
**Research in the National Interest:
Commercialising University Research in
Australia**

July 2000

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Executive Summary

In February 1999, the ARC received a request from the Minister for Education, Training and Youth Affairs to provide advice to him on a range of incentive and culture factors associated with effective university-industry research commercialisation practices in other countries, with particular reference to the United States and the United Kingdom. In preparing its advice the Council has drawn directly on the outcomes of a number of recently commissioned reports, as well as relevant overseas reports. In the light of their critical importance to achieving higher levels of commercialisation of university research, the Council has focussed in depth on selected issues, such as intellectual property policies and management practices.

Context

As well as a number of cultural and structural barriers, which inhibit higher levels of research commercialisation in Australia and some other countries, there are a number of contextual issues, which can influence a country's performance in commercialising research. The key factors concerning the broad environment in which commercialisation takes place, which can influence this performance in commercialising research, are:

- the quality of the research base and the maintenance of science and technology skills;
- the availability of companies willing and able to take up the results of research;
- the strength of links between the research base and industry;
- availability of venture capital;
- the quality of management skills;
- an appropriate regulatory environment; and
- a competitive business environment.

Australia is regarded as being strong on the first point and to some extent the last two. However, Australia faces a number of difficulties – such as the small size of the home market, the “tyranny of distance” to overseas markets, attracting investment capital (both domestic and foreign), an industrial structure which leans towards low technology jobs, a limited entrepreneurial skills base, the relative immobility of human resources and a lack of industry receptors for R&D, a receptor being a company that has the capacity to understand, develop and bring to market the results of public sector research.

Two comparator countries, Scotland and Canada, share a similar profile to Australia – a large science base, but few companies able to exploit that base.

It has been frequently observed that Australia lacks the cultural attributes of the US in providing the desire, incentives and facilitation of processes for academic researchers to generate knowledge and technology based enterprises. We do not accept readily that research and new technology based companies sometimes fail, in contrast to the American view that values failure as an important learning experience. Longer-term efforts to develop a stronger business culture and skills through the education system and to encourage greater awareness of the importance of science and technology at senior management and Board level in companies, may be required. However, if steps are not also taken in the short term to address this cultural problem in Australia then the problem may not be resolved sufficiently quickly given the current rate of change in such endeavours elsewhere in the world.

Structural and Cultural Barriers to the Commercialisation of University Research in Australia

The Melbourne Consulting Group report, commissioned by the ARC in 1997, proposes an action plan in six key areas to boost the research commercialisation performance of university research in Australia. The six key actions are:

- create the right academic environment;
- develop effective commercialisation support structures;
- develop and expand relationships with existing companies;
- facilitate and increase the number of new spin-off companies derived from university research activities;
- strengthen the corporate base; and
- increase the amount of finance available for the commercialisation of research and technological innovation.

The following are the key issues which need to inform the development and implementation of such an action agenda:

Convergence

In the context of the knowledge economy, the traditional boundaries between education and work, research and commercialisation, basic research and applied research, and universities and industry are all blurring. This convergence will, in time, reduce operational impediments between universities and industry, which may be currently apparent.

Trust and Shared Perceptions

The relationship between universities and industry is positive and productive when they are aware of each other's responsibilities and expectations. Trust and shared perceptions bind networks and leverage investment by industry in university research. Increasingly through a variety of mechanisms these productive relations are developing. Cooperative Research Centres (CRCs) and similar government sponsored programmes such as Strategic Partnerships with Industry-Research and Training (SPIRT), have helped change the research environment, with their focus on industry links, commercialisation and the training of postgraduate students.

University Reward Systems

The dominant reward system in universities can act as a major cultural barrier to commercialisation of university research. Researchers are more likely to be rewarded on the basis of their publication rate and success in achieving external research grants. Whilst traditional academic publications and conference presentations continue to be important channels for technology transfer and generating awareness of new technology, universities and funding bodies need to have the flexibility to offer options to researchers pursuing commercial lines of work.

Researchers as Entrepreneurs

Most university researchers are not entrepreneurs and they do not want to learn how to become entrepreneurs. However, there are also some researchers who have the aptitude and taste for entrepreneurship and who might be the best people to commercialise their own inventions. But effective management is critical for the day to day operation of a business, implementation of research, development of marketing programs, securing funding and intellectual property strategies. Australia has a shortage of skills and experience in these areas.

One of the handicaps faced by those researchers who would be entrepreneurs is the gap between the outcomes of an ARC (or an NHMRC) grant and early stage venture capital. Seed funding is needed to provide proof of principle, to exemplify patents, and to prepare business plans. The Department of Industry, Science and Resources has recently launched a new programme Commercialising Emerging Technologies (COMET) which should assist in addressing this gap. As a complementary initiative, an additional stream within the SPIRT programme could also be developed which would enable a university researcher to seek funding to commercialise an outcome from a SPIRT funded project.

Financial and Taxation Regime

Until recently the taxation regime in Australia, particularly with respect to capital gains tax (CGT), worked against the attraction of venture capital (both overseas and domestic) for the commercialisation of research. However, the proposed reforms to the CGT, announced by the Government in response to the Ralph Review of Business Taxation, should go some way to rectifying this problem. There still remains, however, the need to address the gap referred to above between the outcomes from research, particularly basic research, and early stage venture capital. Also, the effects on business expenditure on R&D of the proposed reduction in the company tax rate and the maintenance of the R&D tax concession at 125%, as well as the interaction between these two factors, is not yet clear.

Intellectual Property

One of the tensions inherent in the management of intellectual property (IP) and commercialisation is between a university's objective of maximising its own financial benefits or maximising wealth and jobs to Australia and to its state of location. Maximising the short to medium term financial and other benefits to the university will lead to a primary focus on consultancies, contract research and IP licensing targeted to larger companies, particularly multinationals. Because there is a shortage of industry receptors in Australia much of the "D" stage will go overseas. On the other hand, a greater focus on generating new ventures, through which the university's IP is commercialised (start-up or spin-off companies) can, on the evidence from overseas and locally, lead to a higher multiplier on the university's investment in IP in the longer term, whilst increasing the risks in the short term. The most appropriate mechanism for commercialising IP needs to be considered on a case by case basis, bearing in mind long and short-term considerations and the associated risks.

Publicly Funded Research in Universities and IP

Funding bodies in Australia, such as the ARC, recognise the Common Law right of universities as employers to the intellectual property arising from grant funded research. Under the terms of the *Bayh-Dole Act, 1980*, universities in the US are required to determine in a reasonable time period whether they will take title of federally funded inventions. If they choose not to, title may revert to the federal government. In 1985, in a policy change that paralleled the *Bayh-Dole Act*, the UK Government withdrew the National Research and Development Corporation's first right of refusal on university IP and returned to the universities the responsibility for managing and exploiting it. The Canadian government is considering the introduction of a regime similar to that of the US whereby universities would be required to determine in a reasonable time period whether they will take title to federally funded IP. Unlike the US, however, they may elect to assign title back to the inventor under specified circumstances.

Management of IP Arising from ARC Grants

The ARC does not currently play an active role in either causing the research funded under its schemes to be commercialised or causing the universities receiving such funding to comply with any national interest policy. Intervention has not been the practice of the Government or the ARC on its behalf. However, if a significant change in the culture in Australia towards the commercialisation of university research is required then a top down approach may be appropriate. One such model could be to ensure in the conditions of award for an ARC grant that the researchers hold the license to exploit the IP arising from the research. This could stimulate more entrepreneurial behaviour by researchers by motivating them to seek financial rewards. This approach is essentially that adopted by Cambridge University and commonly referred to as the Cambridge model. At least one Australian university, the University of Melbourne, is considering the adoption of this model for managing the university's IP. Whilst there are risks associated with this approach, the key to its success is to provide support to researchers in exploiting their know-how, in exchange for a share of the royalties.

Other Commercialisation Mechanisms and Issues

Clusters

Clusters, such as Silicon Valley, reflect the synergistic development of high technology firms through linkages between the finance sector, a strong entrepreneurial culture, corporate research laboratories and universities. Recent OECD reports strongly support the development of clusters as drivers of economic growth and employment. In Australia, rather than strong clusters per se, there are concentrations of technology and bioscience companies around universities and research institutes. Fuelled by advances in communications and information technology, clusters can emerge as distributed or virtual networks.

Innovation Platforms

Innovation Platforms, a complementary concept to clusters, offer an enhanced mechanism for coordinating investment in research by bringing together major national facilities, discovery research and training, with industry and venture capital investment. Using communications and information technologies, distributed sites would be networked into multidisciplinary centres of excellence. Such centres would provide a national "one stop shop" for industry to develop new technologies and train skilled personnel. Early phase commercialisation offering venture capital opportunities for investment in innovation off the drawing board is a particular feature of this model and provides a complementary focus to that of the CRCs.

New Technology-Based Enterprises in Australia

US and European universities are moving towards creating new ventures rather than licensing IP to an existing business. A recent paper prepared for the Prime Minister's Science, Engineering and Innovation Council indicates that Australia has the capacity to increase the number of spin-off companies from our universities, and other research organisations. The paper also recommends the establishment of a strategic technology incubator programme for Australia. Technology incubators could be established not only in the major cities, but also in regional areas where the necessary infrastructure is usually less accessible. In selecting sites for incubators regional strengths, proximity to industry and/or educational facilities are essential to building the right intellectual and business environment which can produce a multiplier of positive effects. The incubators could also be used to create interactions with school and tertiary level students and further their broader enterprise education as well as their understanding of the innovation cycle.

