:

- **Applied research and strategic policy advice** – providing accurate intelligence and analysis on economic, political, policy and sectoral developments in Asia and the Pacific.
- **Training** – providing developing Asian economies with customised capacity building training programmes targeted at middle to senior level government officers, business managers and community group leaders responsible for socio-economic development.
- **Public Affairs** - RIAP's public affairs programme delivers to the business and academic communities regular seminars and workshops and an annual international conference. This programme provides an effective link to business, government and the public sector.

The Institute focuses its services in select areas of expertise:

- public sector governance;
- environmental and natural resources;
- education reform;
- corporate governance;
- agricultural and rural development;
- international development management;
- information economy; and
- global economy.

RIAP has an applied research capacity where research undertaken seeks to produce studies with a specific application in view. This may include informing policy development, strategic planning and capacity building. All research conducted is either commissioned by an external client, funded through a competitive tendering process or supported by self-funding international Visiting Research Fellows.

RIAP draws on expertise and knowledge from across the University of Sydney. RIAP also has a network of 13 partner institutions across the Asia-Pacific which enables it to access in-country expertise and knowledge. Partner institutions are located in China, Indonesia, Malaysia, Singapore, Korea, Vietnam, The Philippines and Thailand.

RIAP's clients include APEC, AusAID, UN agencies, foreign and domestic government bodies, non-government organisations and multinational companies. The RIAP 2003 Annual Report also lists a number of 'sponsors and partners', including: ABC Radio; Allens Arthur Robinson; Australia East Timor Business Council; Australia Korea Business Council; Australian Stock Exchange; First Charlton Communications; Australia India Business Council; Macquarie Bank Limited; and, the Department of Foreign and Affairs and Trade.

In addition to its core knowledge transfer services, RIAP coordinates a number of other programmes:

- The Building Institutional Capacity in Asia (BICA) project is a joint research activity between the Japanese Ministry of Finance (MOF) and RIAP. The project is in its seventh year and has to date produced a total of six research reports providing assessments and policy recommendations which partly informs the delivery of Japanese development aid to the Asia-Pacific region. BICA is funded by MOF with RIAP serving as the project design and implementation agency.
- The Young Professionals Program, sponsored by Macquarie Bank, which aims to increase the Asia knowledge of young professionals, build their core leadership and communication skills to engage effectively in the region, and create opportunities for members to develop professional relationships and networks with fellow peers from different sectors and countries, and with key policy leaders and decision-makers from the region.

The University initially funded the establishment of the RIAP to facilitate a more concentrated approach to developing the institution's research strengths and knowledge resources in Asian-Pacific studies, with a view that the Institute would eventually become self-funding. The Institute achieved self-funding status after a number of years of operation, though it continues to rely on the University for in-kind support. It currently generates its income through fee-for-service activities, including:

- executive training programmes conducted in China and for ASEAN/East Asia and short course non award study programs for international students;

- capacity building projects undertaken through the United Nations, AusAID and APEC; and
- research commissioned by governments in the Asia-Pacific and Australian organisations, and research funded by the ARC.

4.2.7 Risky Business

Sources

The information for this case study has been reproduced and/or sourced from the University of Melbourne website including a University of Melbourne press release (Thursday, 20 October 2005), and from the Chief Investigator of the Risky Business research project.

Description

Researchers from the University of Melbourne's School of Creative Arts, Faculty of Education (Language, Literacy and Arts Education) and Department of Criminology have been working in collaboration with government and community partners to instigate and research diversionary arts programmes for young people experiencing difficulties in their lives, including young men and women in custody, and Indigenous and unemployed youth. The young participants in the arts projects face a range of challenges including problems with their mental health, sexuality, peer and family relationships, substance abuse, rural isolation and cultural marginalisation.

Broadly, the longitudinal Risky Business project addressed two interrelated critical problems: the identification of effective diversionary programmes for marginalised young people and an analysis of the social impact of creative arts activity. The study explored whether youth with a background in harmful risk-taking behaviour are more likely to respond to intervention programmes that focus on creative expression and involve excitement and risk, but within a safe framework. It focused on the ways in which involvement in the arts can affect personal and social skills development, resulting in improved self-esteem and social integration, and a decline in self-destructive behaviours. Ten arts programmes involving young people were conducted across Melbourne and rural Victoria.

The programmes were not designed as clinical or therapeutic interventions. The young people participating in the programmes became artists-in-training with the opportunity to develop a range of arts based skills through experiential workshops and under the guidance of established community artists. The programmes focused on different art forms: theatre, writing, painting, photography, stand-up comedy and circus, with a number of programmes involving more than one art form. The aim for participants and artists was the production of high quality art that was subject to public and peer review through productions and exhibitions.

The programmes involved approximately 150 participants aged between 17 and 21 years, with a fairly equal gender split and a high proportion of Indigenous youth. Approximately half the participants were in juvenile custodial centres and one programme was conducted in a residential secondary college. The young people were recruited through the partner support youth agencies who maintained close links with the programmes, generally offering the support of youth workers. Many of young people were dislocated from school and families and a key concern was to analyse the potential impact of the creative arts in assisting young people reconnect with their communities.

The study found that arts intervention programmes can increase personal, social and artistic skills for participants but only if certain preconditions are met, including a safe space in which to work, appropriate artists, a programme which matches the aspirations and expectations of the young people and an opportunity to share the artistic outcomes. The research outcomes provide supporting evidence for the exploration of creative, rather than corrective, diversionary programmes - operating from an assumption of latent or unrecognised potential in people with limited opportunities.

The Risky Business project demonstrates that conducting arts programmes with marginalised young people is difficult. For the programmes to be effective, it is essential that institutions and youth services establish a culture of support for interventionary arts programmes and that there are shared values and goals between the various agencies and with the artists. The effectiveness of the arts programmes will be compromised if they are run in isolation from or opposition to the institutional structures that surround the young people.

The Risky Business study was funded through the Australian Research Council Linkage scheme (2002-2005), with additional funding from key industry partners, including Arts Victoria, the Melbourne Magistrates Courts, the Victorian State Government Departments of Justice and Human Services (Juvenile Justice), VicHealth and providers of youth services, including Whitelion, Visycare and St Luke's, Bendigo. Thirty-six percent of the funding came as cash from the ARC and nineteen percent as cash from the partners. The remaining forty-five percent was in-kind and included essential support such as the provision of performance and workshop spaces and the supervisory attendance of youth workers associated with the various partner agencies. During the life of the project there was additional funding from the Australia Council and VicHealth.

An important outcome of the Risky Business project is that a number of programmes have continued beyond the scope of the research. The artists working with custodial and post-custodial young women have secured ongoing funding from two of the industry partners for ongoing workshops, in part conducted in studios at the University of Melbourne. Similarly, hip-hop music projects investigated in collaboration with St Luke's Youth Services in Bendigo continue to run with funding secured with the support of Risky Business. The Risky Business project team are working towards the implementation of regular arts projects with Worawa Indigenous School. In association with industry partners, Risky Business

researchers are investigating the potential of a centre for Youth, the Arts and Wellbeing to continue this work.

4.3 Observations

The 12 case studies are specific examples of knowledge transfer, making what can otherwise be an esoteric concept 'real'. While only representing a sample of the many and varied knowledge transfer activities conducted by Australian universities, they demonstrate a number of features of knowledge transfer activities, processes and supporting organisational frameworks. In our view, they reflect many of the themes emerging from our desktop research and the principles and definitions we proposed in Chapter 2.

In the following table, we have summarised some of the features of knowledge transfer that emerge from the case studies. For each feature, we indicate the case studies of relevance.

Knowledge transfer feature	Relevant case studies
<p>Knowledge transfer for commercial benefit can result in commercial returns for universities and/or broader commercial benefits for industry and business.</p>	<p>Commercial returns for universities: (HPV Vaccine; InQuirion)</p> <p>Commercial benefits for industry and business partners: (Aggregated Olive Processing and Research Cluster; The Small to Medium Enterprise Research Centre)</p>
<p>Universities seeking to commercialise their IP often need to negotiate with large and well resourced corporations and require access to specialist commercialisation knowledge and skills if they are to optimise their commercial outcomes.</p>	<p>HPV Vaccine InQuirion</p>
<p>Commercial returns to universities can take many years to be realised, and in the mean time universities or their spin-off companies bear the cost and risk.</p>	<p>HPV Vaccine InQuirion</p>
<p>Knowledge transfer partnerships are often facilitated or enabled by the existence of intermediary or coordinating mechanisms or organisations.</p>	<p>The OlivOz group of SME olive growers in the Aggregated Olive Processing and Research Cluster case study.</p> <p>Future Materials was established by its founding partners to provide an intermediary mechanism for linking industry with university knowledge and expertise.</p> <p>The Northern Adelaide Economic Development Alliance provides a supporting mechanism for the Northern Adelaide Partnerships initiative.</p>

Knowledge transfer feature	Relevant case studies
	<p>The Research Institute for Asia and the Pacific provides a coordinating framework for bringing the University's multi-disciplinary expertise together under a common theme.</p>
<p>Knowledge transfer partnerships can have a multiplier effect by providing the foundation for separate future partnerships.</p>	<p>For example:</p> <ul style="list-style-type: none"> • HPV Vaccine – the partnership with CSL, facilitated the later relationship with Merck • Cape York Institute and MULTILIT – the establishment of the Cape York Institute in partnership with Griffith University provided an enabling framework for the creation of linkages with MULTILIT • The Risky Business project has created the impetus for new partnerships between artists and agencies responsible for the health and welfare of disadvantaged youth
<p>Knowledge transfer activities vary in their emphasis on the knowledge processes adopted.</p>	<p>For example, some case studies demonstrate a primary emphasis on:</p> <ul style="list-style-type: none"> • Knowledge access (e.g. AustLII, Capricornia Online) • Knowledge production (HPV Vaccine; InQuirion) • Knowledge relationships (Future Materials; Research Institute for Asia and the Pacific) • Knowledge engagement (Northern Adelaide Partnerships; Cape York Institute; Partnership with Victorian DHS; Risky Business)
<p>Knowledge transfer can have a regional, national, or international reach</p>	<p>Regional: (e.g. Partnership with DHS, Northern Adelaide Partnerships; Capricornia Online; Risky Business)</p> <p>National: (e.g. AustLII, Future Materials)</p> <p>International: (e.g. Aggregated Olive Processing and Research Cluster; HPV Vaccine, InQuirion, AustLII, Research Institute for Asia and the Pacific)</p>
<p>The international networks of Australian universities open up opportunities and access to resources and knowledge that partner organisations may not otherwise have had available to them.</p>	<p>Aggregated Olive Processing and Research Cluster AustLII Research Institute for Asia and the Pacific Capricornia Online</p>

Knowledge transfer feature	Relevant case studies
Knowledge transfer partnerships often involve research and learning and teaching components.	Aggregated Olive Processing and Research Cluster Future Materials AustLII Partnership with the Victorian DHS Northern Adelaide Partnerships Cape York Institute and MULTILIT Capricornia Online Research Institute for Asia and the Pacific
Some knowledge transfer initiatives rely on inter-university collaboration to provide the necessary critical mass, breadth of expertise, credibility and/or resources	AustLII Future Materials Research Institute for Asia and the Pacific (international university collaborations)
Seed funding is often critical to enabling knowledge transfer initiatives to proceed, with many initiatives developing self-sufficiency over time and/or securing multiple sources of sponsorship through demonstrated benefits to sponsors.	Future Materials AustLII Capricornia Online
Many knowledge transfer initiatives are progressed by universities without full funding or with no funding, and often at significant cost.	Aggregated Olive Processing and Research Cluster Northern Adelaide Partnerships Cape York Partnerships
For some knowledge transfer initiatives, universities need to put in place a range of supporting structures such as commercialisation arms, community engagement support units and/or associated governance and management arrangements.	HPV Vaccine Future Materials InQuirion Small to Medium Enterprise Research Centre AustLII Northern Adelaide Partnerships Cape York Institute and MULTILIT Research Institute for Asia and the Pacific

We note with interest the origins of the knowledge transfer initiatives presented in the case studies:

- Individual academics and institutions taking the initiative to pursue partnerships or knowledge transfer arrangements without government funding support, or with seed funding from a range of sources including AusIndustry and the Department of Family and Community Services.
- ‘Discovery’ research, funded through the NHMRC and ARC, leading eventually over the longer term to innovations and commercial opportunities.

- In one case study, an ARC Linkage Project grant.

In a number of the case studies where no government funding or some seed funding was accessed in the establishment stages, the university's initiative in successfully pursuing the knowledge transfer partnership or arrangement often later provided leverage for attracting government funding and funding from knowledge transfer partners in the form of sponsorships or fee-for-service arrangements.

It is also interesting to note that many of the existing funding programmes that support knowledge transfer outlined in Chapter 3 do not feature prominently in the case studies. Admittedly, the case studies represent only a small sample of knowledge transfer activities and some of the funding programmes have only recently been introduced. We also excluded some categories of case study that rely substantially on existing programmes (e.g. CRCs). Nevertheless, the case studies demonstrate that the full scope of knowledge transfer activity is not currently reflected in the current suite of programmes available to support knowledge transfer.

More generally, we note that the case studies lend support to the conclusions we have reached in relation to: the principles that underpin the definition and scope of knowledge transfer; the definition and scope of knowledge transfer; and the assessed gaps in public policy support.

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KNOWLEDGE TRANSFER AND AUSTRALIAN UNIVERSITIES AND PUBLICLY FUNDED RESEARCH AGENCIES

**A report to the Department of Education,
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Contents

Appendix 1: Stakeholders providing input to the project	1
Appendix 2: Summary of stakeholder input	3
Appendix 3: Knowledge transfer for commercial benefit: summary of desktop research findings	6
Benefits of knowledge transfer	6
The nature of knowledge transfer	8
Measuring knowledge transfer	14
Current incentives and barriers to knowledge transfer	18
Appendix 4: Knowledge transfer for material, human, social and environmental benefit: summary of desktop research findings	22
Benefits of knowledge transfer	22
The nature of knowledge transfer	27
Measuring knowledge transfer	37
Current incentives and barriers to knowledge transfer	39
Appendix 5: National research priorities and goals	41
Appendix 6: Existing Australian Government funding programmes supporting knowledge transfer	42
The approach to mapping and tabulating existing programmes	42
Descriptions of existing programmes and the rationale for our mapping decisions	43

Appendix 1: Stakeholders providing input to the project

Consultations and discussions were conducted with the following organisations and their representatives:

- Australian Research Council (Professor Peter Hoj, Jan Muir)
- National Health and Medical Research Council (Nigel Harding, Lorraine Tomlins, Elizabeth Hoole)
- CRC Committee (Dr Peter Jonson)
- Australian Treasury (Maryanne Mrakovcic, Kruno Kukoc)
- Department of Industry, Tourism and Resources (Tricia Berman, Karyn Murray)
- Howard Partners (Dr John Howard)
- IRU Australia (Professor John Yovich, Professor Anne Edwards, Tony Shiel)
- Australian Institute for Commercialisation (Dr Rowan Gilmore, Dr John Kapeleris)

In addition, written input was received from the following organisations:

- Australian Vice-Chancellor's Committee (AVCC)
- Innovative Research Universities Australia (IRU Australia)
- New Generation Universities (NGU)
- Australian Technology Network (ATN)
- Group of Eight Limited (Go8)
- UniQuest Pty Ltd and IMBcom Pty Ltd
- IBM (through Business Industry Higher Education Collaboration Council)
- Australian Industry Group (through Business Industry Higher Education Collaboration Council)

- Australian Universities Community Engagement Alliance (AUCEA)
- Australian Nuclear Science and Technology Organisation (ANSTO)
- National Tertiary Education Union (NTEU)
- Federation of Australian Scientific and Technological Societies
- Dr John Yencken, Swinburne University of Technology.

