Recent Developments in Intellectual Capital and Intellectual Property Universities

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Abstract

This paper reports some preliminary research on international developments of policies regarding University governance, the corporatisation of research, the management of university intellectual capital (IC) and the management of intellectual property (IP). A brief case study is provided which reviews contemporary Australian and Italian policy prescriptions concerning innovation, commercial practices and IP protection issues.

Universities, as creators of knowledge, have a key role in the new ‘Knowledge era’. However, issues remain as to how university research is to be funded and how are the intellectual capital of this research to be distributed. The role of industrial partnerships in meeting this need will be explored, as will issues concerning the complex contracts regarding ownership of IC and IP, the protection of public funds and risk transfer that accompany these relationships. It will be found that there are limits on the financial resources universities can obtain from private industry or other non-government sources. That is, while industrial financing can complement government financing, it will be argued that it cannot replace it. While university research can certainly make direct, short-term contributions to national economic goals, substantial core funding unrelated to identifiable short-term goals will continue to be required, if universities are to conduct the basic research on which the long-term vitality of the knowledge-based economy depends. Without this public funding, universities will be obliged to focus excessively on short-term research that could be carried out in other types of institution. This may be detrimental to the traditional mission of universities to conduct long-term, basic research and to impart knowledge to a new generations of students.

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1. Introduction

The western world has entered what is commonly referred to as the 'Knowledge Age', where information and ideas have overtaken agricultural produce and manufactured goods as key commodities (Dunford, Steane and Guthrie, 2001). National wealth and economic strength are now being measured in terms of knowledge, its usefulness, and the speed with which it can be applied. Nations are being forced to compete in a global information economy where ideas, information and knowledge have no boundaries, instead multiplying and growing at a hectic pace (Petty and Guthrie, 2000).

Essentially demands of globalisation and rapid advances in technology have led to national leaders calling on their nations to become ‘knowledge economies’. The very words ‘knowledge economy’ bring universities, as the producers and transmitters of knowledge, to the forefront of the political and public arena. At the same time universities are experiencing cutbacks in government funding forcing them to find alternative means to meet demand while maintaining their integrity.

Alongside this development, the university sector internationally has also come under pressure to become more ‘relevant’, to establish commercial partnerships, and to collaborate in research endeavours (OECD, 1998). These collaborations can be with other universities, third sector non-profit organisation or private sector profit making organisations.

In this knowledge based world, value and the maintenance of a competitive edge depends more and more on the management of ideas and innovation. As governments and their agencies embrace the ‘Knowledge Age’, the value of, and demand for, government information and services will increase significantly (OECD, 1999a). It is vital that
various national, state and regional governments place themselves in such a way as to be
able to successfully manage, develop and use available intellectual assets to meet such
demands. Given the increasing interaction between the public and private sectors (Olson,
et al., 2001), these demands have much wider ramifications, including the need for
changing accountability relationships between universities and industries, and increased
transparency on outcomes. Martin (2000a) states that the opportunities for many
stakeholders to share in the commercial success of state funded research have also arisen.

The pro-active management of intellectual property (IP) is becoming an increasingly
important consideration for government agencies and other bodies in maintaining
knowledge results (Barrett, 2001). Alongside the growing importance of innovation and
creativity to national wealth creation (Petty and Guthrie, 2000), an increasing need for
detailed research on policy issues associated with the management of university based
intellectual capital (IC), and its legal aspect, intellectual property (IP), can also be
perceived.

This paper reports some preliminary research on the international development of
policies regarding University governance, the corporatisation of research, the
management of University IC and IP. A brief case study is provided which reviews
Australian and Italian policy prescriptions concerning innovation, commercial practices
and IP protection issues.

The aims of the paper are threefold:

1. To undertake a review of OECD and a number of national government statements
   concerning the ‘Knowledge era’, the need for innovation and creativity and the
   role of universities in this process.
2. To identify the current Australian and Italian policy debates concerning the above
   issues.
3. To use the outcomes of this research to contribute to public policy debate
   concerning the relationship between universities and industry in different
   contexts, and to discuss issues concerning the management and exploitation of
intellectual capital by business, research institutions and other users of intellectual property systems.