Technology Transfer

Technology transfer is the process whereby inventions or IP from academic research is licensed or conveyed through user rights to industry. One of the major weaknesses in the Australian innovation system is the innovation progression gap, which starts when the R&D phase ends and the market introduction begins. University commercialisation offices play a critically important role in bridging this gap. However, there is little information available about their contribution to this phase of the innovation process. The ARC believes there would be considerable value in commissioning work to establish international benchmarks based on data from the Association of University Technology Managers (AUTM) survey. Comparisons could then be made with data from Australian Tertiary Institutions Commercialisation Companies Association (ATICCA) members who agree to participate.

University Human Resource Policies and Practices

Human resource policies adopted and followed by universities should have successful technology transfer at the core. Such policies should be guided by best practice in the private and public sectors on blending recognition and rewards policies with corporate commercial goals. The dominant reward system in universities can act as a major cultural barrier to the commercialisation of university research. Universities need to have flexibility to offer options to researchers pursuing commercial lines of work. An increasingly decentralised industrial relations environment in the university sector should allow institutions to tailor terms and conditions of employment and reward structures to suit the particular circumstances and needs of collaborative ventures involving institutions and business partners. The issue of conflict of interest for those staff engaging in commercialisation activities is an important one, which needs to be

addressed and managed through the production of guidelines, including disclosure procedures.

A more far reaching structural option for facilitating collaboration between universities and industry is the introduction in Australia of the American practice at research institutions of allowing staff to earn funds above their normal salary for up to three months each year, normally through consultancy agreements with industry. This practice assists to establish crucial links with industry and makes the process of crossing from one organisation to another much easier. The American practice of scientists leaving their research work to champion its commercialisation is made easier by the fact that the route back again is easier than in Australia.

Innovation Forums

Linking researchers and end users fosters the transfer of critical technologies through the conduct of innovation forums, which could be held in regional as well as metropolitan locations. As a complement to transactions that already occur involving universities or individual researchers and research groups, the ARC can perform a brokerage role, which would enable the sellers and purchasers of research to maximise their knowledge about the research market.

Conclusion

In encouraging stronger links between universities and industry we do not need to (indeed the ARC believes we must not) shift the balance of funding support for university research away from basic research in the direction of applied research. However, we must provide greater focus to our efforts to commercialise research in Australia. A number of suggestions which could lead to a higher level of commercialisation of university research are outlined above.

As the way in which knowledge is produced undergoes fundamental change, the exploitation of research will need to become an integral part of the research process. Participation is unlikely by simply demanding that financiers take more risks or academics get involved for the good of society. It is important that action is taken to ensure that participation is based on mutual self-interest.

The issues and strategies covered in this advice have implications for all parties involved in the commercialisation of Australian research. There is a need to develop an integrated set of actions for industry, government, universities and other research organisations, venture capitalists and the researchers themselves. The process of commercialising research and the culture change, which accompanies that, has been set in train in Australia, but needs to be strengthened significantly. This process will gain some momentum through a number of initiatives such as the Innovation Summit

planned for early in 2000. The Government's release of a White Paper on university research and research training is also an opportunity to introduce an incentive structure more conducive to the commercialisation of university research. In the longer term there may be value in the development, through the Prime Minister's Science, Engineering and Innovation Council, of a whole-of-government Action Plan for the commercialisation of university research in Australia.

Introduction

1.1 Background

The Minister for Education, Training and Youth Affairs wrote to the Chair of the Australian Research Council on 18 February 1999 requesting that the Council provide advice to him by the end of July 1999, on a range of incentive and culture factors associated with effective university-industry research commercialisation practices in other countries, with particular reference to the US and the UK (Attachment 1-A).

In preparing this advice to the Minister, the Council has drawn directly on the outcomes of a number of studies commissioned by it in 1998 and 1999, as well as a number of other recent and relevant reports, both Australian and international, on the general issue of commercialisation of university research. These are listed at Attachment 1-B.

In preparing its advice to the Minister, the Council noted the wide ranging, close and overlapping nature of the incentive and culture factors listed in the Minister's request. Rather than adopting an item by item approach, and to ensure a coherent picture of the issues is provided, the Council has framed its advice in broad terms, covering in a general way the various elements referred to by the Minister. In the light of their critical importance to achieving higher levels of commercialisation of university research, the Council has chosen to focus in some depth on selected issues, such as intellectual property. It is apparent from preparing this advice, that in many instances the barriers to greater commercialisation activity between universities and industry are common to Australia and other countries.

The advice is structured to allow for contextual issues, such as Australia's international competitiveness in R&D to be covered initially, before specific structural and cultural barriers to the commercialisation of university research in Australia are identified and specific mechanisms for dealing with these are presented in the latter part of the paper.

In its 1998 policy statement *Investing for Growth*, the Federal Government identified the key elements of an effective innovation system. Among these were strong links between industry and research providers, as well as a number of capabilities that depend on these links, such as a high rate of technology diffusion and effective and rapid commercialisation of R&D.

The Government's Discussion Paper on research and research training, *New Knowledge, New Opportunities*, released in July 1999, indicates that there are a number of key requirements which must be met if Australia is to lift its performance in the critical area of commercialising research findings.

These include Australian access to overseas technology and overseas markets; improving our skills in the management of intellectual property; fostering an environment conducive to the growth of small and medium sized enterprises; removing unnecessary regulation and red tape; and not the least promoting a national culture which encourages creativity, values entrepreneurship and rewards risk-taking.

1.2 A Strategic Approach to Research Commercialisation

The Melbourne Consulting Group report, commissioned by the ARC in 1997, proposes an action plan in six key areas to boost the research commercialisation performance of university research in Australia. The six key actions are:

- create the right academic environment;
- develop effective commercialisation support structures;
- develop and expand relationships with existing companies;
- facilitate and increase the number of new spin-off companies derived from university research activities;
- strengthen the corporate base; and
- increase the amount of finance available for the commercialisation of research and technological innovation.

Further detail on each of these points is included as Attachment 2 and in the published report.

While these six actions form a complementary set for boosting our performance in the commercialisation of university research in Australia, the issues can be separated into those which are within the responsibilities of the universities and federal university and research funding agencies (such as the first four) and the last two which are external to the universities and which are strongly influenced by economic policy settings, global markets and resulting financial behaviour. In structuring this advice the Council has also adopted this overall approach of:

- identifying general environmental issues which bear on commercialisation of research in universities; as well as
- identifying more specific issues, which may act as barriers or which need to be addressed to achieve higher levels of commercialisation of university research.

1.3 What is Research Commercialisation?

Research commercialisation is a complex and heterogenous concept, requiring complicated interactions between research providers, the companies wishing to exploit the research, and - in many cases - the investment sector. It is a key aspect of innovation. In its most obvious form, the commercialisation process involves taking laboratory scale research results and completing the considerable further experimental development, production and marketing that is needed to deliver new

products and services to consumers. Equally it may involve incremental changes in materials, products and processes leading to improved efficiency and competitiveness.

Commercial outcomes may derive from research conducted by businesses themselves, or the licensing of intellectual property from overseas or from public sector researchers such as the universities or CSIRO. There are a number of commercialisation options for a researcher or a research organisation. These are set out in Attachment 3.

While it can generate substantial economic benefits, research commercialisation is a complex and costly process. For every dollar that leads to a promising research outcome, anything up to 100 dollars or more of further investment may be required for successful commercialisation. Experience in Australia and overseas indicates that only one in one hundred of prospective research outcomes investigated for investment purposes can be successfully commercialised.¹

1.4 What is Entrepreneurship?

Entrepreneurs are agents of change and growth in a market economy and they can act to accelerate the generation, dissemination and application of innovative ideas. Entrepreneurs not only seek out and identify potentially profitable economic opportunities but are also willing to take risks to see if their hunches are right. While not all entrepreneurs succeed, a country with a lot of entrepreneurial activity is likely to be constantly generating new or improved products and services, which in turn generate new employment opportunities. It is also likely to be highly adaptable, so that opportunities are seized upon as soon as they emerge.

Entrepreneurship is the result of three dimensions working together: conducive framework conditions, well designed government programmes and supportive cultural attitudes. Achieving proper framework conditions – the institutional arrangements within which economic activity takes place – should be the foundation of policy. Well-designed and well-targeted government programmes can also complement framework conditions. For example they can encourage and maximise the benefits of collaborative behaviour, augment the flow of information for financing entrepreneurship and provide a flexible response to location specific factors affecting entrepreneurship. Supportive cultural attitudes also complement framework conditions. For instance, other things being equal, an environment in which entrepreneurship is esteemed, and in which stigma does not attach to business failure resulting from reasonable risk-taking, will almost certainly be conducive to entrepreneurship. Indeed efforts to improve framework conditions so as to bring about a closer relationship between risk and return,

¹ Department of Industry, Science and Tourism, 1998, Science & Technology Budget Statement 1998 - 1999

or between individual effort and reward, may be slow to show results unless cultural attitudes support risk-taking and individual reward.

Fostering Entrepreneurship, a study carried out by the OECD, makes it clear that the subject of entrepreneurship is a multifaceted one and the framing of policy to address it is a complex task.² It lends itself to a whole of government approach.

² OECD, 1998, *Fostering Entrepreneurship*, Paris: OECD

2

Context

2.1 Australia's Competitiveness in R&D

There are a number of factors concerning the broad environment in which commercialisation takes place, which can influence a country's performance in commercialising research. These include:

- the quality of the research base and the maintenance of science and technology skills;
- the availability of companies willing and able to take up the results of research;
- the strength of links between the research base and industry;
- availability of venture capital;
- the quality of management skills;
- an appropriate regulatory environment; and
- a competitive business environment.