Appendix 2: Summary of stakeholder input

Our summary of stakeholder input relates principally to the university sector, reflecting the nature and mix of groups and individuals providing input to the project.

The consultation process revealed a widespread consensus that universities and PFRA_s should leverage their knowledge and capacities to enhance material, human, social and environmental wellbeing, and that more could and should be done to encourage and facilitate knowledge transfer.

Definition and scope

Key themes which emerged from the consultations in relation to the definition and scope of knowledge transfer are:

- A preference for the term 'engagement' rather than 'knowledge transfer'.
- Universities are experiencing a growing demand for university knowledge services, both in terms of those that provide a commercial return to the institution and those that offer no immediate return or even represent a cost to the institution. Many users of knowledge (including communities and SMEs) are unable or unwilling to pay the full cost of services.
- The definition of knowledge transfer should not be limited to the commercialisation of IP; the definition needs to embrace knowledge transfer that contributes to human, social and environmental advancement.
- Knowledge transfer requires two-way interaction or engagement with non-academic users of knowledge, and it needs to be deliberate, planned and targeted at specific outcomes. Knowledge transfer partnerships can take a long time to evolve and consolidate before they are capable of producing tangible outcomes.
- Knowledge transfer extends beyond the conventional academic functions of teaching and research, but is heavily integrated with them. Knowledge transfer requires additional capabilities, infrastructure and relationships.
- Care needs to be taken in selecting metrics for measuring knowledge transfer performance, however there is the potential to define indicators of institutional knowledge transfer activity.

Existing funding programmes and gaps in funding

With respect to funding there is a common, though not universal, view that additional funding through a dedicated knowledge transfer fund or programme is desirable to enhance the level and effectiveness of collaboration between universities and business, governments, professions and regional and other communities. There is recognition that existing funding programmes provide some support for knowledge transfer, however, it is strongly argued by the majority of university stakeholders that these funding programmes target very specific types of knowledge transfer, in particular knowledge transfer aimed at the commercialisation of IP, and as such do not lend general support to the diversity of valuable knowledge transfer activities and partnerships that are, and could be potentially, pursued by universities. For this same reason, there are views that a new funding programme should not be overly prescriptive, but should aim to provide the necessary capacity for universities to respond to demand and opportunities as they arise.

There is also a widespread view that a targeted funding programme is needed to facilitate capacity building for knowledge transfer. Funding will create incentives and provide resources to enable institutions to put in place the required organisational cultures, systems, and supporting infrastructure. There are also views that funding support is required to assist universities in the often time consuming and elongated processes involved in the initial establishment of new knowledge transfer partnerships.

While the majority of university stakeholders suggest that current funding support for research commercialisation is adequate, when compared with funding support for other forms of knowledge transfer, the Group of Eight universities and other stakeholders argue that significant funding gaps also exist in the commercialisation domain. In particular, the identified gaps relate to support for:

- The high costs involved in establishing and maintaining commercialisation offices, and protecting and commercialising IP, especially given the time lags in achieving commercial returns.
- The transition from discovery research to proof of concept.
- Knowledge transfer involving SMEs.

With respect to the first dot point, a number of stakeholders highlighted the significant difficulties experienced by universities in recruiting and funding specialist research commercialisation personnel. There was some support for the concept of establishing commercialisation 'centres of excellence' that would service multiple universities and/or PFRAs. This concept builds on recent developments where institutions have partnered to establish joint commercialisation agencies or

have sub-contracted their commercialisation function to another institution. Reference was also made to developments in other countries, such as Germany, where the government reportedly invested A\$84 million in 2001 in the establishment of 20 technology transfer offices to provide research commercialisation services, on a regional basis, to 245 collaborating universities and research institutes.

Some of the other points raised by some stakeholders in relation to funding included:

- Any new targeted funding programme should not:
 - be conceived as a 'compensation fund' for institutions who may not perform well in the proposed RQF
 - subsidise existing fee-for-service or other commercial activities.
- Block funding, or a mixture of block funding and competitive project-based funding, is preferred.
- Funding needs to be 'new money', not funding re-directed from existing programmes.

While there is a majority view that dedicated funding support for knowledge transfer was desirable, a small minority of stakeholders put alternative views, including:

- The majority of universities should not be encouraged to pursue the commercialisation of research – it is not core business and consequently universities lack the necessary culture and expertise. Instead, emphasis should be given to facilitating the role of the private sector in commercialising the knowledge generated by universities.
- Preference should be given to boosting funding levels in existing proven knowledge transfer programmes, such as the CRC Programme and the ARC Linkage programme.
- The major market failure concerns the lack of easy access by industry and business, especially SMEs, to the sources of expertise and knowledge available in universities and PFRA's.
- The need for a focus on demand-side incentives, versus supply-side incentives.
- The low level of business expenditure on R&D (BERD) in Australia needs to be addressed by governments.

Appendix 3: Knowledge transfer for commercial benefit: summary of desktop research findings¹

The topic of knowledge transfer for commercial benefit has been the subject of substantial analysis in Australia in recent years. It has also been a key focus of innovation-related public policy and funding programmes. 'Commercialisation – the commercial application of ideas' is one of the three key themes underpinning the two *Backing Australia's Ability* (BAA) packages, which jointly provided \$8.3 billion in funding from 2001-02 to 2010-11. A secondary BAA theme, 'Skills – developing and retaining skills', also has relevance to knowledge transfer through, for example, the commercialisation training of research postgraduates.

In seeking to define and scope knowledge transfer for commercial benefit, a number of key issues identified in recent studies deserve consideration. In particular, it is important to highlight that 'commercial benefit' can encompass direct commercial returns to universities and PFRA^s themselves, and/or commercial benefits for industry and business. This is discussed further below.

Benefits of knowledge transfer

The growing emphasis in government policy, both in Australia and overseas, on applied research and university collaboration with industry and business is based on the premise that knowledge transfer can deliver real benefits in terms of innovation, economic growth and productivity. The Australian literature makes reference to numerous case studies demonstrating the commercial successes arising from publicly funded research (e.g. National Survey of Research Commercialisation [DEST, 2004]). Also, a recent Allen Consulting Group report on measuring the impact of publicly funded research highlights the broad range of commercial and non-commercial benefits to be derived from research and knowledge transfer (Allen Consulting Group, 2005a). This is discussed in further detail in Appendix 4.

In Australia, efforts to measure the impact of collaborative research and knowledge transfer aimed at commercialisation are in their infancy, however, some recent studies have demonstrated significant returns on investment. A recent study of the economic impact of the Cooperative Research Centre programme, for example, concluded:

¹ Note: References are provided in the main body of the report.

The key finding from this modelling is that over the 1992 to 2010 period the Australian economy's overall performance has been considerably enhanced when compared to the performance that would have occurred in the absence of the Commonwealth Government investment in the round one to seven CRCs that was provided between 1992 and 2005.

(Allen Consulting Group, 2005b; p. vi)

The study conservatively estimated that for every \$1 spent by the Commonwealth Government on the CRC programme, GDP is cumulatively \$0.60 higher than it would have been had that \$1 instead been allocated to general Government expenditure.

An earlier evaluation of the CRC programme also pointed to a range of valuable commercialisation outcomes including: capacity-building in partnership-based research and innovation; the delivery of collective industry benefits through the creation of applicable knowledge to improve and/or enhance industry performance; the expansion and creation of new businesses based on the transfer and/or sale of intellectual property rights and reflected in new products and services; and the training of PhD students with 'a tacit knowledge of the importance of application and adoption of research and how to interact with industry' (Howard Partners, 2003).

The Allen Consulting Group (2005a) also notes that the Rural Development Corporations have a long track record of conducting studies to assess the 'link between research conducted and new or improved products or processes that have subsequently been adopted within industry' (p. 11). CSIRO also released a study in 2001 demonstrating the economic benefits associated with a number of its research projects.

A 2003 DEST-commissioned review of the evidence on science, R&D and productivity concluded:

- business R&D is complementary to public sector R&D – raising investment in one sector stimulates the productivity of the other;
- the rate at which small firms innovate is dependent on their proximity to university researchers in the relevant fields; and
- a country's ability to absorb foreign technology is enhanced by investment in education and by investment in the country's own R&D. (Dowrick, 2003)

The review concluded that in order to benefit from the global public good of world knowledge, countries need to have well trained scientists, a technologically capable workforce and active engagement in cutting edge research.

The AVCC and the Business Council of Australia recently commissioned a joint study on building effective systems for the commercialisation of university research

(Allen Consulting, 2004). The study emphasised the commitment of both the higher education and business sectors to working together for mutual benefit, and highlighted three key areas for action:

- enhancing research commercialisation capabilities in universities;
- building effective partnerships between universities, business and financiers; and
- addressing areas of market failure requiring Government action.

In brief, there is a widespread acknowledgement from universities, PFRAs, industry and governments that knowledge transfer from universities and PFRAs to the commercial sectors is a cornerstone of innovation and economy policy. This acknowledgement is reflected in the focused attention given to knowledge transfer for commercial benefit in recent public policy.

The nature of knowledge transfer

Diversity of knowledge transfer pathways and commercial outcomes

A number of recent Australian studies have emphasised that knowledge transfer in partnership with industry and business for commercial outcomes occurs through diverse and often non-linear pathways, some of which lead to direct commercial benefits for the research organisations themselves and some of which do not. The studies have also highlighted that to date public policy and performance measurement systems have erroneously focused on a single model of research commercialisation – that is, the selling or licensing of IP for the commercial gain of the research organisation. There has also been an increasing recognition that the commercial returns to research organisations take a long time to realise and typically represent a very modest contribution to overall research revenues. A summary of the key recent studies and their relevant findings is provided below.

Processes of knowledge transfer

The recent Howard Partners report, *The Emerging Business of Knowledge Transfer* (2005a), concluded that a particular perspective has arisen in prominence – the ‘standard’ research commercialisation model. As a result, there is a tendency not to acknowledge ‘the plurality and the complexity of the channels and mechanisms through which universities and research organisations generate economic benefits’ (p. ix):

The report argues that the ‘standard’ research commercialisation model, associated with a linear sequence linking basic research to commercial outcomes, is largely specific to the biomedical sciences. Like the ‘linear model’ of research and development (R&D) itself (basic research – applied research – experimental development) to which it relates, the standard model is easily grasped, and the outputs easily measured,

which in turn helps to secure funding. A range of external interests also benefit from the promulgation of this model as the model of how universities and research organisations generate economic benefits.

(Howard Partners, 2005a; p. iv)

The authors propose a more comprehensive framework for understanding research commercialisation and knowledge transfer. They argue that universities and research organisations generate useful economic and social outcomes via four research commercialisation processes, which are summarised in the following table.

Models of knowledge transfer and commercial relationships

Research commercialisation process	Generating useful economic and social outcomes...	Commercialisation objective
Knowledge diffusion (most applicable to commodity-based industries such as agriculture and mining)	... by encouraging the broad industry-wide adoption of research findings	Focus is on adoption. Cover costs through industry contributions
Knowledge production (the 'standard' research model – most applicable to the life sciences)	... by selling or licensing the results of research in the form of commodified knowledge	Make money from sale of 'knowledge products' – patents, multimedia, spin-outs, fee-paying students
Knowledge relationships (most applicable to natural sciences/engineering plus social sciences and business/law)	... by providing services such as consultancy that indirectly exploit broad intellectual property platforms, focusing on cooperation, collaboration, joint ventures and partnerships	Make money from sale of 'knowledge services' – consulting, contract research, industrial teaching
Knowledge engagement (most applicable at the level of the institution)	... as a by-product of shared interests and concerns that transcend the boundaries of the university <i>per se</i>	Business development: mutual long term benefit; base for creating wealth.

The Howard Partners report presents a typology of knowledge products and services to represent the outputs that are subsumed the knowledge transfer processes:

- academic publishing;
- knowledgeable graduates;
- industry-targeted teaching
 - professional education
 - education and training contracts;

- contract research;
- consultancy;
- staff interchange and faculty appointments in industry;
- research publication;
- creation of intellectual property rights; and
- formation of spin-out companies.

The importance of knowledge exchange networks

All four of Howard Partners' knowledge transfer processes rely to some extent on knowledge exchange networks, though they are particularly central to the knowledge diffusion and knowledge engagement processes.

With growing competition and globalisation and the rapid advancement of knowledge, businesses are increasingly more specialised and focused on their own core competencies. They are consequently less self-sufficient with regard to the knowledge and know-how they require for innovation, and are increasingly reliant on linkages with a variety of actors (e.g. suppliers, users, competitors, public research institutions) for knowledge sharing and exchange (OECD, 1999a). This is particularly the case in the Australian context, given its industry structure, location disadvantages, limited economies of scale and density of SMEs.

A recent case study of Radiata prepared for the DEST Science and Innovation Mapping study emphasises the importance of intangible networks:

... The second type of intangible network consists of networks of highly-skilled people who know and trust each other...

The main lesson learnt for science and innovation in Australia is that attention needs to be focused upon the intangible 'asset values' created by networks of highly skilled scientists, engineers and entrepreneurs. These asset values are based upon an increased probability of success in innovating.

(Matthews and Frater, 2003; p.2)

DEST recently commissioned Howard Partners to undertake a strategic analysis of knowledge exchange networks in Australia, where knowledge exchange networks are defined as:

... structured intermediary mechanisms for users to locate, exchange and acquire knowledge in a systematic way, with a view to development of new products, processes and services.

(Howard Partners, 2005b; p. 1)

The project assesses knowledge exchange networks in three broad categories:

- Knowledge communities – involving the sharing of knowledge through what have become known as ‘communities of practice’ and ‘knowledge or science and technology’ clusters.
- Knowledge markets – involving the trading of knowledge between sellers and providers, often through Internet based exchanges, but increasingly involving knowledge brokers.
- Knowledge organisations – entities established to facilitate the application of knowledge by developing skills and capabilities on the part of users through specific programmes and initiatives. These organisations manage the relationship between the creators and users of knowledge.

The study categorises networks according to the arrangements for ongoing management and promotion of the network – that is, networks supported by: universities and research organisations; industry, universities and government; industry associations; professional associations; government enterprise development programmes; and science and technology clusters.

The report concludes that knowledge transfer from the creators of knowledge (research providers) to industry users is most effective through networks that are sponsored and supported through industry associations. It also emphasises the importance of the human interface in networks, noting that paradoxically the greater opportunity for the transfer of knowledge through the Internet, the greater is the need for skilled facilitators, trusted advisers and ‘honest brokers’ who can bridge the cultures and interests of the parties to an exchange.

In terms of knowledge transfer policy, this emphasises the importance of considering both demand-side and supply-side incentives.

The scale and beneficiaries of commercial outcomes

The importance of looking beyond direct commercial benefits to universities and PFRA's when considering the benefits of knowledge transfer is emphasised in a 2004 study undertaken by the Allen Consulting Group:

... in assessing the commercialisation returns associated with publicly funded R&D, it would not appear that high overall economic impacts are likely to be found in the area of revenues accruing to research performing institutions. Even at world best practice levels, total commercialisation returns (excluding contract revenue) to institutions are unlikely to represent more than 5 to 10 per cent of total research revenue in the Australian higher education sector... It is therefore likely that the major economic impacts that Australia could realise in the future through the commercialisation of publicly funded R&D will be associated with the activities of companies that have successfully commercialised publicly funded R&D.