Section 2 outlines key aspects of the knowledge management debate and the rise of IC and IP issues in modern society. The changing role of the public sector, including universities facing this knowledge development will be explored. In Section 3, new configurations of university research finance, which have emerged in several countries in response to the fact that Universities: a) still fund a large part of basic research activities, but b) have been struggling for national funds during previous decades - are outlined. Section 4 seeks to discuss both the collaboration and partnerships models that universities are developing as well as some of the implications of these models. Sections 5 then outlines the Australian and the Italian university policy issues related to research corporatisation and intellectual property. A comparison between these two OECD countries’ experiences can be useful to address future directions in the IP issues debate, given the different experience Australia and Italy have in terms of research corporatisation. Finally, some issues for future policy debate will be outlined.

2. The knowledge era, organisational knowledge and intellectual property.

Knowledge may be defined as information integrated with experience and context, subjected to interpretation and reflection. It is a high value form of information that is ready to apply to decisions and actions. The rising importance of knowledge-intensive employment and the knowledge society is highlighted by various recent OECD reports (OECD, 1997; 1998; 1999b; 2001).

Knowledge management is the process of capturing the knowledge gained by individuals and spreading it across the organisation, in order to increase the capability of the organisation to both create new knowledge and embody it in products, services and systems. Duffy (2001: 59) observed that: “the ultimate objective of managing knowledge is to capitalise on the intellectual capital, specifically to encourage knowledge transfer and support knowledge sharing and reuse.” ‘Knowledge workers’ is a term that has only
existed for some forty-odd years. From obscurity, the emphasis on knowledge has come
to dominate the corporate mind, where today they comprise about a third of the
workforce in industrialized nations, to a position equal in number to manufacturing
workers. The challenge for higher education institutions is to galvanize the knowledge
locked within them to provide formal education and skills at growing the knowledge-acquiring capacity of this rising group within the workforce. Universities will be required
less to provide skilled vocationally-orientated graduates, but graduates skilled in their
vocational choice, but with broader skills at acquiring the knowledge necessary to change
roles and incorporate differing functions during work: working in teams, managing
projects, and so forth.

However, if benefits are to be realised, the right skills, culture and commercial acumen
must be put in place, bearing in mind the nature of public service, public university
administration and the associated responsibility and accountability to citizens. While
explicit knowledge is largely stored in computer systems, a great deal of tacit knowledge
resides within people. The major task of management is to deal purposefully with this
knowledge. Organizational strategy must include means to identify 'missing' or orphaned
knowledge (Caddy et al., 2001) and to be wary of intellectual liabilities (Caddy, 2000).

While perhaps not recognised as such, the management of knowledge has always been at
the core of what the public sector and its associated organisations do, and it is inseparable
from strategy, planning, consultation and program implementation and accountability
reporting.

Similar to the situation with IC, the pro-active management of IP is becoming an
increasingly important consideration for nations and their agencies, including
Universities, in maintaining the capabilities of the nation state to achieve an effective
transformation into a networked, collaborative, knowledge based society (OECD, 2000).
Barrett (2001), the Auditor-General of the Commonwealth of Australia, defined Intellectual Property (IP) as the rights granted by law in relation to the fruits of human creative activity. His more specific and technical definition is as follows:

“Intellectual Property includes all copyright (including rights in relation to phonograms and broadcasts), all rights in relation to inventions (including patent rights), plant varieties, registered and unregistered trademarks (including service marks), registered designs, circuit layouts, and all other rights resulting from intellectual activity in the industrial, scientific, literary or artistic fields.”

The following Figure 1, Grouping within the organizational knowledge framework, locates IP in the wider perspective of organisational knowledge (Contractor, 2000). The figure provides clarification of the concepts used, and their interrelationships, particularly when speaking about IP, IA, and IC.

Figure 1: Groupings within the Organisational Knowledge Framework

Source: Contractor, 2000; Figure 1
Categories (I) and (II) in Figure 1 (above) make the distinction between IP that is registered (say, with a Patent) and that which is unregistered (for example, drawings), but recognisable in a tangible fashion (codified) and central to an organisation's core business, continuity and success. Category (III) is the least tangible (uncodified) asset and is basically tacit intellectual human capital. While the author is concerned to establish a general set of principles for the valuation of IP, the main purpose of this Chapter is to stress IP as part of a whole management of knowledge approach. The issues of measurement, valuation and reporting are not the focus of the current research efforts (see, Guthrie, 2001; Guthrie and Petty, 2000; Guthrie, Petty and Johanson, 2001 for more details).