Australia is regarded as being strong on the first (producing some 2 per cent of the world's research, against a much lower share of the world's population) and to some extent the last two of these, and relatively weak on the others.

Australia faces a number of difficulties – such as the small size of the home market, the “tyranny of distance” to overseas markets, attracting investment capital (both domestic and foreign), an industrial structure which leans towards low technology jobs, a limited entrepreneurial skills base, the relative immobility of human resources and a lack of industry receptors for R&D (a receptor being a company that has the capacity to understand, develop and bring to market the results of public sector research).

In terms of the relative share of national wealth devoted to R&D, Australia lies in the middle range. On the share of national wealth expended on R&D within government agencies and universities, Australia ranks number three out of 24 international economies, 20 of them OECD countries. However, business expenditure on R&D, although it has grown significantly in recent years from a low base, is low by international standards with Australia ranking 19 out of 24 international economies.³ In the past three years the rate of growth has begun to decline.

Further evidence of Australia's strengths and weaknesses in science and technology is provided through the World Competitiveness Yearbook.

³ Department of Industry, Science and Resources, 1999, Science & Technology Budget Statement 1999-2000

Australia's rankings in 1999 were 10/46 for the number of patents in force; and 12/46 for Nobel Prizes. However, entrepreneurship and innovation is one of Australia's weakest factors with a ranking of 28/46. Australia ranks 22/46 on Financial Resources for Technological Development, 31/46 on Venture Capital and 40/46 on the relocation of R&D facilities as a threat to the future of the economy.⁴

The insights into the Scottish university-industry environment provided in a paper by Mr Ron Botham from the Scottish Enterprise, offer a relevant comparison with Australia, as many environmental characteristics are shared between the two countries. Like Australia, Scotland has a large science base which produces research outputs of both high academic quality and commercial relevance. Fifty three per cent of Scottish academics say they are currently working closely with industry, compared with 34 per cent of American academics. However, with the exception of contract research income, few of the economic benefits have materialised in Scotland. The researchers argue that an important reason for this is the absence of companies in Scotland willing or able to fund further research or commercialise the results. A major concern is that the Scottish corporate base, with a large presence of overseas production facilities, does not have the resources or skills to exploit the science base. Consequently there is a need in Scotland to increase the number of companies able to exploit science and technology.

Canada is also a country which provides an interesting point of comparison with Australia. In a recent report prepared by an expert panel for the Canadian Prime Minister's Advisory Council on Science and Technology on the commercialisation of university research, it is stated that Canada has an innovation gap. The explanation provided is that Canada does not have a tradition of widespread innovation due, in part, to low levels of investment in research and development (R&D) by the industrial sector. In 1997, R&D investment by the industrial sector in Canada was the second lowest among the G-7 countries. However, Canadian universities perform a larger share of national R&D than in most other G-7 countries.

Howard and Partners in their study for the ARC observe that university-industry interactions in Australia are not out of line with those in overseas countries, save for the impact of lower R&D intensity by the business sector and the higher rates of overseas ownership and control of Australian industry, factors which we share with Scotland and Canada.

However, the low level of investment in R&D by industry in Australia is a major structural impediment to developing networks between universities and industry. Many foreign owned companies do not undertake research and development in Australia and if they do, the technology strategies are often developed at corporate headquarters overseas. This means that

⁴ IMD 1999 World Competitiveness Yearbook, IT Press, <http://itpress.de/home.htm>

decisions taken overseas as part of global technology strategies can have a major impact on Australia's innovative capacity.

It is likely that foreign firms take into account the effectiveness of Australia's overall innovation system in their foreign direct investment assessments. This will tend to be based on detailed technical assessments of how effectively universities, firms and research organisations are able to work together in particular areas of science and technology.

3

Structural and Cultural Barriers to the Commercialisation of University Research in Australia

3.1 Overview of Australian Universities' Commercialisation Performance

The performance of Australia's universities in commercialisation – the process of converting research into successfully marketed products and industrial processes – is improving. The trend for firms to allocate a growing proportion of their R&D investment to university based projects is indicative of the growing linkages between the two sectors. Based on 1996 data, the proportion of all university performed R&D, which is funded by business, is 5.2 per cent, an increase from 3.9 per cent in 1994.

The cultural gap between universities and industry is being reduced. Whilst it is important that the boundaries between universities and industry are retained to reflect their respective missions, new ways are being found to work across those boundaries. Through the emergence of the knowledge economy, in which knowledge plays a central role in generating wealth, the roles of knowledge production, capture and exploitation are changing radically. The traditional boundaries between education and work, research and commercialisation, basic research and applied research, and universities and industry are all blurring. This convergence will, in time, reduce operational impediments, which may be currently apparent.

Universities in a number of countries, including Australia, are starting to operate in ways more traditionally associated with business enterprises. This involves the adoption of business approaches to management, finance, investments and the development of working relationships with other businesses. Most universities now have corporate plans that define their missions, identify target markets and specify financial and other performance targets. The ability to raise external income is becoming a significant factor in academic career advancement.

Universities are also now actively managing their investment portfolios to purchase and/or redevelop property and construct facilities to encourage technology intensive businesses to locate and collaborate with their research and development capability. Some of the arrangements that are being put in place involve complex structured financial deals with financial institutions and the sharing of risk with developers.

However, Howard and Partners in their report, have indicated that while a business-like approach has been embraced by university administrations in their relationships with industry, many smaller research centres within universities still have much to learn about working with business. As

universities seek corporate funds they will require increasingly business oriented management skills and capabilities.

The relationship between universities and industry is positive and productive when they are aware of each other's responsibilities and expectations. Recent US analyses highlight the importance of social capital (trust, shared perceptions) that bind networks and leverage investment by industry in university research. Increasingly through a variety of mechanisms these productive relations are developing. Cooperative Research Centres and similar government sponsored programmes such as SPIRT, have helped change the research environment, with their focus on industry links, commercialisation and the training of postgraduate students. They have forged new partnerships between the users and the providers of research, involving both sides from the earliest stages of planning. They have cut across boundaries and broken up existing territories.

There is clear evidence from the Turpin et al report, that consultancies often form the first stage in a relationship with an industry partner, which can lead to research contracts, graduate placements etc. The interaction of postgraduate students in a commercial environment is also an excellent mechanism for breaking down what negative attitudes in universities may exist towards the world of commerce and building and developing a future research workforce well versed in these issues.

There is some evidence, however, in the Melbourne Consulting Group report that organisational arrangements used by universities to promote commercialisation of their research can, in some instances, be an issue for the users. One explanation could be that these users prefer not to have to deal on commercial terms involving formal agreements and going rates for royalties. There is also evidence from this study that a positive culture in universities towards commercialisation is more likely to be present when the Vice Chancellor's commitment is overt and it is followed through to the university's Strategic Plan and the operational processes which feed into promotion criteria etc.

3.2 The Academic Environment

Invention, innovation and successful commercialisation depend on the creativity and commitment of scientists and engineers who make the initial breakthrough or discovery. All universities and research organisations in the US, UK, Canada and Australia are encouraging scientists and engineers to take a greater interest in the development and ultimate commercialisation of their research, rather than concentrating on its academic or intrinsic interest.

There are, however, substantial differences between researchers in research organisations such as universities and CSIRO and those who operate in a commercial environment. For example, achievement is recognised differently, through different reward structures. These differences can

inhibit the development of effective linkages between the research base and industry.

In a university, scholarship and research are directed towards gaining fundamental understanding. The reward system in research is based on the priority of discovery – this encourages early disclosure and exchange of information leading to an enhanced reputation for the researcher. The reward system for business derives directly from commercial profits or their expectations. This financial success will usually require monopoly rights on information regarding new technological developments, with disclosure or exchange of information usually needing to be discouraged or strictly controlled.

The Scottish Enterprise paper indicates that about one third of Scottish academics hold the view that their role is to undertake basic research and not to be concerned with its application. On the other hand, the majority is interested in the application of their research and would like to see more done to ensure its commercial exploitation. A significant minority would wish to be involved in the process. However, despite this interest the academic environment is a serious constraint. Most of the Scottish academics complain about time pressures and the absence of adequate assistance to enable the exploitation of their work without adding to their workload. Furthermore, publishing dominates the environment. While few admit to being motivated by money, there are few perceived or actual professional rewards and little recognition for getting involved in the commercial application of research. Within the UK funding system, which is strongly influenced by the Research Assessment Exercise giving priority to publications, there are few financial incentives through the funding system to encourage and reward institutional involvement either. Even in institutions set up to undertake more industrially orientated research, traditional academic career values have a strong influence on academic-industry links.

Within research organisations in Australia, researchers are more likely to be rewarded on the basis of their publication rate and success in achieving external research grants. Whilst traditional academic publications and conference presentations continue to be important channels for technology transfer and generating awareness of new technology that might lead to commercially successful innovations, researchers not infrequently find themselves being confronted with an unpalatable choice between choosing academia or championing the product. Universities and funding bodies need to have the flexibility to offer options to researchers pursuing commercial lines. Whilst there is some indication that attitudes are beginning to change, this attitude to commercialisation in universities is hindering the growth of spin-off companies.