(Allen Consulting Group, 2004; p. 11)

The study also notes that the recent Lambert Review of Business-University Collaboration in the United Kingdom concluded that knowledge transfer from universities to business should not be viewed primarily as a revenue raising activity for universities. This concept has been endorsed by the Higher Education Funding Council of England, which has adopted the following as one of its three key principles for the Higher Education Innovation Fund supporting 'third stream' activities:

HEIF 3 will support a broad range of knowledge transfer activities that benefit the world outside but which may not generate large amounts of net income for the HEIs themselves.

(HEFCE and OST, 2005a; p.5)

The Australian Coordination Committee on Science and Technology (CCST) established a Working Group on Metrics of Commercialisation in November 2003. The Working Group recommended that the current DEST definition of research commercialisation:

...the processes that generate commercial returns via income and capital gains, income from licences and revenue from sales of new products and processes from research conducted

be recast to reflect the range of ways in which publicly funded research activity can provide commercial benefits for industry. Its recommended new definition has since been adopted by DEST for the purposes of the National Survey on Research Commercialisation:

... the means by which universities' and PFRAs' research generates commercial benefit, thereby contributing to Australia's economic, social and environmental well-being. This is achieved through developing intellectual property, ideas, know-how and research-based skills resulting in new and improved products, services and business processes transferable to the private sector.

(Coordination Committee on Science and Technology Working Group, 2005; p.12)

The Allen Consulting Group's assessment of the economic impact of cooperative research centres in Australia also concluded that:

Most benefits from the CRC Programme have come from industry application of research rather than through narrowly defined "commercialisation" events such as spin-off company formation and licensing of IP.

(Allen Consulting Group, 2005b; p. 40)

The role of creativity, design and the arts, humanities and social sciences

Internationally and in Australia, knowledge transfer for commercial benefit has largely been associated with the science and technology disciplines. There has been an increasing recognition, however, of the role played by creativity, design and the arts, humanities and social sciences in innovation. This has been partly fuelled by

the substantial growth of the creative industries sector itself and its increasing importance to GDP and export performance. However, there is also an increasing emphasis on the broader role of creativity and design in global competitive advantage and economic growth.

In the last year, for example, the UK government has commissioned two parallel investigations addressing the issue of creativity, design and business performance. The Cox review of creativity in business was initiated by the UK Treasury on the basis of evidence that, the success of the creative industries notwithstanding, UK business was not realising the full potential of the UK's creative capabilities (HM Treasury, 2005).

In addition, the Department of Trade and Industry undertook new research to explore the role of creativity and design in business performance (UK Department of Trade and Industry, 2005), and concluded 'that firms with higher design intensity have a greater probability of carrying out product innovation and that design expenditure has a positive association with firm productivity growth' (p. vi). The research report describes the relevance of design as follows:

Design is a structured creative process. Design is readily associated with industrial product design for manufactured products – specifically the 'look' of a product. However, the application of design is much broader, for example designing for function; for aesthetic appeal; for ease of manufacture; for sustainability; and designing for reliability or quality and business processes themselves. Service design affects how customers will experience the delivery of a service, such as a bank or a fast food restaurant. Elements of design, particularly graphic design, will form part of product, service and company branding and advertising strategy.

(Department of Industry and Trade, 2005; p. iv)

Both of the UK investigations discuss the desirability of government intervention to overcome market failures and ensure appropriate framework conditions for innovation. The Cox Review, for example, recommends the establishment of a network of centres of creativity and innovation across the UK, with a national hub in London, to raise the profile of the UK's creative capabilities. It also recommends the widespread promulgation of the Design Council's *Design for Business* programme.

In Australia, an independent working group of the Prime Minister's Science Engineering and Innovation Council (PMSEIC) (2005) has recently produced a report, *Imagine Australia*, which addresses very similar issues. This report argues that to be globally competitive, Australia needs to formulate a comprehensive approach to fostering creativity through implementation of the political, economic, social and technological infrastructure that facilitates relationships between creative industries and other sectors. The report recommends that PMSEIC enhance innovation policy by the inclusion of design, creativity and creative industries; facilitate greater cross-disciplinary and cross-sectoral research collaboration

between SET and HASS sectors; and facilitate a critical mass of activity through a Creative Innovation Fund.

A *Handbook on Responsible Partnering* recently issued by the European Commission and the main European organisations supporting research, development and knowledge transfer in companies, universities and public research organisations provides ten guidelines for collaborative research and knowledge transfer. One of those guidelines emphasise that the nature of innovation is trans-disciplinary:

Innovation is not simply technological advance. Choosing the best business model or social structure is sometimes more important than being the first to discover or invent. Similarly, scientific skills must be combined with the humanities, economics, sociology and law. Responsible Partners recognise this transdisciplinary nature of innovation and organise themselves accordingly.

(European Commission and others, 2005; p. 7)

A Business Council of Australia survey also supports the view that innovation requires much more than R&D in science and technology, and that a multi-disciplinary approach is considered the key to success (Lahey, 2005).

In 2003, DEST also invited the Australian Academy of the Humanities to prepare a report on the contribution of the humanities and social sciences (HASS) to the Government's national research priorities (Department of Education, Science and Training, 2003). The priorities were subsequently modified to reflect the ways in which creative, cultural, social and human dimensions impact on the achievement of outcomes reflected by the priorities. This issue remains an area of some controversy for the HASS sector.

A report by the Council for the Humanities, Arts and Social Sciences also recently highlighted that academics working in the humanities, arts and social sciences are engaging in commercial activities (CHASS, 2005). Clients included government (24 per cent); community groups, NGOs, general public (11 per cent); city councils/local governments (10 per cent); industry and business (9 per cent); and the arts industry (8 per cent). Outputs included consultancies, contract research, education packages and production (e.g. DVDs, CDs, websites).

Measuring knowledge transfer

The measurement of R&D activity, research commercialisation, technology transfer and innovation has received concentrated attention both internationally and in Australia. The OECD has played a particularly strong role in defining and providing international comparative data on a range of metrics (OECD 2005b; OECD 2005c). The Association of University Technology Managers in the United States has also been influential with its annual Licensing Survey (AUTM, 2005). In Australia, the National Survey of Research Commercialisation commissioned by

DEST represents the major source of data relating to universities and publicly funded research agencies (DEST, 2004).

The acknowledgement of the multiple pathways to knowledge transfer for commercial benefit poses some challenges in terms of scoping knowledge transfer activity for the purposes of policy development, the design of funding programmes and the measurement of performance. The 'standard' measures of research performance adopted to date are increasingly being judged as inadequate for the purpose of assessing knowledge transfer and innovation performance, both in Australia and overseas (Howard Partners, 2005a; Davis and Tunney, 2005; Allen Consulting Group, 2005a; CCST Working Group, 2005).

In this Section, we examine recent work, in the United Kingdom and Australia, in area of the measurement and metrics of knowledge transfer to provide some insights into the varying ways in which knowledge transfer is being scoped in practice.

United Kingdom

Higher Education Funding Council of England

The annual higher education-business and community interaction survey (Department of Employment and Learning and others, 2005) is the key mechanism employed in the UK for gathering information and data relating to 'third stream' activity. It collects information about:

- institutional strategy;
- infrastructure (e.g. staff dedicated to business and community interaction support, services offered);
- research-based interactions and IP exploitation (e.g. consultancy, licenses, collaborative research);
- social, community and cultural activities;
- regeneration (of localities and regions); and
- education and continuing professional development.

While the survey collects a broad range of data, the HEFCE has adopted a new 'third stream' funding formula from 2006, which only references the survey data relating to external income. The formula includes three components:

- external income as a proxy to reflect the value which demand-side partners place on interaction with an institution (determining 45 per cent of funding);
- potential and capacity building as measured by academic staff numbers (determining 45 per cent of funding); and

- activities not best measured by income (determining 10 per cent of funding)².

The HEFCE acknowledges the limitations of the new formula:

The formula will not be perfect, because of the limitations of the available metrics as precise indicators of the wide range of activities which HEIF 3 is intended to promote, the relative infancy of some types of activity, and the difficulty of capturing the real impact of funding. However it will provide a major step towards a more refined process for potential application to any later rounds of HEIF.

(HEFCE and OST, 2005a; p. 8)

Scottish Funding Council

The Scottish Funding Council continues to discuss with the sector the most appropriate set of knowledge transfer metrics to inform the allocation of its Knowledge Transfer Grant (KTG) (Scottish Funding Council, 2005). The formula was modified in 2004-05 in recognition that the KTG should be allocated using a range of KT measures with less reliance on measures of research activity. The metrics currently used cover: external research grant and contract income; consultancy income; continuing professional development income; income from a variety of other designated funding programmes; licensing income; and, venture capital income.

Science and Technology Policy Research Unit

The Science and Technology Policy Research Unit (SPRU) produced a report for the Russell Group of Universities in the UK on measuring 'third stream' activities (Molas-Gallart et al, 2002). The authors analysed the strengths and weaknesses of 65 possible indicators and selected 34 for potential adoption.

The 34 indicators cover both research-related and teaching-related activities in the following categories:

- technology commercialisation;
- entrepreneurial activities (e.g. spin-offs);
- advisory work;
- commercialisation and use of university facilities;
- contract research with non-academic clients;
- non-academic collaboration with non-academic clients;
- flow of academic staff, scientists and technicians;
- student placements;

² This includes measures of: dedicated third stream staff, SME engagement, sandwich student placements and engagement with non-commercial (including social and civic organisations).

- active alignment of teaching to economic and societal needs;
- learning activities;
- social networking; and
- non-academic dissemination.

Australia

A number of recent studies have been commissioned by the Government to assess the adequacy of current measurement approaches in Australia. As noted earlier, the Howard Partners report on knowledge transfer (Howard Partners, 2005a) concluded that the 'standard' research commercialisation model, which has formed the basis of measurement systems for many years, does not adequately reflect the wide range of circumstances through which universities impact upon the economy.

The authors emphasise the difference between performance measurement (assessment of overall programme performance using a range of programme evaluation methodologies and techniques) and performance indicators (measures of process and output that inform at regular intervals about progress in relation to purpose and objectives). They defined categories of output indicators for the four research commercialisation processes within their knowledge transfer framework, as follows:

Knowledge diffusion	Communication activities Capacity-building activities Extension and education activities Standard setting activities Industry output data
Knowledge production	Academic publication activities Patenting and licensing activities Income streams relating to the above Spin-off company formation activities
Knowledge relationships	Contract research and consultancy activities Income streams Staff and students working on interchange with industry Industry research staff with sessional and adjunct appointments in universities University-appointed 'visitors' from industry

Knowledge engagement Participation in non-academic community and economic activities
 Jointly owned and operated technology property infrastructure—
 technology and research parks, buildings, equipment, instruments
 etc.
 University-organised events for community and regional economic
 and social benefit (workshops, seminars etc.)
 University facilities available for non-academic purposes (for
 example, libraries, cultural centres, sportsgrounds)

The authors also argue that performance measurement for research funding programmes should be approached at four levels, depending on the purpose of the programme: at the level of the economy; the industry; the enterprise; and the region.

The CCST Working Group (2005) recommended that the following 14 metrics be adopted as the basis for future data collection and assessment relating to research commercialisation across Australia's publicly funded research institutions:

Metrics of research commercialisation

Intellectual property	Research contracts and consultancies	Skills development and transfer
1. Patent applications 2. Commercialisation staff and administration 3. Licenses, Options, Royalty agreements, Assignments 4. Pilots/Prototypes/Clinical Trials 5. Gross revenue from licensed technology 6. New products, services or business processes created 7. Start-ups/Spin-outs, Initial Public Offerings	8. Research contracts and consultancies 9. Peer-reviewed publications and reports 10. Repeat and flow-on business	11. Commercialisation and entrepreneurial training for researchers 12. Research graduates employed in industry 13. Research postgraduate income 14. Research postgraduates employed in Spin-outs

(CCST Working Group, 2005; p. 17)

Considerable further work is required to explore the feasibility of measuring the diverse forms of knowledge transfer adopted by institutions and within different disciplines.

Current incentives and barriers to knowledge transfer

Recent research on the topic of knowledge transfer and commercialisation points to a number of demand-side and supply-side incentives and barriers with respect to

knowledge transfer directed towards commercial outcomes (Allen Consulting Group, 2004; Council for the Humanities, Arts and Social Sciences, 2005; Howard Partners, 2005b; Prime Minister's Science, Engineering and Innovation Council Working Group, 2004; Yencken and Ralston, 2005; Group of Eight Ltd, 2005). These are summarised below. It should be noted that most of the research has focused on universities rather than PFRA's.

Demand-side incentives and barriers

Incentives

- Increasing reliance on portfolio approaches to technology and knowledge acquisition, incorporating a combination of in-house R&D, outsourced R&D, collaborative partnerships with companies and research organisations.
- Access to university and PFRA expertise and knowledge.

Barriers

- The structure of Australian business and industry sectors reducing absorptive capacity and encouraging research organisations to engage offshore companies to develop new technologies:
 - the high proportion of Australia's technology oriented companies that are branch offices of multinational corporations, many of which conduct their R&D overseas
 - the relative lack of high technology industries
 - density of SMEs and their fragmentation and isolation
 - low levels of business investment in R&D compared with other OECD countries (though levels of BERD have been increasing and there are suggestions that low BERD levels are not critical to innovation [Lahey, 2005; Davis and Tunney, 2005]).
- Exclusion of arts, humanities and social sciences research from the R&D tax concession.
- Resistance on the part of equity investors, business and industry associations to 'purchasing' information arising from publicly funded research.
- Lack of 'single entry' point into the higher education research system to identify capacity and capability in industry applications of research.
- Lack of management and entrepreneurial skills.
- Lack of collective strategies on the part of technology-based SMEs for driving commercial and export success.
- Lack of expansion capital for SMEs.

Supply-side incentives and barriers to knowledge transfer

Incentives

- Relevance to government, industry and communities.
- Opportunities for collaboration, resulting in access to expertise and activity outside the research organisation and greater research funding.
- Programmes supporting collaboration, such as ARC Linkage Grants and the CRC programme.
- Financial returns including royalties, equity in spin-offs.
- Provision of pre-seed and seed funding for technology development.
- Benefits to promotion (in some institutions).
- Training, networking and linkage opportunities for research students.
- Organisational culture and systems supportive of knowledge transfer.

Barriers

- Cultural issues, including:
 - differences in culture between universities and PFRAs and business, including the importance of 'timeliness' in commercialisation activity
 - the lack of interest by some researchers in commercialisation or resistance to the university claiming IP rights over their research
 - lack of acknowledgement of commercialisation activities and outcomes in promotion and reward systems (though this is reported to be changing)
 - management focus on maximising short run financial returns rather than developing IP to maximise long-run benefits and lack of re-investment of financial returns to build commercialisation capability.
- Skill and knowledge issues, including:
 - capacity and flexibility to offer competitive salary packages to attract highly professional and experienced commercialisation staff
 - difficulties in sourcing the full range of skills needed amongst a relatively small number of professional staff in commercialisation arms of research organizations
 - limited understanding on the part of researchers of the commercialisation process and its costs, thus leading to unrealistically high expectations regarding the market value of their early stage research
 - willingness of researchers to leave their research organisations to take on a role within spin-off companies.