Barrett (2001) rightly indicates the unpalatable fact that: “many public sector entities do not know what they own in the form of intangible assets, such as intellectual property” and also IC and the University sector can also be included in this statement.

Intellectual property rights have gained international standing as some of the most important rights that need legal protection. It is not surprising that governments have therefore focussed their attention on IP management. For example, the United Kingdom (UK) Government is encouraging public bodies to make better use of their IP assets and has focussed on the commercial exploitation of the outputs of publicly funded research in a variety of ways, including joint ventures with private sector partners. In 1999, the UK government published a White Paper "The Future Management of Crown Copyright" (UK Ministry, 1999) that dealt with the issue of availability and access to government information and government-produced materials. The paper allows government departments freedom to decide how works they originate are to be distributed or commercialised, with the exception of Acts of Parliament and Statutory Instruments. The UKNAO, (2001) states that:

“public sector information assets have potential, not only in supporting the business of government, but also in supporting the economy as a whole. …Where value has been
added, or information developed and created within government, [...and it] is enhanced beyond core obligations or statutory duties to produce that raw information, then such information is potentially tradeable.”

Such developments suggest fundamental changes in assessing the higher education market (Holman 2000) where assumptions about knowledge creation are changing along epistemological, pedagogical, organizational and social lines. The White Paper deals with how knowledge within the university environment is manifested and what is done with it. For universities, the invitation is to see an interdependence between content, method, and economic context, that is, in the last analysis, the key to generating knowledge capital.

Leif Edvinsson, formally of Skandia and now with Knexa Enterprises, presented a challenging view of future university education at the 4th World Congress on Intellectual Capital 2001 (Hamilton, Ontario) (Bontis 2001). He envisages the business of higher education as wealth creation via the generation of knowledge, and that the management of such institutions is a business. Edvinsson lamented the inability of university deans in managing their business to keep pace with the innovation and flexibility evident in industry and technology. While the time, expense and effort afforded to acquire almost any product has brought benefits to the consumer over the past 40 years, similar savings and efficiencies and flexibility is not evident in the acquisition of university degrees.

The above section outlined several key aspects of the knowledge management debate and identified the importance of IP and IC to contemporary public services, including universities. Now we can turn our attention to several contemporary policy issues associated with University research.

3. University research in transition

Universities and other higher education institutions are key elements in the development of science and other forms of knowledge in OECD countries. They perform basic and
applied research, and train researchers and other skilled personnel. Differences, however, exist between OECD countries regarding the position of university research in science and its relationship to research undertaken in other publicly supported research institutions. Several profiles can be drawn on the basis of national cultural background and economic structures. The OECD (1999b: 21-23) offers four profiles for understanding these differences:

a) **In Anglo-Saxon countries**, universities are the major source of basic research, but they co-exist with public research institutions devoted to sectors of national interest, such as defence, energy, agriculture and medicine. The latter may undertake basic research where needed, although they are generally involved in applied and technical research activities.

b) **In large continental European countries**, university research co-exists (and co-operates) with a large public sector engaged in basic research in its own laboratories [Germany’s Max-Planck Society, France’s Centre National de la Recherche Scientifique (CNRS), Italy’s Consiglio Nazionale delle Ricerche (CNR)], which are also involved in technical and applied activities, to provide either R&D infrastructures (as in Germany) or mission-oriented activities (as in France and Italy).

c) **In smaller continental European economies**, public research tends to be mainly oriented towards technical and industrial research activities, while universities perform most basic research. There are, however, important differences among countries: some have a large public sector (e.g. Norway, Iceland and Portugal), while others do not (e.g. Switzerland).

d) Finally, **in East Asian countries**, which were formerly strongly oriented towards technical applications and the assimilation of foreign technology, university research has remained modest, owing to a lack of financial support, over-regulation and the burden of teaching tasks. The situation is changing rapidly, however, as these countries, amongst them notably Japan, are boosting their basic research efforts via support for university research.

While university research, including basic research, contributes significantly to innovation and technical change, this contribution is largely indirect. Recently the OECD,
(1999b) identified that firms, key actors in innovation, rely little on university (and public) laboratories as a source of information or stimulus for their innovative efforts, as a number of surveys, including recent empirical analyses of national innovation systems, have demonstrated. Even in science-based sectors, interaction with competitors, suppliers and customers is considered more important for firms’ innovative efforts than information from university or public sector research (OECD/DSTI, 1997b).