One of the handicaps faced by those researchers who would be entrepreneurs is the gap between the outcomes of an ARC (or an NHMRC) grant and early stage venture capital. Seed funding is needed to provide proof of principle, to exemplify patents, and to prepare business plans. A

mechanism is needed to provide this stage of development with seed funding of up to \$500,000. The Department of Industry, Science and Resources has recently launched a new programme Commercialising Emerging Technologies (COMET). The programme will provide critical support to enable individuals, early growth firms and spin-off companies from public research institutions to maximise their potential for innovation and the commercialisation of innovative products, services and processes. Assistance under this programme can take the form of a tailored assistance plan or skill development through a management development programme.

Several of the initiatives proposed in the Government's Discussion Paper, *New Knowledge, New Opportunities*, are intended to address these issues and provide an incentive structure more conducive to the commercialisation of university research.

Government programs have been designed to improve links between universities and the users of research, and a number of universities have established commercialisation arms to facilitate the process of commercialising their research, transfer technology and provide consulting and other services to industry. Through the growth in funding flows from the business sector in support of university research, there is evidence of significant improvements in linkages between industry and university researchers.

Most university researchers are not entrepreneurs and generally do not want to learn how to become entrepreneurs. The Melbourne Consulting Group study suggests that about one-third of university academics are motivated to look for external relationships with research users and to engage in entrepreneurial activities. However, the cooperation of those researchers, who are not interested in personally commercialising their research, is essential to enable other parties to commercialise it on their behalf. Also, we need to provide the necessary skills training for those researchers who have the aptitude and taste for entrepreneurship and who might be the best people to commercialise their own inventions. Effective management is critical for the day to day operation of a business, implementation of research, development of marketing programs, securing funding and intellectual property strategies. A concern often stated is that Australia has a shortage of skills and experience in these areas. Some universities offer courses in various aspects of entrepreneurship and could be encouraged to offer actively training for their researchers and research students in intellectual property management, feasibility studies and business planning.

Commercialisation of innovation in Australia can be improved both by educating scientists and technologists in gaining an understanding of the language and skills of business; and by educating entrepreneurs and business professionals in the commercialisation of scientific and technological innovations.

The University of New South Wales has recently introduced a scheme modelled on a Stanford Business School scheme in which MBA students work with science and technology research students to identify and explore possibilities for commercialisation of their research. This programme has proved highly successful in starting up new businesses in the USA. Other examples include the Swinburne University Entrepreneurship Programme, the Australian Technology Park *New Business Creation* course and the Deakin University science and technology courses which emphasise strong links with industry. Macquarie University also provides a technology management course which aims to teach technology students the fundamentals of business and management practice.

The Working Group believes that Government should more actively encourage all universities to offer training in skills such as intellectual property management, feasibility studies, business planning. This could be made available to all PhD students and any senior researchers who want to take advantage of it. There is evidence that patent attorneys, venture capitalists and others are keen to be involved.

Extract from PMSEIC *Ideas for Innovation*, Occasional Paper 2, DISR, 1999

A key approach to stimulating the acquisition of entrepreneurial skills in researchers is encouraging the mobility of personnel between universities and industry environments. Elements of the SPIRT programme, such as the APA(I)s, APD(I)s and the proposed Industry Fellows and Professorial Fellows, are designed to facilitate this mobility. The numbers involved, however, are small and need to be expanded in the future.

3.3 Researchers as Entrepreneurs

Generally Australian society and culture is risk averse. The community benefit in the form of the creation of new knowledge based enterprises is much less in Australia than would be expected from the considerable investment by the community in higher education research. It has been frequently observed that Australia lacks the cultural attributes of the US in providing the desire, incentives and facilitation of processes for academic researchers to generate knowledge and technology based enterprises. We do not accept readily that research and new technology based companies sometimes fail, in contrast to the American view that values failure as an important learning experience. Longer-term efforts to develop a stronger business culture and skills through the education system and to encourage greater awareness of the importance of science and technology at senior

management and Board level in companies, may be required. However, if steps are not also taken in the short term to address this cultural problem in Australia then the problem may not be resolved sufficiently quickly given the current rate of change in such endeavours elsewhere in the world.

Commercialisation is more effectively financed in the US, which reflects a better developed system for financing high tech entrepreneurship. There are many more sources of finance with more technology orientated early stage venture capitalists and business angels. They invest at an earlier stage in both company development and the innovation process than in Australia and see their role as “hands on” business development rather than financial engineering and deal making. Many have entrepreneurial and technology, rather than purely financial, backgrounds.

Academia in the US is seen as a good source for project proposals and several venture capital funds maintain close links with research universities. The results from focus group discussions convened by the Federation of Australian Science and Technological Sciences on the commercialising the outcomes of research⁵, indicate that Australian scientists find industry surprisingly reticent at coming to them, and express surprise at how few industry people come to research organisations in search of commercialisable ideas. It is a challenge for them to find an industry person keen to understand the science and champion the research.

The Rothschild Biotechnology Fund is cited as an example of good practice in this regard. The Rothschild Fund trawls through universities looking for good ideas and this approach could be taken up across all the sciences.

The COMET programme being developed by the Commonwealth Department of Industry, Science and Resources and referred to earlier has the potential to make an important contribution to filling the gap in the innovation progression process. An additional stream within the SPIRT programme which would enable a university researcher to seek funding to commercialise an outcome from a SPIRT funded project could also be examined as a complementary mechanism for bridging this gap.

A joint venture has been entered into in the UK between the Wellcome Trust, the Gatsby Charitable Foundation, the Treasury and the Office of Science and Technology to establish the University Challenge Fund. The fund will assist universities to access seed funds in order to transform good research into good business. It has been designed to address an identified funding gap in the provision of finance to bring university research discoveries to the point where their commercial usefulness can be demonstrated and first steps taken to secure their utility .

⁵ Federation of Australian Scientific and Technological Societies, 1999, Scientists Commercialising their Research, Occasional Paper Series.

The entrepreneurship program of the National Research Council in Canada also provides a good example of strategic thinking on commercialisation, which has been translated into well-documented policies and operational plans. The main components of the program are:

- inventor and innovator awards which deliver recognition as well as monetary rewards;
- industrial partnership awards that recognise and reward outstanding success in forging successful R&D partnerships with industry;
- improved information resources and training to help employees understand the commercialisation process and entrepreneurial attitudes and skills;
- revised human resource policies to help maximise commercialisation opportunities, including an entrepreneurship leave program and an industrial secondment program; and
- partnership programs with sources of investment financing and management experience to help technology reach the marketplace.

There are good examples of awards, particularly in the US, which encourage research students to be entrepreneurial and actively pursue opportunities for commercialisation that arise from their research. Examples include the Merrill Lynch awards of up to \$US150,000 to recent PhD graduates who best explain the commercial application of their dissertation topic. The aim of the competition is to encourage entrepreneurial literacy among the academic research community, foster greater awareness of market opportunities and highlight the wealth of intellectual capital being created in the world's institutions of higher learning. The Entrepreneurship competition run by Massachusetts Institute of Technology offers \$US50,000 in support to students who submit business plans for real, rather than imaginary, new ventures showing significant business potential. Since its inception the competition has supported the creation of over 35 companies with an aggregate value of over \$500 million.

The National Science Foundation has established Integrative Graduate Education and Research Training awards to cultivate a new breed of scientists and engineers who are well prepared for a broad spectrum of emerging career opportunities in industry, government and academe. The awards emphasise interdisciplinary training and student internships in industry, government and abroad and place a high priority on students' communication and teamwork skills.

The UK Teaching Company Scheme (TCS), which started in 1975, supports partnerships between companies and universities for technology transfer and training.

Teaching Company Scheme (TCS) programmes are financed by Government grants made to the university partner, complemented by financial contributions made by the partner firm. These funds support the employment of graduates, known as TCS Associates, who work in the company partner on projects designed to realise the advances sought by the firm. The Associates are supervised jointly by senior company personnel and academic experts from the university. In addition to practical learning, Associates receive formal training aimed at developing both technical and managerial skills.

Around 600 companies – of all sizes and in a wide range of sectors – are participating in TCS. It supports the training of about 1,000 graduates and involves almost every UK university.

The R&D START programme has a Graduate Programme, which is based on the Teaching Company Scheme, and the ARC's SPIRT programme through the Australian Postgraduate Award (Industry) provides a similar opportunity for postgraduate students to work closely with industry.

However, it is evident from a range of studies that successful commercialisation of the science base requires more than simply the creation of academic-industry links, or indeed, aligning research with the needs of industry. Some of the other issues, which are relevant, are discussed below.

3.4 Financial and Taxation Regime

The financing of technological development and venture capital funding are two of the significant weaknesses standing in the way of wealth generation in Australia.

All recent studies on the issue of commercialising research outcomes in Australia have indicated that key constraints are the short time horizon for investors and the unfavourable capital gains tax arrangements in Australia. The Australian taxation system does not encourage investment in the commercialisation of new technologies. This in turn has led to a shortage of technology gap (business angel) funding and early stage venture capital.

There is no shortage of late stage venture capital in Australia, but the available funds tend to be targeted at the expansion and management buy-out end of the company development life cycle. There is a shortage of equity funding at the seed and early stages of company development, particularly for research-intensive high technology businesses. The formal venture capital sector does not tend to invest in technology firms until after the "proof of concept" stage when marketability has been established.

There are four venture capital funds that specialise in early stage investments in Australia: The Australian Technology Group (ATG) a government owned venture capital fund; Start Up Australia; Technology Venture partners; and Allen & Buckeridge.

In the six months to the end of December 1998 Australian venture capital firms invested just over \$40 million in bioscience and information technology companies. A substantial proportion of this was invested in the early stages. ATG currently has investments in eleven early stage companies – four in the bioscience area and six in the information and telecommunications sector and one in manufacturing.