- Resourcing issues, including:
 - the capacity to commit resources to support:
 - the level of deal activity
 - the maintenance of networks
 - protection of IP
 - access to specialist service providers as necessary (e.g. IP legal services)
 - education of research staff, the early identification of IP and culture change
 - access to capital to support the development of IP to an investment or customer-ready stage .
 - the lack of critical mass for the majority of Australian universities and difficulties in justifying the commitment of funds given the size of research budgets.
 - modest revenues earned from commercialisation activities.
 - lack of acknowledgement of knowledge transfer and commercialisation in current government funding programmes.
- Governance and administrative process issues including:
 - inconsistencies in State and Territory IP laws and in IP policies of universities and research organisations.
 - delays in decision-making with universities.
 - the absence of appropriate governance structures that ensure proper accountability and risk management without the imposition of internal and external administrative processes such as State Ministerial notification and University Council sign-off on all commercialisation activity
 - clarity of policies and procedures.
- Sub-optimal communication and linkages between universities and State governments.
- Financing issues including:
 - lack of value attributed to the skills that venture capitalists can bring a deal over and above the provision of capital.
 - lack of understanding of the risks associated with early stage companies and unrealistic expectations of financial return.

Appendix 4: Knowledge transfer for material, human, social and environmental benefit: summary of desktop research findings³

Government policy research and analysis and measurement systems in the area of university and PFRA knowledge transfer have tended to concentrate on knowledge transfer for commercial benefit. There has been substantially less attention given to knowledge transfer with a focus on non-commercial outcomes.

Some stakeholders are arguing that the historical policy focus on knowledge transfer for commercial benefit fails to recognise the critical role of university and PFRA knowledge transfer in enhancing other material, human, social and environmental wellbeing of communities. This Appendix summarises our findings in relation to this broader concept of knowledge transfer. It should be noted that the broader concept of knowledge transfer is typically considered to subsume the narrower concept of knowledge transfer for commercial benefit. This is reflected in some of the information presented. We have sought, however, to emphasise those aspects of the broader concept that have not been already addressed in Appendix 3.

Benefits of knowledge transfer

Our analysis of the Australian and international literature reveals strong support from the research community and governments for enhancing knowledge transfer with a focus on non-commercial outcomes, based on demonstrated and assumed economic, social and environmental benefits to the community. There is also an increasingly sophisticated understanding of these benefits among community and business organisations.

While there is limited research available on the impact of publicly funded research with a non-commercial focus, a 2003 study by Access Economics concluded that the likely returns on investment in health R&D are extraordinarily high with annual rates of return to Australian health R&D up to \$5 for every \$1 spent on R&D and an 8-year gain in life expectancy as well as improved wellness over 1960-99 (Access Economics, 2003).

A recent Allen Consulting Group report on measuring the impact of publicly funded research concluded that the spectrum of areas that research can generate benefits within is wide:

³ Note: References are provided in the main body of the report.

Existing approaches to measuring the impacts of publicly funded research have tended to focus primarily on the impacts of this research within the academic community. When impacts beyond academic impacts are measured, the greatest focus has been placed on measuring the economic impacts of research through direct commercialisation of publicly funded research, adoption of knowledge by industry and through skills formation improving labour productivity.

To more fully capture the impacts of public research it is necessary to ask 'what does society value?' and 'does publicly funded research contribute to these dimensions of what society values?'.

(Allen Consulting Group, 2005a; p. vii)

The study provides a typology of benefits available from publicly funded research, as reproduced below.

Typology of Benefits Available from Publicly Funded Research

Material dimension	Human dimension	Environmental dimension	Social dimension
Quality and quantity of goods and services available to society	Physical health Mental health Quality of inner life Ability to access pleasurable experiences	Extent of biodiversity Quality of air Quality of land Quality of inland waters Quality of seas	Levels of social attachment Freedom from crime Political rights Political engagement

(Allen Consulting Group, 2005a; p. 24)

The Government's national research priorities reflect all of these dimensions. It is instructive to note that 14 of the Government's 21 national research priority goals have non-commercial benefits as their principal focus, though they may have spillover impacts in the commercial domain (e.g. Water – a critical resource; Ageing well, ageing productively; Understanding our region and the world) (see Appendix 5). While we have not attempted to quantify the public funding directed to those goals, it is plausible that a significant percentage of the \$3,278 million allocated to Commonwealth support for science and innovation and administered by DEST in 2004-05 would have been directed to research primarily concerned with non-commercial outcomes.

In addition, the Australian Treasury has developed a wellbeing framework to underpin analysis and advice across the full range of its public policy responsibilities (Parkinson, 2004). While the wellbeing framework differs in its structure to the Allen Consulting framework, there is some overlap in underlying principles. It recognises, for example, that wellbeing frameworks need to extend beyond conventional welfare economic models that assume the level of income or consumption is the most important determinant of wellbeing. The dimensions of the Treasury wellbeing framework are: (i) the level of consumption possibilities; (ii) the distribution of those consumption possibilities across different groups, geographic regions and generations; (iii) the level of risk that people are required to bear; (iv) the level of complexity that people are required to deal with; and (v) the level of opportunity and freedom that people enjoy.

There is clear economic benefit to Australia in seeking to maximize the return on investment in public funding through effective knowledge transfer partnerships between universities and PFRAs, governments, regional agencies, professional associations, schools, business, the not-for-profit sector, other community groups and the general public.

Forms of capital and their contribution to the wealth and wellbeing of nations

The Allen Consulting typology mirrors the thinking evident in recent OECD and World Bank policy analyses, which differentiate between different forms of capital and their impacts on wealth and human wellbeing more broadly (OECD, 2001; World Bank, 2006)⁴:

- produced capital;
- natural capital; and
- intangible capital, including
 - human capital
 - social capital
 - governance.

Wealth estimates prepared by the World Bank in a very recent analysis of the wealth of 120 nations suggest that the preponderant form of wealth worldwide is in the form of intangible capital, representing 80 per cent of wealth in high-income OECD countries and 59 per cent of wealth in low-income countries (World Bank, 2006). As countries become richer, the relative importance of produced and intangible assets rises in ratio to natural assets. On the other hand, the World Bank argues it is vital to efficiently invest the rents from the exploitation of natural resources if a sustained level of income generation is to be achieved.

This recent research suggests that public policy in the area of knowledge transfer needs to extend well beyond the concept of produced capital, to also incorporate natural, human and social capital, if national wealth creation is to be optimised over the longer term.

The following table outlines definitions for the various dimensions of intangible capital adopted by the OECD and World Bank:

⁴ The Australian Bureau of Statistics also utilises this framework (see Australian Bureau of Statistics, 2002, *Measuring Australia's Progress*).

Dimensions of intangible capital

Human capital	Social capital	Governance
<p>The knowledge, skills, competencies and attributes embodied in individuals that facilitate the creation of personal, social and economic wellbeing.</p> <p><i>(includes attributes such as the physical, emotional and mental health of individuals)</i></p>	<p>Networks together with shared norms, values and understandings that facilitate co-operation within or among groups.</p> <p>There are three basic forms of social capital:</p> <ul style="list-style-type: none"> • Bonding (within groups) • Bridging (between groups) • Linking (relations between different social strata in a hierarchy where power, social status and wealth are accessed by different groups)⁵. 	<ul style="list-style-type: none"> • Political, institutional and legal arrangements (e.g. judicial system, property rights, effective government) • The quality of formal and informal institutional arrangements

(OECD, 2001; p. 12, p. 18 & p. 41-42; World Bank, 2006; p. xviii)

In examining the issue of intangible capital, the OECD has taken a particular interest in assessing its contribution to the wellbeing of nations. Whilst acknowledging the challenges in measuring wellbeing, the OECD has pointed to evidence of an increasing divergence, since the 1980s, between GDP per capita and measures of wellbeing (OECD, 2001; p. 11), suggesting that while economic output is an important component, it does not in itself explain overall levels of community wellbeing.

The importance of human capital has been acknowledged by governments and has received accelerated levels of policy attention in recent decades, particularly in areas such as educational attainment, skills development, lifelong learning and health. This has been driven by a range of factors such as the rise of the knowledge-based economy, increased global economic competition and trade, and changing population demographics. Human capital has been demonstrated to have a positive impact on earnings, employment and economic growth and social factors such as health, dependency on welfare, crime rates; volunteering rates and enhanced subjective wellbeing. A recent Canadian study, for example, found that even a one per cent improvement in literacy levels could increase Canada's GDP by more than \$19 billion a year (Coulombe et al, 2004, quoted in Association of Universities and Colleges of Canada, 2005).

More recently, there has been a growing acknowledgement of the importance of social capital to economic and social wellbeing. An OECD analysis suggests that a

⁵ Linking social capital enables individuals and community groups to leverage resources, ideas and information from formal institutions beyond the immediate community radius (Australian Bureau of Statistics, 2002).

variety of benefits flow from higher levels of social capital, including: better physical and mental health; enhanced child welfare and lower rates of child abuse; lower crime; better government; social cohesion; equity; and, productivity (OECD, 2001)⁶.

There is also recognition of the need to understand the potential negative impacts of social capital which may arise, for example, when strongly internally bonded community groups lack the bridging social capital required to build trust and cooperation with other groups in the community.

Public policy interest in social capital is evident in a number of countries, including the UK (Office for National Statistics, 2005; UK Performance and Innovation Unit, 2002), the US (Hudson and Chapman, 2002; Harvard University, 2005) and Canada (Canada Policy Research Initiative, 2005). In the US, the interest in social capital has been accelerated by research suggesting that the country's stock in social capital has plummeted with increasing rates of social disconnection from family, friends, communities and democratic structures (Putnam, 2000) and the terrorist attacks of September 11, 2001.

Interest in social capital is also strongly evident in Australia. The Australian Bureau of Statistics (ABS) (2002) notes:

In Australia, social capital has emerged as an area of great interest to a large number of government agencies, community and welfare organisations, research institutions and community development practitioners. The potential for social capital to make a positive contribution to outcomes in diverse areas of social concern such as health, community safety and education has captured the interest of policy makers, social analysts and researchers.

(Australian Bureau of Statistics, 2002; p. v)

The ABS has adopted social capital as one of its themes and, with the strong support of public policy agencies, is developing and refining a framework for the measurement of social capital. It has argued that information on social capital may inform policy questions and issues in: education, training and employment; community safety, crime and justice; health; families; arts, culture, sport and recreation; housing, transport and urban planning; volunteering; and women's issues (ABS, 2002).

Other government agencies displaying an interest in social capital include the Productivity Commission (2003), the Department of Family and Community Services (Johnson et al, 2005), and the Department of Communications, Information

⁶ The importance of social capital extends into the industry and business sectors, as social capital can: facilitate regional systems of innovation; enhance levels of cooperation between companies and within companies; and support open and flexible labour markets through the sharing of knowledge and mobility of individuals. The emphasis placed on networks and industry clusters in current innovation frameworks reflects the role of social capital in innovation, commercialisation and productivity.

Technology and the Arts (2005a). The Australian Treasurer has also raised the importance of social capital to Australian society (Costello, 2003).

Many Australian and State government strategies are focused on issues of building human and social capital, for example:

- The *Stronger Regions A Stronger Australia* strategy focuses on building social capital in Australia's regions by assisting regional communities to manage change, realize their potential and lead their own development.
- The Department of Family and Community Services Strategic Framework (Department of Family and Community Services, 2005a) is focused on five outcomes, all of which have significant social capital objectives.
- The Department of Communications, Information Technology and the Arts has adopted *community connectivity* as one of its themes and has developed supporting strategies where government intervention is required to achieve wider uptake and effective use of technology (Department of Communications, Information Technology and the Arts, 2005b).
- Victoria's *Growing Victoria Together* and Tasmania's *Tasmania Together* strategies are focused on building human and social capital.

Knowledge transfer, in partnership with national, state and local governments, regional bodies, NGOs, public and private schools, business and a range of other community groups, with the aim of safeguarding natural capital, building human and social capital and strengthening governance frameworks is increasingly seen to be central to the role of universities.

The nature of knowledge transfer

There has been a growing interest both internationally and in Australia in university and PFRA 'engagement' with their communities. The concept of 'engagement' is often seen to encompass both research- and teaching-related activities.

As noted earlier, the governing Acts of PFRAs have always made the requirement for knowledge transfer quite explicit, and the *modus operandi* of PFRAs has consequently been shaped by a strong emphasis on collaboration with government agencies, business and the community.

International bodies and agencies

A recent international higher education conference attended by 29 University Presidents from 23 countries adopted *The Talloires Declaration on the Civic Roles and Social Responsibilities of Higher Education* and also established The Talloires Network aimed at catalysing a worldwide movement of individuals and institutions dedicated to promoting the civic roles and social responsibilities of higher education

(Tufts University, 2005). Signatories to the Declaration agree, amongst other things, to:

- Foster partnerships between universities and communities to enhance economic opportunity, empower individuals and groups, increase mutual understanding and strengthen the relevance, reach and responsiveness of university education and research.
- Expand civic engagement and social responsibility programmes in an ethical manner, through teaching, research and public service.
- Create institutional frameworks for the encouragement, reward and recognition of good practice in social service by students, faculty, staff and their community partners.

The OECD has also initiated an international project to 'strengthen the contributions of higher education institutions by devising steps to be taken to improve the interplay and mutual capacity building between HEIs and their regional stakeholders and partners at different territorial levels' (OECD, 1999b & 2005a).

The Association of Commonwealth Universities has argued that engagement should be a core value of universities (ACU, 2001) and has undertaken a project to further develop this concept (ACU, 2003). Three levels of engagement are identified: joint participation in developing policy and strategy; strategic alliances and collaborative action around a particular agenda; and, provision of defined services by the university.

United Kingdom

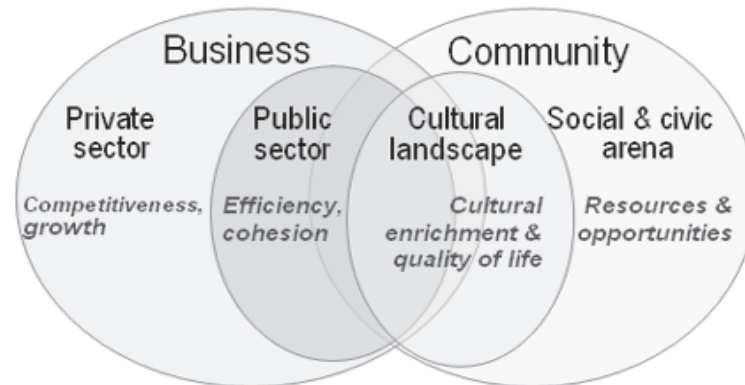
The Higher Education Funding Council has adopted 'Business and community' as one of its core themes:

The strategic aim of the Business and Community theme is to enhance the contribution of higher education to the economy and society. We aim to support all institutions in making a significant and measurable contribution, through knowledge transfer and related activities, to economic development and the strength of communities.

(HEFCE, 2005b)

The HEFCE has adopted a simple model for its business and community engagement theme, which identifies four overlapping dimensions and associated *typical* outcomes of engagement (HEFCE, 2005b):

Scope and typical *outcomes* of Business & Community engagement



Note: This diagram does not represent scale of activity

The HEFCE also noted in its 2002 HEIF funding guidelines:

Alongside their more traditional roles of teaching and research, higher education institutions (HEIs) and public sector research establishments (PSREs) have increasingly been adopting a further role as stimulators and facilitators of knowledge transfer to business and society.