Internationally, in response to these issues, there have been significant changes in the past decade in the university environment which have affected the research-related missions of these institutions. In particular, universities are becoming more diverse in structure and more oriented towards national and international economic and industrial needs. At the same time, they have to cope with higher student enrolments, and lower student subsidies, particularly in continental Europe (OECD, 1999b: 6). These trends raise serious questions regarding the capacities of universities to continue making a significant contribution to long-term research, whilst maintaining an appropriate balance between research, training, teaching and knowledge transfer.

A recent OECD (1999b) report on university research in transition, notes that university research represents between 15 and 35 per cent of overall R&D expenditure in the OECD economies. It also indicates six major implications concerned with university research in the last decade:

1. Declining government R&D finance. Government R&D budgets have been reduced in several OECD countries, often leading to a levelling off, or even a decline, in university research support. Traditionally, 80 per cent or more of university research was financed by governments as a “public good”, but this share has been declining, with the result that universities are seeking new sources of financial support.

2. Changing nature of government finance. Government funding for academic research is increasingly mission-oriented, contract-based and more dependent on output and performance criteria. This can lead universities to perform more short-term and market-oriented research.
3. *Increasing industry R&D finance.* Private industry is funding an increasing share of research in universities. This support, in the form of joint projects, contract research, and financing of researchers, is also leading universities to perform research more directed to potential commercial applications.

4. *Increasing systemic linkages.* The institutional context of research is changing as universities are encouraged to enter into joint ventures and co-operative research with industry, government facilities, and other research institutions.

5. *Growing demand for economic relevance.* Universities are under pressure to contribute more directly to the innovation systems of their national economies. However, they are often constrained by rigidities arising from the traditional disciplinary organization of research and other University structures. This can cause considerable tension in the university research environment.

6. *Internationalisation of university research.* Globalisation, stemming partly from advances in information and communications technologies, is affecting the climate for research and the conduct of R&D. It is also making research more competitive and leading to increased specialisation.

The OECD (1999b: 8) report indicated that universities are recognised as essential to the knowledge-based economy, and that no nation will willingly permit a serious, permanent decline in the research, training or knowledge-transfer capabilities of their national systems. In the early part of the 21st century, however, university research and its relation to society are likely to be different from what they were at the end of 1990s. The report notes that OECD countries need to ensure that universities can continue to perform their functions to the benefit of society at local, national, and global levels.

What is needed is university education that encompasses greater flexibility. It is so-called ‘knowledge nomads’ who are the likely inheritors of the new knowledge economy emerging in innovative universities. These universities are institutions that see their role as brokers of knowledge-workers, who are free to generate knowledge-wealth, rather than be merely protectionist-style employees of institutions concerned about brand and products. Such defensiveness mimics the enclosed monasteries from which many
universities arose and does not deal with the challenges of knowledge creation in today’s economies.

One of the fundamental lessons arising from these reformist approaches to university research in the OECD is the importance of flexibility and particularity. There is less interest in centralised and inflexible ways of delivering education services. Knowledge generated through research can be maximised through systemic partnerships. As the earlier Figure 1 emphasises, intellectual capital includes the way knowledge is managed within organisations and involves some "creative dislocation", that is, loose networks between researchers and business.

It must be noted that, quantitatively speaking, university research plays a relatively modest role in OECD science systems. In the five largest scientific powers (the United States, Japan, Germany, France and the United Kingdom), it represents about 15 per cent of the total R&D expenditure, and in other countries it ranges between 25 and 30 per cent (OECD, 1999b: 20). However, universities do fulfil an essential function as the principal performers of basic research. For the five largest scientific powers, universities undertake 60 per cent or more of basic research. In general, basic research amounts to half of university research, although this share is tending to diminish.

Universities are increasingly involved in applied and technical tasks as their relations with the business sector intensify. At the same time, it should be noted that modern technologies (e.g. biotechnologies) are blurring more and more the boundary between basic and applied research (and, to a certain extent, technical development).