The Federal Government's Innovation Investment Fund (IIF) has supported the commercialisation of a number of early stage technology and bioscience investments. For example, Encompass Bioinformatics, a University of Sydney spin-off has been supported by IIF funds managed by Allen & Buckeridge and the Rothschild Bioscience Unit.

One indication of the extent of the problem can be gained through a comparison with the situation in the US. In 1998, in the US the total funds available per head of population through formal venture capital providers was around \$3 per head of population. In the same year in Australia, the amount was \$1 per head of population. However, in the areas of provision of informal venture capital, the US funding was around ten times the amount of formally provided venture capital. In Australia, by comparison the amount provided through informal sources was half that provided formally. As a result, total venture capital available in the US per head of population is around \$33 while in Australia it is around \$1.50.

As well as lifting investment by Australian industry in R&D, reform of Australia's taxation system needs to include more incentives for foreign investors, notably US Pension Funds, to underline the basic attractiveness of Australia as a place to invest in R&D and commercialise research results.

In commissioning the Ralph Review of Business Taxation, the Government has indicated its objective of developing a business tax regime, which promotes investment, exports and jobs and improves the capacity of Australian business to compete internationally.

Recent announcements by the Federal Government in its response to the Ralph Review, indicate that it will significantly reduce the level of capital gains tax in Australia. As a result, Australia may become an attractive destination for overseas venture capital investment. There still remains the need, however, to address the innovation gap referred to above between the outcomes from research, particularly basic research and early stage venture capital. Also the effects on business expenditure on R&D of the proposed reduction in the company tax rate and the maintenance of the R&D tax

concession at 125 per cent, as well as the interaction between these two factors, is not yet clear.

3.5 Intellectual Property Issues

One of the tensions inherent in the management of IP and commercialisation generally, is between a university's objective of maximising its own financial benefits or maximising wealth and jobs to Australia and to its state of location.

Maximising the short to medium term financial and other benefits to the university will lead to a primary focus on consultancies, contract research and IP licensing targeted to larger companies, particularly multinationals. Because there is a shortage of industry receptors in Australia, much of the "D" stage will go overseas.

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

The experience in the US is that in the vast majority of research universities the revenues from commercialising research constitute a small addition to university budgets – well below 1 per cent. The amount of incremental income might be sufficient to provide useful incentives to the researchers involved, and to pay some of the cost of managing IP, but it could not be counted on to relieve the financial pressures that universities face. The Canadian report, however, recognises that the potential is much greater if policies are designed to make university research the source of new value-added activities to the national economy. An economic impact model developed by the AUTM shows that, in fiscal year 1997, \$28.7 billion of US economic activity, supporting 245,930 jobs, can be attributed to academic technology transfer from the licensing of intellectual property.

At a general level it needs to be noted that ownership of IP developed in the normal course of employment belongs to the employer. This is especially true when someone is employed to do research where invention is an expected outcome. Ownership by employers is a Common Law right, which may be reinforced through employment contracts. In the UK the University of Cambridge adopts a flexible approach to the ownership of IP and where possible will assign it to the inventor, provided that if an invention is successfully exploited, the University receives an appropriate share of the royalty income. The University attributes the considerable commercial success of its science parks to this policy. However, the Melbourne Consulting Group study found that most of the Australian universities interviewed preferred a simple approach of a percentage sharing of the net benefits after all costs, between the inventor, their Department and

the university. Models such as the Cambridge model were seen to be too complex to administer and potentially lead to disputes about benefit threshold levels. Further detail on the “Cambridge model” is contained in Attachment 4.

Companies, which have close working relationships with academia, continue to emphasise the difficulties they face in finding out about, and accessing academic expertise, as well as a variety of problems in taking academic research to market.

The Melbourne Consulting Group study indicates that for research users, protecting both their own know-how and any new IP in which they invest is critical. They want exclusive access to IP and need to be able to trust researchers to maintain secrecy. They want legal agreements that are quickly made, inexpensive and fair. They want to be able to revisit these agreements should their objectives and expectations change.

According to the Jamieson study the intellectual property policies of Australia’s universities provide by far the most generous benefits to inventors of all the sectors. Almost all universities in Australia have a policy of including employees as beneficiaries of the distribution of the net revenue arising from the commercial exploitation of IP. The government and private sectors generally do not do so, with the private sector using its more flexible remuneration and rewards system, rather than any percentage of actual net revenue, to recognise achievements in the commercialisation of IP.

3.6 Publicly Funded Research in Universities and IP

Funding bodies in Australia, such as the ARC, recognise the Common Law right of universities as employers to the intellectual property arising from grant funded research. Under the terms of the *Bayh-Dole Act, 1980*, universities in the US are required to determine in a reasonable time period whether they will take title of federally funded inventions. If they choose not to, title may revert to the federal government.

In the UK, until 1985 universities were required to assign ownership of IP from publicly funded research to a public technology transfer company, the National R&D Corporation (NRDC). In a policy change that paralleled the *Bayh-Dole Act*, the UK Government in 1985 removed the monopoly rights of the NRDC, returned to universities ownership rights to IP they generated, and gave them responsibility for managing and exploiting it.

The Canadian report on commercialising federally funded university research proposes the introduction of a regime similar to that of the US whereby universities would be required to determine in a reasonable time period whether they will take title to federally funded IP. Unlike the US, however, they may elect to assign title back to the inventor under specified circumstances. Both the US policy and the proposed Canadian policy operate a tight requirement to disclose to the federal government inventions arising from federally funded research. By comparison UK and Australian

funding agencies operate a more hands off approach, based on the belief that IP is most effectively exploited by individuals and universities rather than public agencies, with the Cambridge model being at the far end of that spectrum. Though the UK and the Australian approaches are both operationally hands off, the UK approach is more strategic than the Australian approach.

Reflecting the substantial public funds being invested in university R&D, the change of policy in the UK in 1985 included the requirement that each university develop a commercialisation strategy and submit it for approval by a national scrutiny committee before being given the operational freedoms of the new policy. A detailed comparison of the US, UK and the proposed Canadian approach to IP for publicly funded university research is contained in Attachment 5.

3.7 Management of IP Arising from ARC Grants

The ARC does not currently play an active role in either causing the research funded under its schemes to be commercialised or causing the universities receiving such funding to comply with any national interest policy. However, the ARC is the provider of a particularly relevant source of funds that may lead to new enterprises.

Intervening in a top down way in the commercialisation of university research has not been the practice of the Government or the ARC on its behalf. However, when there is a real problem requiring a real solution then a top down approach may offer the most effective approach to bring about a significant change in the culture in Australia towards the commercialisation of university research. One policy option that could be considered which could encourage more entrepreneurial behaviour by researchers and thereby stimulate greater levels of commercialisation of university research, would be to ensure in the conditions of award for an ARC grant that the researcher has the licence to exploit the intellectual property arising from the grant funded research.

The arguments in favour of assigning IP to university researchers are firstly that researchers may feel a greater motivation to seek financial rewards. One reason for the approach to IP followed by Cambridge University is that to do otherwise would be counter to the objective of encouraging and facilitating academic creativity. Furthermore, if know-how is to be successfully commercialised, it must depend on the motivation of the individual to do so and this motivation necessarily includes a financial dimension. However, most universities (as is the case for Cambridge University) are still likely to require a share of royalties from any IP deals secured by their employees. Secondly, there would be greater pressure on the researcher to commercialise IP before the patent costs started to mount. However, there is a risk that some worthy patents would lapse because of a lack of time and financial resources on the part of the researcher.

Without suitable support arrangements and education for researchers, most individual Australian researchers seeking to commercialise their own research could be disadvantaged. This could result from:

- A lack of expertise in IP management, which requires a knowledge of the different phases of the patenting process, some knowledge of foreign patent practices and attention to detail in responding to questions from patent offices, etc.
- A lack of financial means to meet patents while searching for a commercial partner. While an Australian provisional patent can be relatively inexpensive, the need to move to a full patent after 12 months and the need to file internationally can involve very large costs. If the patent has been assigned to the researcher, then he/she (as the owner of the IP) would be liable for these costs.
- A lack of commercial and legal expertise to negotiate deals involving IP. To undertake such negotiations requires knowledge of what the market will bear in terms of licence fees and royalties. It also requires experience in commercial negotiation. In addition, researchers may miss opportunities in these negotiations, such as ensuring benefits for Australia, getting patent fees and defence costs paid etc. Mistakes in the legal documentation can leave a researcher and his/her university open to litigation.
- A lack of time, information networks and travel funds to locate commercial partners.

The key to overcoming these risks is to provide the researchers with suitable support arrangements. In the Cambridge model, the Cambridge University Industrial Liaison and Technology Transfer Office provides an advisory service for academics that need help in exploiting their know-how and Lynxvale Limited, the university's limited liability company, handles the commercial development of ideas. The University has made it respectable for academics to exploit their knowledge and make money out of doing so, and at the same time still retaining their academic position. This in turn has helped to seed the process of new firm formation.

In Australia, the University of Melbourne expects to adopt an approach similar to the Cambridge model to the ownership of intellectual property.

Another model, which operates at the University of Wollongong, has the following characteristics:

- researchers present a proposal for the commercialisation of intellectual property to a three person committee;
- if the committee agrees that the commercialisation of the IP should proceed, the researcher will be part of the commercialisation team;

- if the university, through the committee, decides not to proceed the ownership of the IP reverts to the individual, who may proceed to commercialisation; and
- the committee must respond to a commercialisation proposal within two months of receipt.