The White Paper on enterprise, skills and innovation, 'Opportunity for all in a world of change', recognised the crucial role of HEIs in the economy as powerful drivers of innovation and change. But different HEIs and PSREs have different contributions to make: some as world class centres of research excellence and players in global markets; others primarily as collaborators with local businesses and communities, and with regional bodies. Institutions must choose the role which best suits their strengths...

(HEFCE, 2005a)

The HEFCE funding programmes have placed an emphasis on collaboration between higher education institutions, particularly within regions, and partnerships with regional development agencies.

In its study for the Russell Group of Universities on measuring 'third stream' activities, the Science and Technology Policy Research Unit (SPRU) at the University of Sussex adopted a relatively broad definition of the 'third stream' as follows:

Third stream activities are therefore concerned with the generation, use, application and exploitation of knowledge and other university capabilities outside academic environments. In other words, the Third Stream is about the interactions between universities and the rest of society.

(Molas-Gallart, J. et al, 2002; p. iii)

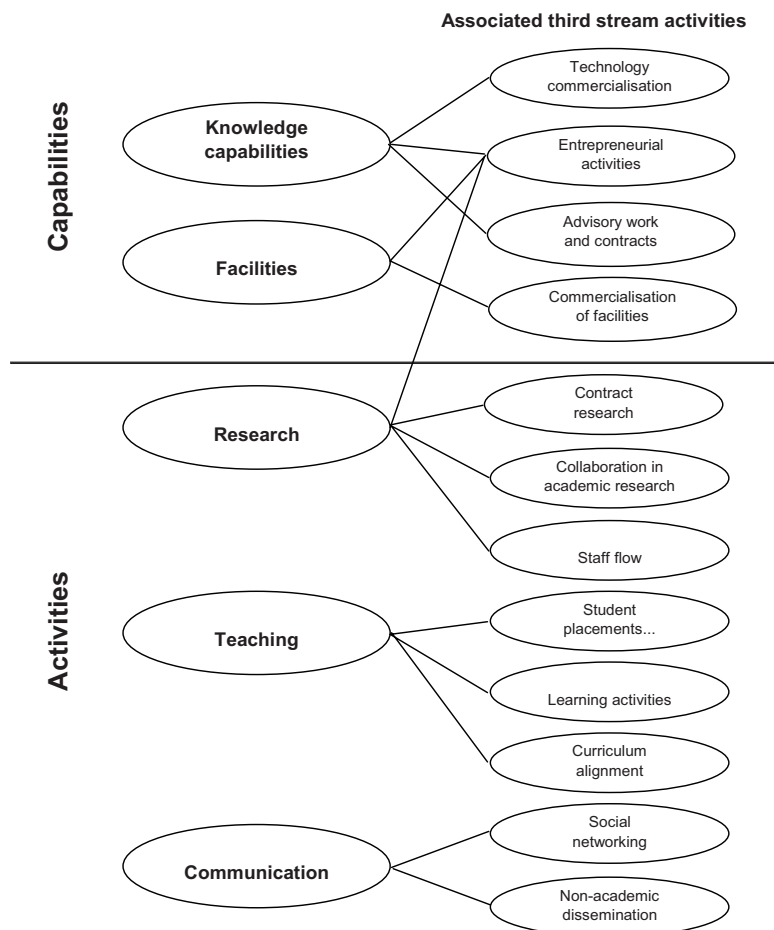
The Unit argues that the relationship between universities and the rest of society extends beyond merely commercial activities:

Universities make contributions to government and civil society as well as the private sector, assisting not only with economic performance but also helping to improve quality of life and the effectiveness of public services. Any approach to university Third Stream activities that focuses purely on university commercial activities is likely to miss large and important parts of the picture.

(Molas-Gallart, et al, 2002; p. iv)

It put forward a holistic conceptual framework for 'understanding the web of interactions that span universities and the rest of society' (p. iv), as presented below.

SPRU Conceptual Framework for analysing Third Stream activities



United States

There has also been a very active movement in the United States to 'renew the civic mission' of universities. The 1999 Wingspread Declaration on Renewing the Civic Mission of the American Research University was influential in mobilising peak bodies and universities to reflect upon the role of universities.

It states:

... there are new stirrings of democracy in American higher education. From one campus to another, there is increasing interest in efforts to better prepare people for active citizenship in a diverse democracy, to develop knowledge for the improvement of communities and society, and to think about and act upon the public dimensions of our educational work.

(Boyte and Hollander., 1999; p.7)

Organisations that have since taken the lead in the debate in the US include the Kellogg Commission on the Future of State and Land-Grant Universities (2001), the American Association of State Colleges and Universities (2002) and Campus Compact, a national coalition of over 900 college and university presidents committed to the civic purposes of higher education.

The movement has, in part, focused on producing graduates for a civil society. The AASCU American Democracy Project which spans 144 member institutions, for example, grew out of 'a concern about decreasing rates of participation in the civic life of America in voting, in advocacy, in local grassroots associations, and in other forms of civic engagement that are necessary for the vitality of our democracy' (AASCU, 2005). There has also been an associated emphasis on increasing student volunteering and 'service learning':

College students are more civically engaged than they were five years ago, and the time they spent volunteering last year was worth \$4.45-billion to the communities they served, according to a survey report released last week by Campus Compact, a nonprofit group that advocates for student involvement in public service.

(Campus Compact, 2005)

The movement has also focused, however, on the broader community or public engagement role of universities. The Kellogg Commission (2001) argues that the 'engaged university' must put its critical resources (knowledge and expertise) to work on the problems the communities it serves faces. It highlights the 'panoply of problems' requiring the application of new knowledge, including: agriculture and food; rural America; health care; urban revitalisation and community renewal; children, youth and families; and environment and natural resources. It notes that 'the lack of stable funding for engagement remains a critical problem' (p. 17).

The AASCU (2002) has built on the findings of the Kellogg Commission to develop a guide for leading public engagement at State colleges and universities. The AASCU offers the following definition of the publicly engaged institution:

The publicly engaged institution is fully committed to direct, two-way interaction with communities and other external constituencies through the development, exchange, and application of knowledge, information, and expertise for mutual benefit.

(AASCU, 2002; p. 9)

It notes that, in contrast to the research mission which is deeply embedded in university cultures, systems and structures, 'public engagement remains on many campuses very fragile and person-dependent' (p. 8).

Canada

The Association of Universities and Colleges of Canada (2005) has developed a model of knowledge transfer with the following multiple inter-related dimensions:

- commercialisation of research;
- expert advice and consulting;
- community service and outreach;
- public policy engagement;
- inter-sectoral partnerships;
- publications and presentations;
- socio-economic development; and
- graduates.

The model identifies 10 significant benefits for Canadians, including:

- a competitive and innovative economy;
- a healthy population and a sustainable health system;
- a sustainable environment;
- a cohesive, diverse and inclusive society;
- an informed and engaged citizenry; and
- responsive and responsible government.

Australia

There is a longstanding expectation that Australian universities and PFRAs will contribute, through knowledge transfer, to the economic, social and environmental development of Australia. Many University Acts, for example, explicitly compel institutions to not only undertake teaching and research, but to also fulfil a range of community service and regional development functions. The Acts governing PFRAs place an explicit focus on their role in encouraging or facilitating the application of their research and on working in co-operation with a wide range of organisations and government agencies in carrying out research.

The issue of knowledge transfer, however, has recently attracted heightened attention particularly with regard to the university sector. The Research Quality Framework initiative has escalated the debate about the preferred definition of knowledge transfer and associated public policy and funding priorities. We sought the views of key stakeholders in the consultation phase of this project, and these are summarised in Appendix 2.

In addition, there has also been considerable commentary on the topic of 'engagement' in the public domain, which is briefly outlined below.

Higher education and science peak bodies

In January this year, the AVCC released its proposal for a national engagement programme where:

Engagement focusses on universities' application of research, teaching and scholarship in partnership with the needs of business and communities. It can also focus on specific projects designed to generate social and economic benefits within its community of interest. In both cases the outcomes are reflected back into the refinement of university programs to ensure their continued relevance.

(AVCC, 2005; p. 4)

The primary objective of the proposed national engagement programme is to 'enhance the level and effectiveness of collaboration between universities and business, governments, professions and regional and other communities'. It is intended to increase the capacity of universities to use the skills and knowledge of their staff and students, and their built environments and facilities, towards greater knowledge transfer, wealth creation and health, environmental and social wellbeing across the community. The AVCC argues that incentive, in the form of a dedicated block grant programme, is needed to assist universities to continue to build their level of engagement.

Similar perspectives on university engagement have been expressed by the IRU Australia in its Discussion Paper on the third mission of universities – business and community engagement, outreach and regional development - aimed at building a case for the establishment of a dedicated funding programme in Australia (IRU Australia, 2005). In particular, it argues that the commercialisation of research is already supported through Commonwealth and State government funding programmes and services, and that the real area of need is for funding that recognises 'the value and cost of what universities can and do offer that is not likely to have commercial potential and which currently does not attract public funding' (p. 4).

In a July 2005 article, the then President of FASTS argued there is a strong and growing case for new funding to support 'forms of knowledge transfer where universities share their knowledge widely to communities and industry to enhance

economic, cultural or regional development, industry/business linkages or sustainability' (Barlow, 2005). He also put forward the following view in relation to the scope of 'third stream' activities:

While third stream activities have an important role in a comprehensive approach to economic development and commercialisation, they must not become a mere subset of such policy. There is a strong imperative to legitimise the considerable benefits to regional, environmental and cultural development through wholesale diffusion of 'public good' knowledge in, for example, environmental sciences, arts and social sciences.

(Barlow, 2005)

Other higher education groups

The level of interest in Australia in further developing the concept of 'engagement' is demonstrated through the formation of a number of alliances. The Australian Universities' Community Engagement Alliance (AUCEA), for example, was formed in September 2003:

AUCEA is an alliance of Australian universities committed to university-community engagement in order to promote the social, environmental and economic and cultural development of communities. AUCEA promotes direct and mutually beneficial interaction between universities and communities that is essential for the development and application of knowledge and the shaping of our future citizens.

(AUCEA, 2006)

The Australian Consortium on Higher Education, Community Engagement and Social Responsibility, launched in 2003, is aimed at developing the capacity of a national network of established academics and early career researchers in order to interrogate community engagement in theory and application.

Governments

The Department of Transport and Regional Services (DOTARS) has been promoting the importance of university and community engagement for a number of years. It defines good practice in engagement as follows:

Good practice in engagement means a relationship involving mutual learning and knowledge exchange, where roles and expectations coincide, and which addresses objectives that are important both locally and institutionally.

A successful engagement generates creative solutions to identified priorities. This is done through the mobilisation of ideas, expertise and processes of learning available in both the university and the community.

(DOTARS, 2005)

DOTARS commissioned a study in 2002 to collate case studies of university and community engagement. In a submission to the Higher Education Review (Garlick, 2002), one of the authors of the study report, noted a continuum of engagement

practices: the fully engaged university; the partially engaged university; and the non-engaged university. The study found that most universities fell into the 'non-engaged' category, while the 'partially engaged' category was more prevalent and only a small number of universities rated as 'fully engaged'.

Garlick argues:

Apart from local government authorities, tertiary education institutions represent the only organisational entity with the independence, critical mass, skills, information and networks consistently represented in many of the regions...

Both the substance and the form of the newly emerging relationships between communities and their university campuses is now being shaped by the need for 'real' partnership and 'real' regional community outcomes, rather than simple geographic equity concerns that influenced the regionalisation of campuses in the early and mid 1990s. There are now a number of pressures pushing for these new and deeper sets of relationships between universities and their regional communities.

(Garlick, 2002; p. 3)

He comments that existing higher education and regional development policies and funding programmes have not supported partnership-building at the community level, and may in fact be counterproductive in this regard. For example, the regionalisation of university structures over the past decade has created a system of vulnerable campuses located in vulnerable regions, making unfunded partnerships difficult to sustain.

The Victorian Government recently commissioned a survey of universities: *Australian Universities as Sites of Citizenship and Civic Responsibility (Victoria)*. The report of the survey findings concludes in its executive summary:

The recent history of university-community engagement initiatives in Victoria highlights the importance of community engagement partnerships (i) in defining university identity; ii) as a foundation stone for high quality teaching and research; iii) in delivering social and economic benefits to local and regional communities and iv) in providing the essential social and physical infrastructure for thriving, sustainable cities and regions...

There is an urgent need for the current national debate on the purpose of Australian universities to include their role in working with and for local, regional, national and international communities.

(Winter, Wiseman and Muirhead, 2005; p. 3)

The study scoped the breadth of engagement activities undertaken by universities in Victoria, including: economic; business and industry; teaching and learning (particularly through industry or work placements and volunteering); research; social and cultural; and schools.

In its key findings, the report of the study also noted:

- Significant inter-university diversity in engagement strategies and emphasis.
- Teaching and research remain core to university-community engagement.
- There is a 'risk that the educational, social and economic benefits of community engagement will be undermined by higher education policies which emphasise competitiveness, commercialisation and cutbacks' (p. 6).

Some State governments have entered into partnerships with universities aimed at enhancing knowledge transfer for the benefit of the State. This is discussed further in Chapter 4 of the main body of the report.

Knowledge transfer processes

The framework of knowledge transfer processes recently proposed by Howard Partners (2005a) (i.e. knowledge diffusion, knowledge production, knowledge relationships and knowledge engagement), and presented in summary in Appendix 3 in the context of the narrow concept of knowledge transfer, is equally applicable to the broader concept of knowledge transfer.

While the framework was developed specifically with reference to knowledge transfer for commercial benefit, it applies equally as well to the broader concept of knowledge transfer. Even the 'knowledge production' process has applicability to the broader concept of knowledge transfer. For example, in some specific instances, knowledge targeted at human or social wellbeing benefits may be most effectively absorbed by the community through marketed products (the CSIRO Total Wellbeing Diet publication⁷ and the Triple P: Positive Parenting Program⁸ are examples of this).

The important point is this: just as the commercial benefits of knowledge transfer are realised through a complexity of channels and mechanisms, so to are the other material, human, social and environmental benefits of knowledge transfer.

Similarly, the role of knowledge exchange networks or 'communities of practice', as discussed in Appendix 3, applies equally to the narrow and broader concepts of knowledge transfer.

⁷ See <http://www.csiro.au/csiro/channel/pchaj...html>

⁸ See http://www.pfsc.uq.edu.au/02_ppp/ppp.html

Measuring knowledge transfer

While the 'science' of measurement in knowledge transfer with a commercial focus is in its infancy, it is almost non-existent with respect to knowledge transfer with a non-commercial focus. Difficulties in the measurement of knowledge transfer for non-direct commercial benefit to universities and PFRA's have been associated with a tendency for public policy to inappropriately focus on a narrow set of knowledge transfer outcomes.

Hatakenaka (2005) also cautions against the simplistic use of performance metrics for knowledge transfer more broadly:

The most fundamental reason for not using such simple metrics at this stage in the development of third stream activities is that the approach would not be likely to help inculcate the culture change that needs to pervade the institution. In fact there is a risk of the very reverse: encouraging the establishment of separate 'third stream' units focused on meeting the metrics, which would shield the academic community from the very culture changes that need to be made.