In summary, the above discussion indicates the importance of Universities in the knowledge based economy and the changing nature of the financial mix between University and other organizations’ R&D expenditure. More importantly, it indicates some major implications that must be addressed by Universities, particularly in the nature of research, research training and in the management of knowledge-transfer capabilities.
4. Collaboration and partnerships with industry

With the increasing emphasis on knowledge transfer between the Universities and society, one notable form of knowledge transfer has been the commercialisation of research results and innovation. Universities have several stakeholders in this process, including the individual researcher or research team, the private business partners and possibly an entrepreneur who might take the product to market. These relationships require complex contracts regarding ownership of IC and IP, protection of public funds and risk transfer.

The dominant patterns of collaboration between industry and universities relate to technology transfer, with the universities being seen as a source of knowledge to support commercial purposes. A variety of links exist between universities and business enterprises. Knowledge generated from universities can be understood as a public good that needs management in order to maximize the wealth creation activity. Partnerships between universities and industry are part of broader interdependencies between different economic entities. Such linkages can be seen in the rhetoric of, Tony Blair's *Third Way* and Gerhard Schroeder's *Neue Mitte*, as well as present efforts by George W Bush's Office of Faith-Based Action, designed to generate greater alliance between churches and the delivery of government services. In all this interdependency, universities sit at the cusp of an opportunity to both be competitive and build cohesion at the same time.

There has been a dramatic growth in the development of a very wide range of public private-type partnerships. As a crude measure of their extent and importance, a search through GOVBOT, the US federal government's database of web sites using the words 'public private partnership' resulted in 8,830 hits. A similar search through the UK government's CCTA Government Information Service resulted in over 1,000 documents being identified. Influential national lobby groups promoting public private partnerships have been established in the USA (The National Council for Public Private Partnerships, the successor to The Privatization Council, established in 1985) and Canada (The Canadian Council for Public-Private Partnerships).
The OECD (1998) reports several schemes, which have proven effective, and these are described below. The four main schemes are: the pre-competitive approach, the centre based approach, the direct business funding approach and the University entrepreneurial approach. These are now expanded, the first, the pre-competitive approach involves government funding of University and business research to solve a basic industry problem. For example, Germany has encouraged university-industry partnerships as a means of speeding up technology transfer. German policy towards knowledge transfer has been to support pre-competitive approaches across industries. The OECD (1998) reports that between 1991 and 1996, some 350 projects were funded in the areas of medicine/pharmacy, food, plant breeding, and environmental biotechnology. This was done in an attempt to facilitate the rapid transfer of research results to industry and to increase the R&D activities of small and medium-sized enterprises (SMEs). This support programme was found to have contributed substantially to speeding up the commercialisation of biotechnology in Germany.

Collaborative research between different business enterprises and research institutions on a single project has been found to contribute to the better exploitation of limited research capacities through the pooling of resources, the speeding up of technology transfer between science and industry, the generation of synergy, and large-scale (as opposed to selective) promotion. As government support is available only at the pre-competitive stage, projects tend to involve basic industrial research. Subsequent company-specific solutions are developed without government support.

The second scheme, center based research, seeks to foster co-operation between Universities and industry research laboratories. Since the late 1970s, the US National Scientific Fund has had a number of different programs to facilitate co-operation between university and industrial research laboratories and to promote knowledge transfer. The two most ambitious of these, initiated in the late 1980s, involve the Engineering Research Centres and the Science and Technology Centres, which provided substantial support for
up to ten years for research in areas of interest to industry. A recent and highly positive evaluation of the Science and Technology Centres affirmed the value of long-term stable funding and found the centres to have produced research of high scientific quality which could only have been addressed through such centre-based research. The evaluation concluded that dissemination of both their basic and applied research had been highly successful (OECD, 1998). The active co-operation and participation of industry was seen to lead to better research, new ideas, leveraged funding, increased staff appreciation of the industrial sector and better preparation of students entering the workforce.

The third scheme involves direct business funding of University research. Governments are encouraging universities to seek direct industrial funding research support by various means (e.g. by making support partially conditional on establishing industrial research partnerships). Industrial support, whether in the form of contracts or research partnerships, promotes the integration of universities into the knowledge-based economy. As a result, during the last fifteen years, most OECD countries have experienced a higher growth of private funds for research in universities compared to the government funds rate. On average, as seen in Table 1 Share of total business enterprises funds and government funds performed in the University R&D sector, the growth rate of business enterprise funds deployed in the university R&D sector has been 150.8% in the decade 1985-1995. In the same period, the growth rate of government funds has been only 25%.