Commercialisation Mechanisms and Issues

4.1 Clusters

The significance of clusters in supporting university-industry relationships is receiving a great deal of attention. Recent OECD reports strongly support the development of clusters as drivers of economic growth and employment. The most celebrated technology cluster is Silicon Valley. It and another similar area around Boston, Massachusetts, reflect the synergistic development of high technology firms through linkages between the finance sector, a strong entrepreneurial culture, corporate research laboratories and universities. In a broad sense, a cluster, which may be geographically concentrated or distributed through virtual networks, is simply a smaller scale version of a national innovation system.

In Australia there are concentrations of technology and bioscience companies around universities and research institutes, rather than strong clusters per se. However, geographic co-location is not sufficient in identifying a cluster – the key to the success of a cluster, and the reason why it continues to attract more and more firms to set up there, is networking. Canadian government policy has sought to foster links between innovative activities through distributed networks that take advantage of advances (and give impetus to further developments) in communications and information technology. These can be thought of as virtual clusters. Irrespective of particular models or developmental pathways, the formation of clusters appears to depend on two factors – the creation of centres of research excellence and competition for government and private sector funding as an incentive for firms and researchers to integrate their activities through collaborative networks. Concentrations of economic activity involving innovative firms, universities and public research institutes can act as magnets for new technology, skilled personnel and investment in research, including international investment. They offer firms economies of scale and scope and access to a strong science and technology base and a culture conducive to entrepreneurship. In turn the development of clusters and networks at a local, regional or national level provides an enhanced capacity to link into global innovation networks.

The CRC program has demonstrated the importance and effectiveness of linkages between publicly funded research and industry. However, rather than have a national institute on a single site, today's communication and information technologies encourage the development of a dynamic model drawing together the best research and skills training into a networked centre of excellence with distributed sites involving many universities, in metropolitan and regional locations, and providing opportunities for participation by other public research institutes. In this way several disciplines could converge to provide a multidisciplinary approach to

problem solving. This would provide a broad and extensive foundation of resources and personnel to provide an innovation platform for technology transfer and commercial development. Early phase commercialisation offering venture capital opportunities for investment in innovation off the drawing board is a particular feature of this model and provides a complementary focus to that of the CRCs.

4.2 New Technology-Based Enterprises in Australia

According to the Melbourne Consulting Group study, to promote commercialisation, US and European universities are moving towards creating new ventures rather than licensing IP to an existing business. This has arisen because it is difficult to find enough existing businesses that are willing to invest in technology development and marketing resulting from university research.

This problem is also common in Australia. According to some commentators Australian industry does not often look 20 or 30 years ahead to see the “new” technology. It tends to be timid about exploring new opportunities and reluctant to stretch itself financially. Industry prefers proven ideas from overseas to innovative home-grown solutions and reflects a broader community view focussed on stability rather than opportunity. Whilst for some markets the most appropriate way to exploit university research will be through multinational enterprises, an alternative response to a low industry receptor capacity is to create spin-off companies to exploit university discoveries.

There are over 70 university spin-off companies in Australia. A recent paper prepared for the Prime Minister’s Science, Engineering and Innovation Council indicates that Australia has the capacity to create at least 100 companies per annum from our universities, and other research organisations, but observes that the present number is more like 10. This contrasts with a total of 333 start-up companies formed in FY 1997 in the US and reported in the AUTM 1997 survey. However, the US figure may be understated due to the non-reporting of companies, which no longer have a formal link with their university of origin. The key issue, however, is the importance of establishing successful new technology based ventures at a reasonable rate from Australia’s research organisations.

Establishing spin-off companies has helped to create high tech industrial clusters in a few regions, the best known examples being Silicon Valley, Massachusetts and Cambridge, England. In the case of Massachusetts, it is claimed that there are around 800 spin-offs employing 200,000 people, while spin-offs are making an important contribution to the growth of an IT cluster in Austin and biotechnology in San Diego. The significance of the early spin-offs is that they may seed further high tech new starts, setting in motion a cumulative process of new firm foundation and growth.

The willingness of the research body and the researchers to work closely with the new company, as consultants, members of scientific advisory boards or as directors (non-executive or executive) is frequently a decisive factor in raising venture capital and securing partnerships with larger companies. To secure these close links, shareholdings are increasingly offered by spin-offs to research institutions and to individual researchers. In particular, most venture capital funds would be reluctant to invest without securing the close involvement of the lead inventor(s). Taking an equity stake is regarded as evidence of commitment to the new technology and as an incentive to drive forward with its development. This close relationship between the spin-off company and the parent institution is, however, a constant source of conflict of interest issues.

The decision to establish a spin-off company as a vehicle for commercialising university research needs to be taken on a case by case basis, bearing in mind the long and short term considerations and the associated risks.

4.3 Technology Incubators

A paper prepared for the June meeting of the Prime Minister's Science, Engineering and Innovation Council recommends the establishment of a strategic technology incubator programme for Australia. The proposal envisages an Australia-wide network of technology parks accommodating technology incubators.

Technology incubators are specialised business incubation facilities that focus on supporting high technology-based start-up companies. They are closely managed, supportive environments where entrepreneurial companies can develop the essential management skills and systems that enable them to grow and succeed. Such skills and systems include financial management, marketing, computer systems and technological and human resource management. Companies housed in a technology incubator tend to grow more rapidly and are less likely to fail than unsupported companies.

We have noted that innovators who have developed a product to the proof of concept stage face difficulties in moving on to the commercialisation and business development of this innovation. The technology incubator structure has been demonstrated around the world to be an excellent mechanism for helping start-up firms through this difficult stage.

The Israeli technological incubator program initially funded 28 incubators, 26 of which are still operating around the country, as at 1997. About 55 percent of the companies that have emerged from the incubators (usually after two years) continue as independent businesses, with 75 per cent of these having subsequently attracted a total of over US\$85 million in investments. This success rate compares very favourably to that of around 10 per cent for other incubators trialed elsewhere in the world.

The incubators enable entrepreneurs to conduct their R&D programs in a professional, friendly, supportive atmosphere, while receiving the guidance that they need in the starting phase of technological entrepreneurship. Entrepreneurs are provided with physical premises, financial resources, tools, professional guidance and administrative assistance, so that they may turn their ideas into products of proven feasibility, novelty and attractiveness in the international marketplace. Unlike commercial entities, the incubator program gives a chance to projects that are unable to attract commercial investors in the initial stages of development. The venture capital industry tends to ignore high-risk start-ups, preferring business ventures of at least \$5 million. One of the special requirements of the program is that the new product be manufactured in Israel.

In addition to providing assistance with developing business management skills, incubators provide flexible space and opportunities to network with other entrepreneurial companies. Enterprises may also be able to access sources of finance, and link with major customers and other strategic allies. Companies generally stay in an incubator for two to three years.

While Australia has many business incubators, there are currently very few technology incubators. Of the business incubators operating in Australia at present only about six are specifically focussed on developing technology-based companies. Those that do exist have proved highly successful in encouraging linkages between research organisations and industry. For example, the Australian Technology Park has graduated 12 companies from its incubation programme with a total estimated value at the time of graduation of \$5.5 million.

Technology incubators are often located within technology parks⁶, many are linked to university centres and much of the new technology and the entrepreneurs may come from the university.

Technology incubators could be established not only in the major cities, but also in regional areas where the necessary infrastructure is usually less accessible. In selecting sites for incubators regional strengths, proximity to industry and/or educational facilities could produce a multiplier of positive

⁶ Technology parks are not the same thing as technology incubators. The former are areas of real estate, where groups of companies are co-located. The main objective of technology parks is to cultivate technology transfer and promote networking among enterprises. Upon graduating from the incubator, some companies will stay on in the technology park, but moving to a new location in the park.

effects. The incubators could also be used to create interactions with school and tertiary level students and further their broader enterprise education as well as their understanding of the innovation cycle.

The Building on IT Strengths (BITS) programme announced in the last Budget, aims to increase the rate of formation of new small to medium sized enterprises (SMEs) in the Australian information industries. BITS will fund the establishment of incubator centres in each state and territory and it is expected that at least some of these will be operated by research institutions. Incubators and other methods of supporting spin-off creation should be encouraged in order to increase new firm formation in other sectors.

4.4 Technology Transfer

Technology transfer is the process whereby inventions or IP from academic research is licensed or conveyed through use rights to industry.

Universities, primarily through their knowledge production function, play an important role in the national innovation system. One of the weaknesses in the Australian innovation system is the innovation progression gap, which starts when applied research or experimental development ends and market introduction begins. The various stages involved include securing IP rights, prototype product and production process development, and compliance with regulatory standards and marketing activities. The innovation progression gap results in a vicious circle in which low rates of “learning-by-doing” in commercialisation mean that the investment processes are inefficient and poorly mapped out – thus discouraging investment in this crucial stage of innovation. At the moment there is simply not enough reliable information about the contribution of university commercialisation arms to bridging this gap. However, it is likely that university research commercialisation arms do not have the financial resources to finance the crossing of the innovation progression gap. The COMET programme and the extension to the SPIRT programme referred to earlier could be expected to contribute to a narrowing of this gap.

A Canadian report on the commercialisation of university research examines in some detail the performance of the commercialisation offices in Canadian universities and concludes that if IP is assigned to universities it is critical that these offices are properly resourced and staffed with people who are able to manage the innovation process efficiently and effectively. The report recognises that money alone, however, will not enable commercialisation offices to perform. There is a skills shortage that must also be addressed.

In Australia, there is a similar view to that in Canada, that not enough of the staff in these units have the skills or experience to handle all of the issues the commercialisation process can generate, and that the consolidation of these units into fewer larger centres of advice would be helpful.