(Hatakenaka, 2005; p. 4)

He argues three practical reasons for not using simplistic metrics at this stage in the development of the 'third stream' culture:

- 'Third stream' activities are still at an early stage of development – best practice and impacts are not well understood and it is too early to begin to reward some types of activities and not others.
- 'Third stream' activities are meant to be diverse as each university should respond to external needs in its own way reflective of its core strengths, and each discipline will make its contributions in different ways – simple metrics may serve to 'straightjacket' institutions.
- Most performance metrics are too crude to reflect true impact and cannot function effectively as incentives for institutions.

The volume of external income may, for instance, reflect the kind of clientele the university serves rather than the intensity of demand or the success of the university: different users come with different abilities to pay (p. 15).

Considerable work has been progressing overseas in the area of measurement and assessment of 'engagement' or knowledge transfer (Molas-Gallart et al, 2002; Committee on Institutional Cooperation, 2005; The Higher Learning Commission, 2003).

Holland (2005) reports that the Carnegie Foundation will shortly be revising its influential *Carnegie Classification of Institutions of Higher Education* to include measures of 'engagement'. This scheme will be voluntary during the pilot phase,

with the intention of identifying a few measurable indicators that all institutions could collect and report.

Some Australian universities have also been exploring approaches to the measurement of 'community engagement' (Adams et al, 2005). We also note that the Australian Universities Quality Agency assesses the quality of community engagement activities in its audits of Australian universities.

In examining the impact of publicly funded research, the Allen Consulting Group (2005a) suggests that the impact of publicly funded research is 'likely driven by some combination of the quality research and the extent to which knowledge is diffused to end users of the research' (p. 40). The Group's report argues that the relative importance of quality and diffusion in determining future impact may differ by type and field of research, and similarly, the appropriate indicators to measure quality and diffusion paths may also differ. It outlines a range of possible indicators of diffusion:

Indicators of diffusion that may relate to impacts

Field	Diffusion indicators that may relate to impacts
Physical and biological sciences	<ul style="list-style-type: none"> • Presentations given at industry sponsored conferences • Presentations given at academic conferences • Presentations given at learned societies • Distribution of research newsletters to industry stakeholders • Meetings attended with potential industry adopters of research • Results from surveys of government and industry research managers as to who they regard as 'high impact' academic researchers • The number of research students that are subsequently employed within industry.
Humanities and social sciences	<ul style="list-style-type: none"> • Presentations given at learned societies • Presentations given at academic conferences • Submissions made to government inquiries • Citations of research in government policy publications • Citations of research in court judgements • Articles published in the popular press • Research cited in articles in the popular press • Results from surveys of heads of policy sections in government departments as to who they regard as 'high impact' academic researchers • The number of research students that are subsequently employed within government departments, Ministerial offices and industry.

(Allen Consulting Group, 2005a; p. 41-43)

Current incentives and barriers to knowledge transfer

There is little research available in relation to the incentives and barriers to knowledge transfer with a non-commercial focus. Based on our desktop research and consultations, however, the following incentives and barriers appear to apply.

Demand-side incentives and barriers

Incentives

- Access to expertise and knowledge, including world best practice.
- Access to networks that extend beyond the university or PFRA.
- Access to free services (e.g. student projects).
- Opportunity to inform curriculum development and contribute to the production of graduates aware of human, social and environmental issues.

Barriers

- Lack of cohesiveness of community groups and relevant agencies in terms of capacity to define issues and work together towards solutions.
- Some community groups' sense of intimidation by the size and status of universities and PFRA_s.
- Lack of capacity, or resistance, to paying for knowledge transfer services.

Supply-side incentives and barriers

Incentives

- University and PFRA desire for relevance to the community.
- Access to 'real world' research problems, subjects and funding.
- Flow-on benefits to students through relevant curriculum, work placements, applied research.

Barriers

- Funding constraints, leading to a focus on teaching and research and knowledge transfer activities that will generate income.
- Relative invisibility of community engagement as a priority in organisational policies, structures and reward systems.

- Workload allocation and promotion policies in universities that emphasise core teaching and research contributions rather than community engagement.
- The complexities associated with knowledge transfer partnerships concerned with social issues and problems, including the multitude of players that need to be engaged.
- Lack of financial viability of some knowledge transfer activities with some user communities unable or unwilling to pay the 'full costs' of the services, even when there are obvious public benefits.

Appendix 5: National research priorities and goals

Research Priorities and Goals	Commercial benefit as the principal focus	Other material, human, social or environmental benefit as the principal focus
<p>AN ENVIRONMENTALLY SUSTAINABLE AUSTRALIA</p> <ol style="list-style-type: none"> 1. Water – a critical resource 2. Transforming existing industries 3. Overcoming soil loss, salinity and acidity 4. Reducing and capturing emissions in transport and energy generation 5. Sustainable use of Australia’s biodiversity 6. Developing deep earth resources 7. Responding to climate change and variability 	<p style="text-align: center;">√</p> <p style="text-align: center;">√</p> <p style="text-align: center;">√</p> <p style="text-align: center;">√</p> <p style="text-align: center;">√</p> <p style="text-align: center;">√</p>	<p style="text-align: center;">√</p> <p style="text-align: center;">√</p> <p style="text-align: center;">√</p> <p style="text-align: center;">√</p> <p style="text-align: center;">√</p> <p style="text-align: center;">√</p>
<p>PROMOTING AND MAINTAINING GOOD HEALTH</p> <ol style="list-style-type: none"> 1. A healthy start to life 2. Ageing well, ageing productively 3. Preventive healthcare 4. Strengthening Australia’s social and economic fabric 		<p style="text-align: center;">√</p> <p style="text-align: center;">√</p> <p style="text-align: center;">√</p> <p style="text-align: center;">√</p>
<p>FRONTIER TECHNOLOGIES FOR BUILDING AND TRANSFORMING AUSTRALIAN INDUSTRIES</p> <ol style="list-style-type: none"> 1. Breakthrough science 2. Frontier technologies 3. Advanced materials 4. Smart information use 5. Promoting an innovation culture and economy 	<p style="text-align: center;">√</p> <p style="text-align: center;">√</p> <p style="text-align: center;">√</p> <p style="text-align: center;">√</p> <p style="text-align: center;">√</p>	
<p>SAFEGUARDING AUSTRALIA</p> <ol style="list-style-type: none"> 1. Critical infrastructure 2. Understanding our region and the world 3. Protecting Australia from invasive diseases and pests 4. Protecting Australia from terrorism and crime 5. Transformational defence technologies 		<p style="text-align: center;">√</p> <p style="text-align: center;">√</p> <p style="text-align: center;">√</p> <p style="text-align: center;">√</p> <p style="text-align: center;">√</p>

Appendix 6: Existing Australian Government funding programmes supporting knowledge transfer

The approach to mapping and tabulating existing programmes

For each identified Australian Government funding programme supporting knowledge transfer, the following descriptors have been utilised in the summary tables presented in Chapter 3 of the first volume of the report:

Descriptor	Explanation
Government Funding	The Australian Government funding allocated to the programme, and where appropriate, the average quantum of funding available per annum. The maximum or range of funding available per project is also provided where available. It is important to highlight that funding levels are not directly comparable across programmes as they relate to different time periods and conditions, however, they do provide an indication of the relative size of the programmes.
Research sector participants	Indicates whether universities, PFRA's or both are participants in funded projects.
Who can apply?	Indicates which organisations are entitled to apply for funding.
No. Funded	The number of separate projects funded.
Targeted non-academic users of knowledge	The principal audiences external to universities and PFRA's that are targeted by the programme.
Commercial benefit the primary focus?	Indicates whether the programme is targeted, in the first instance, at enhancing the success of commercial enterprises (either the commercial arms or spin-off companies of universities and PFRA's or industry and business more broadly).
Other material, human, social or environmental benefit the primary focus?	Indicates whether the primary focus of the programme is not targeted, in the first instance, at enhancing the success of commercial enterprises.

Descriptor	Explanation
Knowledge Transfer Processes (adapted from Howard Partners) ⁹	Indicates whether the programme places a primary, secondary or no substantial emphasis on each category of knowledge process.
Knowledge access Knowledge production Knowledge relationships Knowledge engagement	Primary emphasis (◆) Secondary emphasis (◇) No substantial emphasis (blank)
Unmet demand?	Where available, information relating to 'demand and supply' for the programme is provided.

Descriptions of existing programmes and the rationale for our mapping decisions

Funding programmes administered through the Education, Science and Training portfolio

Cooperative Research Centres (CRC) Programme

The information presented in this section has been drawn from the CRC Programme website and the 2006 Selection Round Guidelines for Applicants which is published on the website¹⁰.

The objective of the CRC Programme is:

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

The CRC Programme was established in 1990 to improve the effectiveness of Australia's research and development effort. It links researchers with industry to focus R&D efforts on progress towards utilisation and commercialisation. The close interaction between researchers and the users of research is a key feature of the programme. Another feature is industry contribution to CRC education programmes to produce industry-ready graduates.

Following the latest selection round in 2004, there were expected to be 72 CRCs operating in 6 sectors: environment, agriculture and rural based manufacturing, information and communications technology, mining and energy, medical science and technology, and manufacturing technology.

⁹ These are explained briefly in Chapter 2 of Volume 1.

¹⁰ See <https://www.crc.gov.au/Information/default.aspx>, accessed 7 February 2006.

There is no set upper or lower limit of funding available for each applicant under the CRC Programme, however, applications for funding of less than \$2 million per year (or \$500,000 per year for applicants for supplementary funding) are unlikely to be competitive. Applications may be for any period up to 7 years. The amount of funding provided to new CRCs in the 2004 round ranged between \$20 million and \$40.25 million over 7 years. Supplementary funding ranged from \$1.65 million over 3 years to \$4.93 million over 5 years.

There is no restriction on the fields of research that may be included in a CRC, but every CRC must include some research in the natural sciences or engineering.

Applications (other than supplementary funding applications) must involve all of the following: undertaking research, commercialisation/utilisation activities and education and training activities (including a PhD programme).

Applications at Stage 2 of the selection process must include firm commitments of cash and/or in-kind contributions from participants that will at least match the amount of funding sought from the CRC Programme over the funding period. Firm commitments by individual participants may be for some or all of the years of the funding period.

Mapping criteria

We have categorised the CRC programme as having a focus on knowledge transfer for commercial benefit and a focus on other material, human, social and environmental benefit, depending on the CRC.

Examples of CRCs with a focus on commercial benefit include:

- Cotton Catchment Communities CRC;
- CRC for Wood Innovations;
- CRC for microTechnology; and
- Australian Photonics CRC.

Examples of CRCs with a focus on other material, human, social or environmental benefits include:

- CRC for Aboriginal Health;
- CRC for Asthma and Airways; and
- CRC for Coastal Zone, Estuary and Waterway Management.

In addition, we have judged that the programme places a primary emphasis all four of the knowledge transfer processes (once again, with some likely variations across CRCs). We have made this judgement for the following reasons:

- Knowledge access - Education and training activities are a vital component of the activities of CRCs.

- Knowledge production - the CRC programme emphasises the commercialisation of research and this is often achieved through spin-off companies etc.
- Knowledge relationships - the CRC programme generally requires the partners to enter into joint ventures through incorporation of the CRC, and to contribute cash and/or in-kind contributions.
- Knowledge engagement - the CRC programme aims to build sustainable long term alliances aimed at mutual benefit.

Collaboration and Structural Reform Fund

The information presented in this section was drawn from the DEST website¹¹.

The objective of the Collaboration and Structural Reform Fund (CASR) is to achieve better higher education outcomes in teaching, learning, research and innovation by promoting structural reform and collaboration in the sector. Structural reform involves large scale change that aims to significantly improve performance and the achievement of outcomes at the level of individual institutions or the higher education system as a whole.

The priorities for collaboration which applied to the initial 2005 funding round were:

- in course provision between two or more providers;
- between vocational education and training provider/s and higher education provider/s in course provision or an area related to teaching and learning;
- between universities and their communities, particularly regional communities; and
- between universities and business/industry/employers or professional associations.

Accordingly, it can be argued that the Fund is not universally targeted at knowledge transfer, but may support some knowledge transfer initiatives.

At the time of its inception, the funds planned to be allocated under the CASR Fund were \$13.1 million in 2005, \$13.3 million in 2006 and \$10.9 million in 2007. In the 2005 round, 10 of the 150 applications received were successful, attracting \$3.9 million in total.

The priorities of the CASR Fund are currently being reviewed prior to the call for applications for the second funding round. It is proposed to amend the funding priority areas to focus more on structural change in the sector (e.g. institutional

¹¹http://www.dest.gov.au/sectors/higher_education/programmes_funding/programme_categories/key_priorities/collaboration_and_structural_reform_fund.htm, accessed 6 February 2006.

mergers) and projects that address national skills shortages especially in the areas of science, health and engineering.

Mapping criteria

With respect to the knowledge transfer aspects of the Collaboration and Structural Reform Fund, we have categorised the Fund as having a focus on knowledge transfer for other material, human, social and environmental benefit as the emphasis of most relevant funded collaborations has been on building human capital through education and training. While some of the funded collaborations are aimed at knowledge transfer partnerships with industry and business, their immediate aims are to enhance skills rather than to commercialise knowledge.

With respect to knowledge transfer processes, we have judged that there is a primary emphasis on:

- Knowledge access - Many funded projects are aimed at aligning academic and industry/business knowledge bases for leading-edge education and training.
- Knowledge engagement - Many of the funded collaborations are aimed at building sustainable relationships that will deliver mutual benefits over the longer term.

We have also judged there to be a secondary emphasis on:

- Knowledge relationships - some projects require partners to provide cash or in-kind contributions, suggesting some form of loose 'contractual' agreement for knowledge services.

Australian School Innovation in Science, Technology and Mathematics (ASISTM) Programme

The information presented below was sourced from the *Backing Australia's Ability* website¹² and the ASISTM page on the DEST website¹³.

This Programme is intended to raise the scientific, mathematical and technological literacy and the innovative capacity of Australian school students, to create learning environments from which more world-class Australian scientists and innovators will emerge, and to provide impetus for the development of a new generation of excellent teachers of science, technology and mathematics.

The Australian Government is providing a total of \$33.66 million for ASISTM projects, over 2004-05 to 2010-11.

School projects involve building school clusters (school partnerships with other schools, science organisations, tertiary education institutions, teacher professional

¹² <http://backingaus.innovation.gov.au/2004/skills/boosting.htm>, accessed 6 February 2006.

¹³ http://www.dest.gov.au/sectors/school_education/programmes_funding/programme_categories/key_priorities/asistm/, accessed 7 February 2006.

associations, business and industry, and the broader community), thereby:- providing teachers and students with access to wider world expertise, activities and resources; fostering better coordination of teaching and learning between primary and secondary schools; and helping to connect science, technology and mathematics teaching and learning with other disciplines.

Over the seven year life of the Programme, a total of about 1,300 tertiary students, researchers and other specialists in science, technology and mathematics are expected to be engaged for a limited duration as an integral part of ASISTM school projects.

Leadership of ASISTM school projects is provided either by a nominated school or other project partner. School clusters will typically consist of 4 to 12 schools and other non-school partner organisations, with examples of the latter including:

- science, technology and mathematics organisations (eg museums, hospitals and environmental organisations);
- teacher and principal professional organisations;
- tertiary education institutions; and
- industry and the broader community.

Individual school cluster initiatives may apply for ASISTM funding in the indicative range of \$20,000 to \$80,000, with most successful proposals expected around the middle of that range. Most projects are expected to be completed over a period of 12-18 months.