< Insert Table 1 about here >

The fourth scheme seeks to encourage Universities to establish ‘profit’ centres and generate their own form of venture capital, that is, to undertake an ‘entrepreneurial’ approach. By exploiting opportunities for industrial contracts and partnerships, some academic institutions are gradually transforming themselves into partially, or even predominantly, self-financed “profit” centres. This trend is likely to be amplified, although it will not become the dominant pattern for academic research within national science systems. Concerns expressed in the past about the ownership of intellectual property resulting from university research linked to industry, or about possible
limitations imposed on the publication of commercially relevant research results in the open literature, have most often been settled to the satisfaction of both university and industry partners. A more serious problem centres around the fact that not all types of higher education institutions, nor all disciplines, can prosper equally in this way. For example, medical and engineering schools tend to excel in this arrangement; science-oriented institutions, however, find it more difficult, while for most of the social sciences and all of the humanities, it is virtually impossible.

In summary, industrial partnerships can be of benefit to university research. However, there are limits on the financial resources universities can obtain from private industry or other non-government sources. While industrial financing can complement government financing, it cannot replace it. While universities can certainly make direct, short-term contributions to national economic goals, substantial core funding unrelated to identifiable short-term goals will continue to be required, if universities are to conduct the basic research on which the long-term vitality of the knowledge-based economy depends.

5. Current Australian and Italian Policy Debate

This section will briefly discuss a number of current university research policy debates in the Australian and Italian context. This brief case study will provide a more in-depth comparison of the two OECD countries experiences with research corporatisation and highlight a number of issues for the future direction of the IC and IP issues debate. We will start with Australia in section 5.1 and then proceed to Italy in section 5.2.

5.1 Australian policy debates

In Australia, during the last decade, overall support for university research has been maintained, with a marked increase in contract-based funding and development of output criteria. More funds have been provided for industry-university co-operative schemes such as Strategic Partnerships with Industry Research and Training (SPIRT).
The management of the commercialisation of research is increasingly being seen by many as part of a broader business management imperative cutting across the broad range of university teaching, research and community service functions. To contextualise these statements, the Australian higher education sector (AHES) revenue totalled some $9,600 million in 1999, of which 39% was raised from non-Commonwealth sources. Total higher education sector equity, including commercial entities, was $19,500 million at end 1999 compared with $18,800 million when commercial entities are excluded. Some 34 higher education institutions reported having commercial entities in their 1999 financial statements. Nineteen had commercial entities contributing a net surplus (before abnormal items) totalling $43.4 million. Twelve had commercial entities contributing an aggregate new deficit of $8.5 million to their consolidated operating result. The largest negative effect of commercial entities to the operating result of a university was around $2 million in 1999. The aggregate consolidated revenue for the sector in 1999 increased by $417 million (4.5%) from 1998. Of the $417 million increase, more than a third, (around $151 million) was contributed by commercial entities. The contribution of the commercial entities to total sector revenue was 6.1% ($583 million) in 1999.

Over the last few years, many universities have been reviewing the nature of their technology transfer activities (including research, testing and consultancy services, as well as supply of post graduate research students). Many have taken action to professionalise their management of commercial activities, activities that, for any business, are inherently risky, demanding that commercial, legal and ethical judgements be made. Measures taken have included separation of functions, clear assignment of responsibilities, appointment of business managers with commercial expertise, formation of Boards of Directors with a range of commercial experience, promulgation of institutional policies and procedures, and engagement of expertise from outside as required (eg Patent Attorney).

Michael Gallagher (2000), Head of the Australian Higher Education Division, DETYA, indicated that in addition to the desirability of documenting the emergence of new
policies, structures and procedures being adopted by universities in relation to research commercialisation, some questions need to be addressed, including:

- What new skill sets are required of leadership teams in modern universities and how are those skills obtained?
- How and to what extent do different IP ownership policies motivate researchers to pursue commercialisation options?
- What lessons can be learned from the variety of approaches taken to IP scanning?
- What differences (by field of research) exist in terms of conditions and effective strategies for commercialisation?
- What is the relationship between effective industry take-up of research and enterprise size?
- What specific lessons have been learned from experiences with incubators and science/technology parks?
- What are the roles of the humanities and social sciences in innovation?