The results of the Melbourne Consulting Group study which involved interviews with research users, indicate that many users are very satisfied with their university research partners. However, the interviews also indicate that for people working in university commercialisation support services – understanding the commercial partner’s needs and expectations, including how they value IP, is critical. It is clear from this study that some research customers wish to deal directly with the research provider and an important role for the support providers is to expedite this relationship as a consultant/coach rather than as a project manager.

Australian universities have experimented with a range of organisational models for operating commercialisation offices. Some are owned and operated by the university; some are owned by the university but managed by arms-length corporations whose activities are guided by boards of directors; and some involve a hybrid model.

There are virtually no published data on the activities of commercialisation entities in Australia that would indicate their business performance. The absence of Australian data, notwithstanding statutory reporting by members of ATICCA, stands in contrast to that provided through the annual AUTM survey, the US counterpart of ATICCA. In light of the critically important role played by these companies in technology transfer and the commercialisation of university research, the ARC believes there would be considerable value in commissioning work to establish international benchmarks based on data from the AUTM survey and against which Australian data drawn from ATICCA members which agree to participate, could be compared.

A Canadian report on the commercialisation of university research proposes a generic model for a university commercialisation office and identifies four fundamental building blocks to ensure success: the core business; specialised support to core business; office operations; and the Directorate of the commercialisation office.

The core business is focussed on technology licensing and spin-off company development. The specialised support for these activities is a blend of in-house legal and intellectual property expertise, prototype development funds, patent funds, specialised assistance in industrial grants/contracts that are commonly tied to licensing and spin-off opportunities, and marketing and business development with external clients in the public and private sector.

The office operations include database and financial management, communications, office operations and clerical functions etc.

The key element in this generic model is to have a dedicated team (technology commercialisation manager and assistant) in each disciplinary area producing potential commercial technology opportunities. In the context of the University of Alberta, the report suggests this would require an annual base operating budget of some \$C2.9 million, with an additional \$C1 million for intellectual property protection (patent) costs and prototype development.

4.5 University Human Resource Policies and Practices

Human resource policies adopted and followed by universities should have successful technology transfer at the core. Such policies should be guided by best practice in the private and public sectors on blending recognition and rewards policies with corporate commercial goals.

The dominant reward system in universities can act as a major cultural barrier to the commercialisation of university research. Whilst traditional academic publications and conference presentations continue to be important channels for technology transfer and generating awareness of new technology, universities and funding bodies need to have the flexibility to offer options to researchers pursuing commercial lines of work.

An increasingly decentralised industrial relations environment in the university sector should allow institutions to tailor terms and conditions of employment and reward structures to suit the particular circumstances and needs of collaborative ventures involving institutions and business partners. In particular, there is a need for universities to have flexible employment arrangements for those academics that want to get involved in a spin-off company.

The issue of conflict of interest for those staff engaging in commercialisation activities is an important one, which needs to be

addressed and managed through the production of guidelines, including disclosure procedures.

4.6 Conflict of Interest Considerations

Interactions with industry can create conflict of interest problems for employees who may have legitimate personal financial interests in companies that have commercial agreements with their employer, from which they receive gifts or consultancies, or in which they hold equity or executive or non-executive directorships. Potential conflicts are heightened when the scientists and engineers who invent the technology are offered, or acquire, financial interests as part of their employer's business deal with a commercial partner. Commercialisation arrangements that involve industrial secondments or other close working with private companies also have potential for undesirable conflicts of commitment.

In the US, the pattern in universities and research institutes has been set by the comprehensive and rigorous conflict of interest policies of the main federal funding agencies, the National Science Foundation (NSF) and the National Institutes of Health (NIH), as well as by State laws in the case of employees of public universities. These policies involve active monitoring and management of potential conflicts of interest and require annual filing of personal financial interests by the scientists and researchers concerned. In NSF and NIH guidelines, a personal interest occurs when shareholdings greater than US\$5000 or more than 5 per cent of equity of a company are owned by the individual or immediate family. All universities in the US have committees that review the materiality of potential conflicts declared in employees' annual returns.

Equity holdings and non-executive appointments can create three way conflicts of interest between the university, the spin-off and the individual, which would need to be disclosed. However, recognising the fragility of spin-offs in their first few years, non-executive and advisory positions in spin-offs would generally be approved in US universities.

Many Australian universities allow employees to take equity in spin-off companies, without specifying limits and also allow non-executive posts for university employees in such companies. In most cases executive positions are also allowed, subject to the positions not interfering with university duties or is dependent on individual employment contracts, where these exist, such as at the University of Queensland.

The holding of executive positions in spin-off companies by university staff is uncommon in the US, though it is permitted in the UK by the University of Cambridge and some other universities. Such appointments have potential for serious conflicts of interest. Unpaid leave of absence to work with the spin-off company would be an alternative. Because of split loyalties, the Jamieson report advises that dual appointments should always be avoided. However, given the significant benefits which can arise from

these arrangements the ARC would prefer to emphasise the importance of the careful management of any conflict of interest issues through robust policies.

It is important that the basic principles of conflict of interest and commitment are understood by employees, especially those negotiating commercial agreements or working with companies. The production of guidelines on these issues is one way, but the procedures then have also to be actively managed, preferably through disclosures by employees. Provided this is achieved, universities should be able to commercialise technology including joint ventures with industry and new spin-offs.

Some but not all universities in Australia have formal conflict of interest policies. Those that do have such a policy require a declaration of all external appointments, directorships, consultancies and interests and approval by the relevant University authority.

The NSF's investigator financial disclosure policy and the conflict of interest and commitment policies of universities like Stanford and Harvard provide useful models.

A more far reaching structural option for facilitating collaboration between universities and industry is the introduction in Australia of the American practice at research institutions of allowing staff to earn funds above their normal salary for up to three months each year, normally through consultancy agreements with industry. This practice assists to establish crucial links with industry and makes the process of crossing from one organisation to another much easier. The American practice of scientists leaving their research work to champion its commercialisation is made easier by the fact that the route back again is easier than in Australia.

4.7 Innovation Forums

The ARC currently plays a role in linking researchers and the end users of research through direct investment mechanisms such as the SPIRT scheme, Key Centres of Teaching and Research and, to a lesser extent, Research Infrastructure Equipment and Facilities grants. In addition the users of research are exposed to a range of university research by virtue of appointments of highly qualified individuals from the private sector to Council and, to a lesser extent, to its committees and panels. The Government's Discussion Paper on research and research training includes proposals for strengthening these links. In both of these areas, however, there is scope for further enhancement.

The ARC is also able to link researchers and end users and foster the transfer of critical technologies through the conduct of innovation forums, which could be held in regional as well as metropolitan locations. Through this brokerage role the ARC can enable the sellers and purchasers of research to have as complete as possible knowledge about the research market. The ARC could extend its brokerage role to match the best

Australian researchers with the needs of national and international firms wishing to purchase research services – a “one stop shop”, not as an alternative, but as a complement, to transactions that already occur involving universities or individual researchers and research groups.

In addition to its other mechanisms for linking researchers and research outcomes with the users of research, the ARC intends to convene on a regular basis innovation forums in particular fields to discuss research developments and potential commercialisation partners with appropriate stakeholders, in both regional and metropolitan locations.

5

Conclusion

In encouraging stronger links between universities and industry we do not need to (indeed the ARC believes we must not) shift the balance of funding support for university research away from basic research in the direction of applied research. The quality of our basic research and its links to industry is one of our most important national assets for innovation – the success of innovation will depend on knowledge flows stimulated by such mechanisms as joint industry research, public/private sector partnerships, technology diffusion, shared infrastructure and movement of personnel. However, we must provide greater focus to our efforts to commercialise research in Australia.

As the way in which knowledge is produced undergoes fundamental change, the exploitation of research will need to become an integral part of the research process. Participation is unlikely by simply demanding that financiers take more risks or academics get involved for the good of society. It is important that action is taken to ensure that participation is based on mutual self-interest.

Also it is important that the innovation process is “owned” by the community in general and not just by researchers and industry. On the other hand, we need to recognise the danger of over-selling the benefits of research to the community and must be careful to give realistic assessments of the potential for science and research in general to contribute to Australia’s economic development.

The issues, recommendations and models covered in this advice have implications for all parties involved in the commercialisation of Australian research. There is a need to develop an integrated set of actions for industry, government, universities and other research organisations, venture capitalists and the researchers themselves. The process of commercialising research and the culture change, which accompanies that, has been set in train in Australia, but needs to be strengthened significantly. This process will gain some momentum from the Innovation Summit planned for early in 2000. The Council believes, however, that the development of the Government’s White Paper on research and research training presents an immediate opportunity to provide an incentive structure more conducive to the commercialisation of university research. The ARC believes that there would be value in the development, through the Prime Minister’s Science, Engineering and Innovation Council, of a whole-of-government Action Plan for the commercialisation of university research in Australia.

**Extract from a Letter from The Hon. Dr David
Kemp MP to the Chair of the Australian
Research Council, Professor Vicki Sara, dated
19 February 1999**

“Following the discussions we had on 12 February regarding biotechnology and related matters, I see the need to obtain as quickly as possible some information to guide the Government’s decision process. I have asked the department to commission a study of the factors contributing to successful technology transfer and commercialisation in Australian science parks and to conduct that study in cooperation with the ARC. There is also a need for us to obtain information about the incentive and culture factors associated with effective university-industry commercialisation practices in other countries. I envisage a project that would compare Australian experiences with those of the United States and the United Kingdom. I would be grateful if the ARC could commission such a study and to supervise its conduct in cooperation with my department. I would like to receive advice on the outcomes of both projects before the end of July 1999. An initial outline of these projects is attached [see Attachment 1-B].”