Mapping criteria

The programme is aimed at building human capital through enhanced science, technology and mathematics education, and we have accordingly categorised it as having a focus on knowledge transfer for other material, human, social and environmental benefit. In addition, in our judgement, the programme has a primary emphasis on the 'knowledge access' process, aiming to make academic knowledge available to promote innovative approaches and cultures in schools.

Due to the short duration of funded projects, we have judged that the programme does not have an emphasis on 'knowledge engagement' (which infers a longer term alliance for mutual benefit). The lack of emphasis on 'selling' knowledge or services has also led us to judge that the programme has no emphasis on 'knowledge production' or 'knowledge relationships'.

Australian Research Council (ARC) Linkage programme

The information presented in this section is drawn principally from the programme funding rules¹⁴, the selection reports¹⁵ published on the ARC website and information provided by the ARC.

The ARC's Linkage programme comprises a number of schemes, all of which are intended to support the objective of brokering research partnerships within the Australian innovation systems and capturing the economic, social and cultural benefits of research. *Linkage Projects*, *ARC Research Centres* and *ARC Research Networks* are among the Linkage schemes whose objectives specifically include interaction with actual or potential users of research outcomes.

Total funding for the ARC Linkage programme in 2005/06 is \$261.1 million, more than double the level of funding provided in 2001.

Linkage Projects

The objectives of *Linkage Projects* are to:

- Encourage and develop long-term strategic research alliances between higher education organisations and other organisations, including within industry, in order to apply advanced knowledge to problems and/or to provide opportunities to obtain national economic, social or cultural benefits.
- Support collaborative research on issues of benefit to regional and rural communities.
- Enhance the scale and focus of research in National Research Priorities.
- Foster opportunities for postdoctoral researchers to pursue internationally competitive research in collaboration with organisations outside the higher education sector, targeting those who have demonstrated a clear commitment to high-quality research.
- Provide outcome-oriented research training to prepare high-calibre postgraduate research students.
- Produce a national pool of world-class researchers to meet the needs of the broader Australian innovation system.

The minimum level of funding which will be provided by the ARC for a project is \$20,000 per annum. Generally, the maximum level of ARC funding for a project is \$500,000 per annum. Funding for projects may be awarded for 1 to 5 years, subject to sufficient funding being available for *Linkage Projects*, and the provisions of the ARC Act.

¹⁴ http://www.arc.gov.au/grant_programs/default.htm, accessed 7 February 2006.

¹⁵ http://www.arc.gov.au/funded_grants/default.htm, accessed 7 February 2006.

Proposals must contain a partner organisation contribution, in cash and/or in kind:

- For Proposals which do not involve a request for an APAI stipend, the combined Partner Organisation contributions, in cash (i.e. funds to be transferred to the Administering Organisation) or in kind (i.e. other eligible contributions of resources), must at least match the total amount sought from the Commonwealth.
- If a Proposal is seeking on average \$50,000 or more per year from the Commonwealth, the combined Partner Organisation contribution in cash must be at least 20 per cent of the total amount sought from the Commonwealth.
- If a Proposal is seeking on average \$500,000 or more per year from the Commonwealth, the combined Partner Organisation contribution in cash must be at least 50 per cent of the total amount sought from the Commonwealth.

Between 2002 and 2005, the average ratio of partner organisation to ARC funding as measured across the life of the project ranged between 1.6 and 1.4, indicating a willingness by partners to contribute significantly greater amounts to projects than required in ARC project rules.

Mapping criteria

We have categorised the Linkage programme as having a principal focus on knowledge transfer for commercial benefit for some projects, and a principal focus on knowledge transfer for other material, human, social and environmental benefits for other projects. A scan of projects funded under the latest round provides examples of projects undertaken in partnership with private companies, with a clear focus on the commercialisation of findings and other examples of projects undertaken in partnership with government and not-for-profit organisations to improve human, social and environmental wellbeing.

With respect to knowledge transfer processes, we have categorised the programme as placing a primary emphasis on:

- Knowledge access – a primary goal of the programme is to make knowledge accessible for application in real world settings.
- Knowledge engagement – a primary goal of the programme is to develop and encourage long-term strategic research alliances.

We have also categorised the programme as placing emphasis on:

- Knowledge production – many projects are aimed at the achievement of commercial benefits for the university or PFRA, as well as the partner(s).
- Knowledge relationships – the cash and/or in kind contribution of partners facilitates the provision of knowledge services.

ARC Research Centres

ARC Centres of Excellence

The ARC established the *Centres of Excellence* scheme to create the scale and focus necessary to maintain and develop Australia's international standing in Australia's areas of research priority. Through highly innovative research that addresses challenging and significant problems within the priority areas, these Centres will build national research capability and produce outcomes of economic, social and cultural benefit to Australia.

The objectives of the *ARC Centres of Excellence* scheme are to:

- Undertake highly innovative research at the forefront of developments within areas of national importance, with a scale and a focus leading to outstanding international and national recognition.
- Enhance the scale and focus of research in designated National Research Priorities.
- Promote research that will enhance Australia's future economic, social and cultural wellbeing.
- Link existing Australian research strengths and build new capacity for interdisciplinary, collaborative approaches to address the most challenging and significant research problems.
- Build Australia's human capacity in a range of research areas by attracting, from within Australia and abroad, researchers of high international standing as well as the most promising research students.
- Provide high-quality postgraduate and postdoctoral training environments for the next generation of researchers in innovative and internationally competitive research.
- Offer Australian researchers access to world class infrastructure and equipment, and to key research technologies.
- Develop relationships and build new networks with major international Centres and research programs that help achieve global competitiveness and recognition for Australian research.
- Establish Centres of such repute in the wider community that they will serve as points of interaction among higher education institutions, Governments, industry and the private sector generally.

Funding for ARC Centres of Excellence is usually between \$1,000,000 and \$3,000,000 per annum for five years, subject to parliamentary appropriation. Applicants are encouraged to maximise the impact of ARC funding by obtaining additional financial contributions (either cash or in-kind) from other sources, such as

State/Territory Governments, industry partners, venture capital firms and similar bodies.

ARC Special Research Centres

Special Research Centres are funded by the ARC on the basis of research excellence and potential to contribute to the economic, social and cultural development of Australia. Subject to satisfactory performance, the Special Research centres have been funded for nine years. Although the ARC does not fund new Centres under this scheme, it continues to fund many excellence Centres.

The objectives of the *Special Research Centres* scheme have been to:

- Establish concentrations of research workers and resources in Australian higher education institutions.
- Encourage the pursuit of excellence in research, as measured at national and international levels.
- Establish Centres that will act as major linkages to international centres and programmes.
- Provide high-quality research environments for postgraduate research education and postdoctoral training.
- Promote research in areas of national importance which will enhance Australia's future economic, social and cultural wellbeing.
- Establish Centres of such repute in the wider community that they will serve as points of interaction among higher education institutions, the Government, industry and the private sector generally.

Funding for Special Research Centres is usually between \$600,000 and \$1,000,000 per annum for up to nine years, subject to a satisfactory performance review every three years and parliamentary appropriation. Special Research Centres are encouraged to seek additional financial support from other sources, such as State/Territory Governments, industry partners and similar bodies. The last year of funding for these Centres is 2008. No new Special Research Centres are being funded by the ARC.

ARC Co-Funded Centres

The ARC, in partnership with other Australian Government agencies, co-funds three large Centres – the Biotechnology Centre of Excellence (the Australian Stem Cell Centre); the ICT Centre of Excellence (National ICT Australia); and the Australian Centre for Plant Functional Genomics. The overall purpose in funding these Centres is to ensure Australia is a participant in key emerging technologies.

ARC funding for the Australian Stem Cell Centre will total \$50,000,000 over nine years, subject to parliamentary appropriation.

ARC funding for National ICT Australia will total \$183,450,000 over nine years, subject to parliamentary appropriation.

ARC funding for the Australian Centre for Plant Functional Genomics will total \$10,000,000 over five years, subject to parliamentary appropriation.

All Co-Funded Centres are encouraged to seek additional financial support from other sources, such as State/Territory Governments, industry partners and similar bodies.

Mapping criteria

We have categorised the Research Centres schemes as having a principal focus on knowledge transfer for commercial benefit in some cases, and a principal focus on knowledge transfer for other material, human, social and environmental benefits in other cases.

With respect to knowledge transfer processes, we have categorised the schemes as placing a primary emphasis on:

- Knowledge access – a primary goal of the schemes is to serve as points of interaction among researchers, research users and the wider community.
- Knowledge engagement – a primary goal of the schemes is to develop and encourage long-term strategic research alliances, including internationally.

We have also categorised the programme as placing emphasis on:

- Knowledge production – all Centres expect to be able to commercialise the intellectual property they develop.
- Knowledge relationships – the provision of knowledge services to non-partners is facilitated by the cash and/or in kind contribution of partners who have a contractual relationship with the Centre which may encompass the supply of knowledge services.

ARC Research Networks

ARC Research Networks are intended to assist groups of researchers to coordinate and communicate their research activities across disciplinary, organisational, institutional and geographical boundaries. Without duplicating established co-ordination bodies and mechanisms, they favour research concentrations that encourage and support:

- Open exchange of information and sharing of resources.

- Development and implementation of coherent and integrated research plans among researchers working independently and in small teams on topics of common interest.
- Efforts to nurture the careers of young investigators and research students by promoting a sense of community, collaboration and strong, effective mentoring, and encouraging them to shape the future direction of the research fields.
- Links with actual and potential end users, and with the broader community, especially in respect of the development of research plans, the absorption of international and national know-how, and the adoption of new discoveries made by researchers in the Network.

The following are examples of costs supported under Research Networks:

- personnel salaries and on-costs, including the Network Convenor, research associates, administrators and specialist professional staff;
- development or purchase of shared research resources that would not be eligible for funding by other ARC schemes, such as databases; and
- activities bringing people together, including workshops and planning, co-ordination and outreach activities.

The Programme does not fund research activity *per se*.

The maximum ARC financial assistance for a Network funded under Research Networks is \$500,000 per annum. Applications requesting less than \$100,000 per annum are discouraged, since they are unlikely to be competitive in scope and vision. Research Networks financial assistance may be awarded for up to five years, subject to parliamentary appropriation.

To support the effort of planning and preparing full ARC Research Networks proposals, the ARC provided seed funding from its Special Research Initiatives Program. In December 2003, 147 Seed Funding grants were awarded to potential Research Network applicants.

Mapping criteria

We have categorised the programme as having a focus on both knowledge transfer for commercial benefit and knowledge transfer for other material, human, social and environmental benefits. The funded networks span a broad range of topics, many of which have direct applicability to industry application for commercial benefit (e.g. Research Network on Intelligent Sensors, Sensor Networks and Information Processing) and others which are aimed at non-commercial objectives (e.g. The Governance Research Network).

With respect to knowledge transfer processes, in our judgement, the primary emphasis in this programme is on 'knowledge access'. In their first year of operation, most networks appear to be focusing on enabling researcher-to-researcher knowledge relationships. However, many already play a significant role

in brokering end-user access to knowledge and research capability, and this function is likely to increase as they develop.

CSIRO National Flagships Programme

The information presented below has been sourced from the Backing Australia's Ability website¹⁶ and the CSIRO website¹⁷.

The National Research Flagships are partnerships of leading Australian scientists, research institutions, commercial companies, CSIRO and selected international partners.

The six Flagships and their goals are:

- Preventative Health – To improve the health and wellbeing of Australians and save \$2 billion in annual direct health costs by 2020 through the prevention and early detection of chronic diseases.
- Food Futures – To transform the international competitiveness and add \$3 billion annually to the Australian agrifood sector by the application of frontier technologies to high-potential industries.
- Light Metals – To lead a global revolution in light metals, doubling export income and generating significant new industries for Australia by the 2020s while reducing environmental impact.
- Water for a Healthy Country – To achieve a tenfold increase in the social, economic and environmental benefits from water by 2025.
- Energy Transformed – To halve greenhouse gas emissions and double the efficiency of the nation's new energy generation, supply and end use, and to position Australia for a future hydrogen economy.
- Wealth from Oceans – To position Australia by 2020 as an international benchmark in the delivery of economic, social and environmental wealth based on leadership in understanding ocean systems and processes.

In these fields, the national flagships are intended to achieve technological revolution, by discovering, developing, commercialising and applying technologies which dramatically improve performance.

Flagships are large scale collaborative projects that are specifically designed to integrate, focus and direct national scientific resources to address issues of national significance. Flagships are closely aligned to the National Research Priorities.

Each Flagship also serves an industry export cluster, many being new industries. Technology clusters have underpinned the success of Australia's wine, cotton,

¹⁶ http://backingaus.innovation.gov.au/2004/research/csiro_flagships.htm, accessed 7 February 2006.

¹⁷ <http://www.csiro.au/csiro/content/standard/pspg,,.html>, accessed 7 February 2006.

mining technology, information and communications technology (ICT), scientific instrument, medical device and other industries: Flagships are seeking to replicate that success in their sectors.

CSIRO allocated A\$62.3 million directly to the Flagships initiative in 2004/05.

This direct allocation to the Flagships led to co-investment of other CSIRO, research partner and industry funds, more than doubling the total resources available for research to A\$145 million in 2004/05.

The Government has now awarded additional funding of A\$305 million over seven years from 2004/05. The combination of new Government funding, redirected CSIRO funding and external revenue will take the total investment to close to A\$1.5 billion. This makes the Flagship initiative one of the largest targeted scientific research programs in Australia's history.

The Flagship Collaboration Fund has been established with A\$97 million of this additional funding. This fund will further strengthen the collaborative research between universities, CSIRO and other research agencies. The Flagship Collaboration Fund includes a contestable collaborative research program (which offers funding for Flagship Clusters and projects), visiting fellowships and postgraduate scholarships.

Flagships are managed according to the program performance framework which aims to ensure the achievement of program objectives and the appropriate use of resources. The key elements of the performance framework are:

- a focus on objective measures of success and failure at the Flagship, theme and stream levels;
- linkages between annual performance and long-term goals by focussing annual goals on the most critical outputs;
- regular reporting on progress to the Flagship Oversight Committee;
- linkages between scientific outputs and delivery/technology transfer milestones to ensure uptake by industry and/or the community; and
- encouragement of the best use of resources by rapidly redeploying them from projects that are not meeting expected outcomes into more promising areas.

Mapping criteria

We have categorised the programme as having a focus on both knowledge transfer for commercial benefit (e.g. the Food Futures and Light Metals flagships) and knowledge transfer for other material, human, social and environmental benefits. (e.g. the Preventative Health and Water for a Healthy country flagships).

The programme covers all four knowledge transfer processes:

- Knowledge access – academic and partner knowledge is pooled to inform research agendas and apply knowledge to enhance performance.
- Knowledge production – many flagships are intended to accelerate the commercialisation of research-generated knowledge.
- Knowledge relationships – the cash and/or in kind contribution of partners suggests a 'loose' contractual arrangement for the provision of knowledge services.
- Knowledge engagement – through the aim of building long term alliances between research organisations and industry clusters.

Funding programmes administered through the Industry, Tourism and Resources portfolio

The information presented in this section is drawn principally from the 2004-05 Annual Report of the Industry Research & Development Board (Industry Research & Development Board, 2005), as updated by representatives of the Department of Industry, Tourism and Resources.

Pre-Seed Fund (PSF)

The Australian Government announced the Pre-Seed Fund programme as part of *Backing Australia's Ability* to help the commercialisation of research and development undertaken by universities and public sector research agencies. The program encourages the private sector to take a more active role in funding and managing the commercialisation of research from those institutions.