Current thinking within the IMHE group of the OECD (OECD, 2000) suggests that large firms look to university research to complement their own R&D in, for example, chemistry. However, in biosciences, IT, pharmaceuticals and computer graphics, where the distinction between basic and applied science has largely dissolved, scientific parity rather than division of labour exists between industry and academic workers. Research-based relationships with small entrepreneurial firms or start-ups generally pose greater complexities for universities than their contacts with large firms. Small firms, lacking the financial resources to support overheads for internal R&D, focus on applying research findings to developing marketable products and seek direct involvement of university scientists and, lacking cash, pay with equity. It is in this area where conflicts of interest can arise for academic researchers. This is also the area of greatest involvement in Australia, fostered through the creation of research parks and business incubators.

A recent report of the OECD’s DSTI (2001) working group on national innovation systems stresses that “innovation patterns are highly country-specific, depending on the
individual country’s economic specialisation and institutional set-up.” It would therefore be useful to know much more about Australian circumstances, including:

- In what significant ways does Australia’s industry and enterprise structure differ from US and European structures? And what do these differences mean for the supply of and demand for R&D from industry?
- In what ways does the supply of Australian public sector R&D differ from public sector supply arrangements and concentrations in the US and Europe?
- What is the extent of industry take up of Australian research by industry sector, enterprise size and by field of research?
- What are the constraints operating on industry take up of public sector research in Australia by industry sector, field of research and enterprise size?
- What are the main options for commercialisation of research outside of industry take-up by either Australian or foreign enterprises?
- What makes for success in business start-ups and spin-offs from university research? What are their expected success rates and how do they compare with those of small businesses generally?

Australian policy makers believe that the best mechanism for knowledge transfer is the mobility of persons who have both transferable skills (including research problem-solving abilities) and a good informal network of professional contacts. The Co-operative Research Centres (CRC) programme has supported long-term collaborative ventures linking research and research users from universities, Commonwealth and state-funded research organizations and business enterprises. The program has also improved Australia’s research culture.

Recently, Neumann and Guthrie (2002) provide a detailed case study of the development of academic research policy in Australia from the mid eighties. Their research highlights a move away from individual academic and disciplinary autonomy in the determination of research, towards a performance economy in research. Through funding policies and strategies, there has been a continual increase in the centralisation of ever-scarce
resources by the government and a competitive redistribution system that rewards those aspects of research that achieve government policy goals (eg. collaboration, private–public partnerships). Ironically, while the rhetoric of government policies has been that of competition and corporatisation, with implied decentralisation and freedoms, the impact appears to be stronger government control and intervention (Boyer, Altbach and Whitelaw, 1994). International comparisons show that Australian government control of universities and research and publication is above average of OECD nations) (Anderson and Johnson, 1998).

5.2 Current Italian Policy Debate

In Europe, there are notable differences in the treatment of research funding and links with private funds, particularly between the countries with the largest scientific investment. The OECD (1998) report on research in different countries highlighted the substantial growth that Italy experienced during the 1970s and 1980s. It also notes that since that time, Italy has seen a regular decline in government support for the R&D sector, the overall university R&D effort being reduced in nominal terms in 1996. Italy spends about 1.4 per cent of GDP on R&D, compared to the OECD average of 2.8.

Universities and other public institutions (such as the National Research Centre\(^1\), the Italian Space Agency, the National Institute of Nuclear Physics, the National Institute of Health) are required to carry out research. From the mid-nineties, R&D expenditure policy affected an increase in the level of responsibility held by universities over the outcomes of research projects. Public R&D funds (both from the Ministry of Higher Education and from the National Research Centre – CNR) have become heavily focused on research issues identified as priorities by public institutions.

\(^1\) Besides funding research grants and scholarships for research training, and advising government, the CNR itself undertakes scientific work directly in 289 research bodies. Of these, 115 study centres and 17 research groups involve collaboration with universities and other agencies.
The relatively poor level of national and local research finance should, in theory, be compensated for by means of European Union R&D funding mechanisms. However, in practice, few Italian researchers have been able to obtain such funding, owing to the high level of competition for funding amongst research teams from other European nations.

Recent R&D policy has sought both to concentrate research activities in fewer universities and, within those universities, to concentrate effort in particular research specialisations. Thus, a number of highly specialized centres have been created and funded (Centri di Eccellenza). This policy reflects in part a response to the increasing levels of competition and growing research costs being experienced by many disciplines. It also reflects the need of scientists in an increasing number of disciplines to use large-scale research facilities which are beyond the resources of any single institution and, in some cases, any single country, to provide. For a number of reasons, however, the trend towards concentration and specialisation is likely to be self limiting.