Proposal for a Comparative Study of Entrepreneurial Research Culture: the United States and the United Kingdom

There are concerns that higher education research culture in Australia is not sufficiently entrepreneurial to take advantage of opportunities arising from innovation, and to pursue effective university-industry commercialisation practices.

A comparative study of higher education entrepreneurial practices in the United States and the United Kingdom with those of Australia would help identify possible areas to enhance an entrepreneurial research culture in Australian Universities. Specifically, such a study could include an examination of:

- organisational governance structures:
 - industry funding of academic chairs;
 - management styles; and
 - is scale an issue?
- investment in research infrastructure:
 - balance between government and industry investment; and
 - location and access to cutting edge research infrastructure.
- employment arrangements:
 - flexibility including freedom to pursue research projects;
 - superannuation;
 - career structures; and
 - staff training and support.
- professional incentives:
 - shared equity in research projects; and
 - intellectual property.
- technology transfer:
 - tacit knowledge;
 - personnel; and
 - instrumentation techniques.
- other organisational culture factors.

This study could also identify on the basis of these comparative findings, and specific impediments to enhance an entrepreneurial culture in Australian universities.

Strategic Action Plan for Improving Australia's Performance in Commercialising Research

The six strategic actions for commercialising research in Australia's universities are:

Create the right academic environment

- Institutions and individuals within them are committed to increasing the opportunities and rewards for commercialisation.
- Research and administration personnel improve their understanding of the commercialisation process and of the expectations of research users.
- The university addresses disincentives, such as finance allocation mechanisms, and promotion criteria that discount external research commercialisation activity.
- The university establishes and maintains effective policies and practices on IP ownership and management.
- The university encourages and facilitates entrepreneurship.

Develop effective commercialisation support structures

- Bridge the gap between academics and industry by building on existing organisations and where necessary creating new mechanisms and improving networking.
- Ensure adequate support services.

Develop and expand relationships with existing companies

- Expand the number of academic-industry links.
- Improve access by companies to university competencies.
- Build relationships with new companies.
- Work proactively to maintain existing relationships.

Facilitate and increase the number of new spin-off companies derived from university research activities

- Expand the number of new ventures (particularly those with global market potential) based on science and technology.

Strengthen the corporate base

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

Increase the amount of finance available for the commercialisation of research and technological innovation

- Increase access to both private and public sector investment, particularly seed funding and early stage venture capital financing.

(extract from ARC commissioned report number 60 by the Melbourne Consulting Group, "University Research: Technology Transfer and Commercialisation Practices")

Commercialisation Options for a Researcher/ Research Organisation⁷

Corporate deal

- Licensing to established company
- Joint venture with an established company

Start-up company

Funding Options

- Debt
- Government assistance programme (eg. START)
- Seed capital from business angel (eg \$300k)
- Loan capital
- Private stock offering
- Equity investment by a corporate
- Venture capital funds
- High risk (eg. \$2-5m)
- Development capital/mezzanine funding (eg. >\$5m)
- Public market (IPO)

⁷ Extract from Mitchell, G and Nossal, G, 1999, Funding options for research: facing the market as well as government, International Journal for Parasitology.

The Cambridge Model of IP Management

Cambridge University recognises that, as an employer of staff who are likely to make inventions in the normal course of their duties, it may acquire intellectual property rights in those inventions, in accordance with English patent law. However, it is not the policy of the University. Instead the University adopts a flexible approach to the ownership of intellectual property, and where possible will assign it to the inventor, provided that if an invention is successfully exploited, the University receives an appropriate share of the royalty income. The Cambridge University Industrial Liaison and Technology Transfer Office provides an advisory service for academics who need help in exploiting their know-how and Lynxvale Limited, the university's limited liability company, handles the commercial development of ideas.

One reason for this approach, in the view of Cambridge University, is that to do otherwise would be counter to the objective of encouraging and facilitating academic creativity. The University believes that if the know-how is to be successfully commercialised, it must depend upon the motivation of the individual to do so and that this motivation necessarily includes a financial dimension. The University asks, on an honour system, that academics declare and pay for the use of University facilities where they are used as part of the commercialisation process.

Through this approach, the University of Cambridge has created a culture of excellence and openness, excellence in research and openness in its dealings with the outside world, and in the dealings permitted and encouraged on the part of individuals.

The University has made it respectable for an academic to exploit their knowledge and make money in doing so, which in turn has helped seed the process of new firm formation. Cambridge is now surrounded by a flourishing high-technology sector.

Cambridge University is not alone in taking this approach to intellectual property ownership. Other leading universities which are well known for their record in the commercialisation of research results but which do not claim ownership of intellectual property, unless research contracts or other agreements state otherwise, include the Massachusetts Institute of Technology and Stanford University.

Comparison of US Bayh-Dole Act, Proposed Canadian IP Policy and UK IP Policy for Publicly Funded University Research

Provisions of the Bayh-Dole Act	Proposed Canadian Policy Principles	UK Policy
<p>Universities are required to determine in a reasonable time period whether they will take title of federally funded inventions. If they choose not to, title may revert to the federal government. Universities are restricted in their ability to assign title to any other party.</p>	<p>Universities are required to determine in a reasonable time period whether they will take title to federally funded IP. They may elect to assign title back to the inventor under the following circumstances:</p> <ul style="list-style-type: none"> • If the university has decided not to pursue commercialisation; • If the university fails to commercialise the innovation within a reasonable period of time; or • If the university agrees that the inventor can maximise returns to Canada without undue conflict of interest. <p>Universities may assign IP to firms when this is considered necessary to ensure the success of the innovation.</p> <p>Universities can assign IP to affiliated research organisations (eg. hospitals, research centres and NCEs) if they determine that the other party can maximise returns to Canada without undue conflict of interest.</p>	<p>British universities own the IP they generate from research funded by the funding bodies and are solely responsible for protecting, managing and exploiting it. If universities decide not to pursue commercialisation, they are free to assign IP to employee inventors.</p>

Provisions of the Bayh-Dole Act	Proposed Canadian Policy Principles	UK Policy
The university must disclose inventions to the federal government in a reasonable time period. Failure to do so entitles the government to take ownership of the undisclosed invention.	The university must disclose IP to the federal government annually, provided that such information is not subject to the Access to Information Act.	Consistent with a policy of delegation, the funding bodies do not require universities to disclose formally the IP they generate, nor to seek authority to protect and commercialise it.
Once a university takes title to a federally funded invention it must file patent applications in a reasonable time period, otherwise title reverts to the federal government.	Once a university (or affiliated organisation) takes title to IP arising from federally funded research, it must make reasonable efforts to commercialise IP in a manner that maximises benefits to Canada.	There is no explicit requirement on universities to exploit IP in a manner that maximises benefit to the UK. The UK Government believes that all exploitation and commercialisation from the science and engineering base has potential to create wealth and contribute to the UK economy, in some cases through inward industrial investment by overseas manufacturers.
The government retains a non-exclusive right to utilise any innovations that it needs.	The government retains a non-exclusive right to utilise any IP that it needs.	The funding bodies have no retained rights to licenses of any type or to a share of revenues.

Provisions of the Bayh-Dole Act	Proposed Canadian Policy Principles	UK Policy
<p>The federal government requires periodic reporting by universities on commercialisation efforts.</p>	<p>The federal government requires annual reporting by universities on commercialisation efforts.</p>	<p>There are two types of reporting:</p> <ul style="list-style-type: none"> • Both the funding councils and the research councils require universities to submit annual reports of their commercialisation activities and achievements. These reports give an overview of their IP management performance in generating and managing IP. The funding bodies are attaching greater importance to these reports and it is likely that more detail will be required in the near future. • In the case of research project funding, the research councils expect universities to give a full account of IP arising from each research project in final project reports.
<p>Universities are required to share royalties with inventors, and use any net gains to support scientific research or education.</p>	<p>Universities (and their affiliated organisations) are required to share royalties and equity with inventors, and use any net gains to support scientific research or education. Tenure and promotion policies must also appropriately reward innovative researchers.</p>	<p>As part of their commercialisation strategies, universities are expected to secure a suitable financial return (royalties or equity shares) for inventors and any others directly involved in generating exploitable IP.</p>
<p>Universities may not grant exclusive rights unless the invention is manufactured substantially in the US.</p>	<p>Universities (and their affiliated organisations) will use reasonable efforts to license or assign innovations locally or nationally. Whenever possible, licensing should be to a Canadian company or a Canadian subsidiary of a foreign company. Commitments to Canadian value added should be obtained when foreign licensing is the only feasible route.</p>	<p>There are no explicit directions or guidance to favour British companies, which in any case would breach European Union regulations.</p>

Provisions of the Bayh-Dole Act	Proposed Canadian Policy Principles	UK Policy
<p>Small businesses are given priority when licensing innovations in cases where they submit equally credible plans as larger firms.</p>	<p>Small business, including local spin-off companies, will be given priority to license federally funded IP when they submit equally credible plans as larger firms.</p>	<p>There is no formal process for favouring small businesses in licensing. The UK Government has created broad ranging incentives and structures to encourage small businesses, spin-offs, incubators and S&T business parks. These policies have been set out most recently in the 1998 White Paper on Competitiveness <i>Our competitive future: building the knowledge based economy</i>. More effective transfer of knowledge and technology from universities to industry and commerce lies at the heart of the Government's vision for a knowledge-based economy.</p>

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