The Pre-Seed Fund program has established four early-stage venture capital funds to invest in projects or companies spinning out from universities or government agencies. The funds are managed by venture capitalists experienced in research commercialisation and the development of sustainable businesses.

These managers acquire an equity interest in the companies or projects, and provide management and technical advice to develop the commercial potential of the technology. The maximum investment in any project or company is \$1 million. It is expected that the managers will eventually divest their interest in successful projects and companies to later-stage investors.

The Government will provide \$72.7 million to the four PSFs which, when combined with capital from private sector investors, universities and public sector research agencies, amounts to \$104.1 million in available funding.

The objectives of the PSFs are to:

- assist the commercialisation of R&D activities undertaken by universities and public sector research agencies by providing financial and managerial advice;

- encourage private sector investment in R&D activities undertaken in universities and public sector research agencies for commercialisation;
- build linkages between universities, public sector research agencies, the finance community and business for the commercialisation of R&D activities;
- build entrepreneurial and intellectual property management skills in Australian universities and public sector agencies; and
- encourage researchers in universities and public sector research agencies to consider the commercial opportunities of their research discoveries.

From the inception of PSF to 30 June 2005, more than 1,100 investment proposals have been received. In 2004-05, \$5.98 million was invested in 17 companies and projects, of which the Government provided \$4.17 million. There were six new investments in 2004-05.

The Pre-Seed Funds commenced in late 2002 and will run for a period of ten years.

Mapping criteria

We have categorised the Pre Seed Fund as focusing on knowledge transfer for commercial benefit through the process of 'knowledge production'.

Innovation Investment Fund (IIF)

The Innovation Investment Fund (IIF) program was announced by the Prime Minister in the Small Business Statement of March 1997. The objectives of IIF are to:

- encourage the development of new-technology companies commercialising R&D, by addressing capital and management constraints;
- develop a self-sustaining, early-stage, technology-based venture capital industry;
- develop fund managers with experience in the early stage venture capital industry; and
- establish in the medium term a 'revolving' or self-funding program.

IIF funds are managed by nine private sector fund managers who have been awarded ten-year licences through two competitive selection processes (held in 1997 and 2000). Fund managers were selected for their skills and experience in managing venture capital investments and their ability to raise matching private capital. They are responsible for all investment decisions, which are made on a commercial basis in accordance with their own investment practices, subject to the IIF Ministerial Directions. The nine licensed funds have total capital of \$358.05 million, of which the Australian Government is contributing \$220.7 million and the private sector \$137.35 million.

At 30 June 2005, the number of investee companies (not including co-investments) for all IIF fund managers increased to 74 and the amount invested since the inception of the program was \$219.8 million, of which the Australian Government

provided \$138.5 million. In the 2004–05 financial year, 31 investee companies (not including co-investments) received funding of \$34.33 million, of which \$19.4 million was provided by the Government. There were eight new investments in 2004–05.

In 2004–05, the Australian Government received returns of \$5.9 million from fund managers GBS Venture Partners, Foundation and AMWIN. As at 30 June 2005, this brings total returns to \$265.5 million, of which the Australian Government has received \$57.6 million. In 2004/05, however, there were some funds for which the valuation of investments was lower than the initial cost.

Companies eligible for investment by IIF fund managers must:

- be commercialising the results of R&D activities;
- have a majority of their employees (by number) and their assets (by value) inside Australia at the time the licensed fund first invests in the company; and
- have an annual revenue of \$4 million or less, averaged over the past two years, with a maximum of \$5 million in either of these years.

Companies supported must also be at the seed, start-up or early expansion stage of their development.

Mapping criteria

We have categorised the Innovation Investment Fund as focusing on knowledge transfer for commercial benefit through the process of 'knowledge production'.

Commercialising Emerging Technologies (COMET)

COMET was established to increase Australia's sustainable economic growth through stimulating the successful commercialisation of Australia's innovation. It provides critical support to increase the prospects for successful commercialisation of innovation developed by individuals, early-growth stage companies and spin-off companies from public or private research institutions. Assistance is provided through access to private sector Business Advisers and a tailored plan of assistance including financial support.

The program has been extended twice and extensively enhanced since it was first announced in November 1999 as a three-year, \$30 million competitive grants program to provide individuals and early-stage growth companies with help in commercialising their technologies. Most recently, changes were announced in the Government's 2004 *Backing Australia's Ability* statement which extended the program to 2010–11 with additional funding of \$100 million.

The enhanced COMET program came into effect from 13 September 2004. Program design changes included a greater focus on universities and public research institutions, further expansion into outer metropolitan and regional areas, and an increase in the number of Business Advisers. Under the new arrangements, the maximum grant is \$120,000.

In 2004–05, the COMET Program Delegate considered 155 new applications (of which 127 were approved) and 63 variation applications for additional financial assistance from existing customers.

Mapping criteria

We have categorised COMET as focusing on knowledge transfer for commercial benefit through the process of 'knowledge production'.

Renewable Energy Development Initiative (REDI)

The Renewable Energy Development Initiative (REDI) is part of the Australian Government's commitment to maintaining a strong and internationally competitive economy with a lower greenhouse gas signature.

The program was announced on 15 June 2004 as part of the white paper, *Securing Australia's Energy Future*, in which the Government outlined its comprehensive approach to addressing the greenhouse gas challenges associated with the production and use of energy.

Renewable energy technology, alongside improving energy efficiency (in energy supply and use) and accelerating energy market reform, are key elements of Australia's overall greenhouse gas response in the energy sector. REDI aims to support the development of new renewable energy technology products, processes or services that have strong early-stage commercialisation and emissions-reduction potential. In supporting such projects, the program will reduce the environmental impact of energy demand, contribute to the international competitiveness of Australian businesses and generate national benefits for the Australian economy.

REDI will:

- Provide matching competitive grants totalling up to \$100 million over seven years to 2010–11 to eligible applicants to undertake new renewable energy projects involving R&D, proof of concept and early stage commercialisation activities.
- Allow all Australian businesses undertaking renewable energy projects a chance to compete for grants of \$50 000 to \$5 million.

Mapping criteria

We have categorised the REDI programme as focusing primarily on knowledge transfer for commercial benefit. In terms of knowledge transfer processes, the programme is focused on 'knowledge production'.

Renewable Energy Equity Fund (REEF)

The Renewable Energy Equity Fund (REEF) is a specialist renewable energy equity fund based on the Innovation Investment Fund (IIF) model. REEF was designed in conjunction with the Australian Greenhouse Office, a division of the Department of

Environment and Heritage, and was announced in the Prime Minister's 1997 statement, *Safeguarding the Future: Australia's Response to Climate Change*.

REEF provides venture capital and managerial advice for smaller scale companies in the early stage of commercialising technologies and services. Examples of technologies being developed are wind power, a hybrid energy storage system for use in waste collection vehicles, long-life batteries for energy storage in remote areas, renewable transport fuels, and renewable geothermal energy from hot dry rocks. The investee company receives capital, managerial expertise and enhanced business reputation as a result of the REEF investment. In return for the provision of capital, the fund manager acquires a part-ownership of the company and usually a seat on the Board of Directors. The Commonwealth contributed \$17.7 million to establish the fund, CVC REEF Ltd, which is matched by private sector funding of \$8.9 million for a total fund of \$26.6 million.

The objectives of REEF are to:

- encourage the development of companies and other incorporated bodies which are commercialising R&D in renewable energy technologies, by addressing capital and management constraints; and
- develop fund managers with experience in the renewable energy industry.

At 30 June 2005, ten investee companies had been supported under the REEF. The amount invested since inception of the program totalled \$12.84 million, of which the Australian Government provided \$8.56 million.

Potential eligible investee companies must be commercialising renewable energy technology; be at the seed, start-up or early expansion stage of development; have a majority of employees and assets inside Australia at the time the licensed fund first invests in the enterprise; and have an average annual revenue over the previous two years of income that does not exceed \$4 million per year and a revenue in either year not in excess of \$5 million. The maximum investment in an investee by CVC REEF Ltd is \$2.66 million.

Mapping criteria

We have categorised the REEF programme as focusing primarily on knowledge transfer for commercial benefit. In terms of knowledge transfer processes, the programme is focused on 'knowledge production'.

Commercial Ready

The Commercial Ready program was announced on 6 May 2004 by the Prime Minister as part of the 2004 *Backing Australia's Ability* package. Commercial Ready is a competitive grants program that provides support for research and development (R&D), proof-of-concept (PoC) and early-stage commercialisation (ESC) activities.

Commercial Ready will provide, from 2004-05 to 2010-11, approximately \$200 million annually in grant funding and is expected to assist around 1 700 small to

medium enterprises (SMEs) over that period. Successful applicants receive 50 cents for each dollar they spend on eligible activities.

Commercial Ready aims to:

- encourage the growth and successful innovation of Australian companies by increasing the level of research and development, proof-of-concept and early-stage commercialisation by Australian businesses;
- increase the international competitiveness of Australian businesses;
- foster greater collaboration between industry and industry and research institutions; and
- generate national benefit for the Australian economy.

Commercial Ready provides grants from \$50,000 up to a limit of \$5 million for eligible projects of up to three years in duration.

Mapping criteria

We have categorised the Commercial Ready as focusing on knowledge transfer for commercial benefit, primarily through the process of 'knowledge production'. We have also judged it as having a secondary emphasis on 'knowledge relationships' as the program creates demand from SMEs for university and PFRA contract research services.

TechFast

The Australian Government has provided through the Department of Industry, Tourism and Resources \$2.5 million in funding to the Australian Institute of Commercialisation (AIC) to support the pilot TechFast programme (due to be completed in June 2006). The following description of the TechFast programme has been extracted from the TechFast website (www.techfast.com.au).

Australian SMEs have experienced challenges in their endeavours to find and adopt new technologies. Only 34% of Australian SMEs, on average, have taken up external technologies compared to over 85% in Europe and the US. To not only remain competitive but to also enter new markets, SMEs must adopt new technologies at a faster rate. SMEs are better positioned to allocate resources to new sectors and meet market demands with more agility and efficiency than larger ones.

TechFast is intended to help established, well performing technology-based SMEs accelerate into larger, sustainable, fast growing businesses that will make a significant contribution to economic growth and development. This will be achieved through fast tracking the adoption by SMEs of external technologies sourced from research organisations.

The program is intended to also provide greater opportunities for participating research institutions to commercialise their research as well as enhancing their overall commercialisation capability. The AIC provides local delivery of

commercialisation improvement services and assistance to the target institution or agency to be served, ensuring skills transfer and improvement of capability.

The TechFast program accelerates and 'de-risks' the transfer and commercialisation of new technology by:

- identifying established, technology-responsive SMEs that have a track record in a sector and are ready to grow;
- sourcing technologies and know-how with commercial potential from research organisations; and
- providing and funding the 'hands-on' advice and support needed to ensure that the process is successful for all parties.

Mapping criteria

We have categorised the TechFast programme as focusing on knowledge transfer for commercial benefit, primarily through the process of 'knowledge access' (i.e. one of the major aims of the programme is to 'accelerate the transfer and diffusion of innovative technology from research organisations to SMEs'). We have also judged it as having a secondary emphasis on 'knowledge relationships', as the program creates demand from SMEs for university and PFRA contract research services, and a secondary emphasis on 'knowledge production', as the partnerships formed through the programme can facilitate the commercialisation of IP by participating universities and PFRA's.

Funding programmes administered through the Health portfolio

The information presented in this section was sourced from the NHMRC website and its Research Grants Funding Policy¹⁸.

NHMRC Development Grants

The NHMRC's Development Grant Scheme aims to:

- support the development of health or medical research that has commercial potential and the potential to benefit the Australian community; and
- provide funding for research commercialisation at the early proof-of-concept stage.

The scheme is pitched at the perceived funding gap between the end of a high quality basic research program and the developments required to make the project commercially attractive to potential investors. The scheme is not intended to be an alternative to the NHMRC Project Grant scheme, nor is it meant to be an alternative to Industry Development schemes.

¹⁸ <http://www.nhmrc.gov.au/funding/apply/granttype/prodevapply.htm>, accessed 6 February 2006.

Applicants are encouraged to have a commercial partner, however this is not essential. A commercial partner may include venture capital firms that have a reliable record of commercial development of innovative Australian research.

Applications must demonstrate a basic understanding of the process and steps to move from research to outcomes that can be commercialised. This includes the process and steps to a market, the nature of the market, the milestones and risks of the venture and an understanding of possible means of handling intellectual property connected with the project.

Development Grants are available to all researchers, based in Australia, working in any field relevant to health.

The grant request will usually not exceed \$200,000 per annum, unless there are exceptional circumstances. Funding will normally be awarded for a period of one year. More than one year of funding may be available subject to satisfactory achievement against agreed milestones.

Mapping criteria

We have categorised this programme as having a principal focus on knowledge transfer for commercial benefit, as it is aimed at the commercialisation of knowledge.

With respect to knowledge transfer processes, we have judged the programme to have a primary emphasis on 'knowledge production' as the aim is for research organisations to derive commercial benefit from their IP.

NHMRC Centre of Clinical Research Excellence Grants

In 2007 the NHMRC will provide a total of \$2 million funding over five years for six Centres of Clinical Research Excellence (CCRE).

The aims of the CCRE grants are to:

- support clinical (human) research with potential to lead to improved health outcomes for the community;
- foster training of clinical researchers, particularly those with a capacity for independent research and future leadership roles; and
- ensure effective translation of research outcomes into clinical practice.

Centres may be actual (i.e. comprising a single physical entity or institute), or virtual (i.e. geographically disparate, linking collaborative research effort from several different organisations).

The grants encourage the following types of collaborations:

- synergistic approaches between basic biomedical sciences and clinical research and/or between clinical research and population health research or health services research;
- collaborative interactions between different clinical disciplines;

- community consultation with relevant groups; and
- processes for consultation and management of health issues relating to Indigenous Australians.

It is intended that Centres be financially sustainable at the end of the five-year funding period.

Mapping criteria

We have categorised this programme as having a principal focus on knowledge transfer for other material, human, social and environmental benefit as its key desired outcome is improved health for the community through excellence in clinical research.

With respect to knowledge transfer processes, we have judged that the primary emphasis of the programme is on 'knowledge access' through aligning the information and knowledge needs of health clinicians with research programmes.

NHMRC Health Services Research Program Grants

The program supports multi-disciplinary research into how financing arrangements, organisational structures and processes, health technologies and social factors affect the quality, cost and availability of, and access to, health care.

Priority is afforded to research which:

- addresses significant gaps in evidence required for Australia 's most important policy and practice issues;
- covers issues related to the Australian Government's National Research Priorities or National Health Priority Areas and or Aboriginal and Torres Strait Islander health and access to health services;
- has the potential to develop new productive partnerships between researchers, policy makers, health service providers and citizens.

In 2003, \$50 million was set aside for up to five calls for health services research grants. The first round has been completed, and successful applicants for the second round are due to be announced in February 2006.

Mapping criteria

We have categorised this programme as having a principal focus on knowledge transfer for other material, human, social and environmental benefit, as it focuses on the achievement of enhanced health services.

With respect to knowledge transfer processes, we have judged the programme to have a primary emphasis on 'knowledge access', as it is targeted at making knowledge accessible to policy makers, health service providers and citizens for application in health service delivery. We have also judged it to have a secondary emphasis on 'knowledge engagement' as the programme gives priority to research

that has the potential to develop new productive partnerships between researchers, policy makers, health service providers and others.