*The University of Ferrara: a case analysis.*

The University of Ferrara is a medium sized university in Italy. Since its establishment in the fourteenth century, its primary research emphasis has been science. Pharmaceutical science, surgery, medicine, biology and embryology account for the bulk of research investment. Partly in recognition of, and partly to enhance, this long tradition, the University of Ferrara was recognised in 2000 as an area of research excellence in the field of infective pathology (“Centro di Eccellenza sullo studio delle patologie infettive”), the only such centre in the region. As shown in Table 2, University of Ferrara, share of business enterprises funds and government funds in the University R&D areas, the “health” research area attracts almost 63% of total research funds, including infrastructure finance, matching the general situation of many other universities.

Amongst the 9 research areas (Table 2), the majority of funds (75%) are absorbed by the ‘health’ and ‘chemistry’ research areas, leaving just 25% of funds for the other 7 areas.
The research area of Economics receives the least funding (1.9%). This probably reflects the fact that the school was only recently established.

As has been common elsewhere (OECD 1999), R&D funding has generated extensive discussion during the last two decades at the University of Ferrara. The traditional approach to research funds management, combined with the rigid institutional structure of Italian research and the recent experience of research training in Italian universities, has resulted in many universities managing research funds through a dedicated non-profit organization, such as the Consorzio Ferrara Ricerche (CFR) at Ferrara University. CFR manages almost 50% of the R&D funds deployed by the University of Ferrara. Of these funds, 75% are supplied by business enterprises, 23% by local authorities, with the final 2% being supplied by government. All government R&D funds are managed through the university’s individual departments.

The use of a non-profit organization to manage research funds provides the flexibility necessary to develop a business oriented management structure for the tertiary R&D sector. The service provided by the CFR benefits not only local enterprises: it performs the bulk of its services for enterprises located in other regions of the country (69%) and also abroad (10%). The business enterprise funds undertaken at the University of Ferrara (through the CFR) support both the ‘evergreen project’ and applied research, in addition to basic research.

During last few years, the research policy emphasised the link between outcome, output and results of the research. Following the new national R&D policy, the University of Ferrara has shown an increase willingness to undertake collaborative research projects. As a result, a more business oriented attitude has been developed. Researchers believe that 44% of research outcomes could generate patents, among which 32% could be European patents. The corporatisation of research has thus raised the issue of intellectual property. As can be seen from table 2, the departments of pharmaceutical science,
biology and medicine are undertaking a marked program of corporatisation. Within this new collaborative approach, the business enterprise bears the risk of failure and the potential benefits of a successful new product launch.

Another aspect of the corporatisation of research requiring attention concerns ‘spin offs’ from research outcomes. The Ministry of Higher Education (2000) reports that it has noted a low incidence of such ‘spin offs’. This is partially due to the weak rate of patents and the bureaucracy of the Italian funding system and demonstrates the weak link between university R&D and market business. In an attempt to remedy this problem, the University of Ferrara spin-off centre has been established. In less than one year, it has already generated business valued at $US400 000.

6. Summary and future policy issues

The higher education sector has performed an increasing share of government-funded R&D in most countries. The relative decline of government financial support has been partly compensated by support from the business sector, which nonetheless remains relatively modest in the vast majority of countries. Moreover, overall business R&D efforts have also been severely affected by the economic recession characterizing many OECD countries during the last decade.

These trends are relatively worrying, in that university research will continue to depend largely on government funding, even if funding from other sources necessarily grows. In fact, support for university research will likely be determined by the importance given to the R&D budget in overall government budgets.

Government policies intended to link academic research more directly to other sectors of the economy, and to require that at least some of the research supported by public funds be performance-based, are consistent with the importance of academic research to the knowledge-based economy. However, if carried to extremes, they can distort and undermine academic research by obliging universities to focus excessively on short-term
research that could be carried out in other types of institution. This may be detrimental to the traditional mission of universities to conduct long-term, curiosity-driven research and to impart knowledge to a new generation of students.

References


8. Tables

Table 1: Share of total business enterprises funds and government funds in the University R&D sector.

<table>
<thead>
<tr>
<th>Country</th>
<th>Business enterprises funds (%)</th>
<th>Government funds (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>United States</td>
<td>1</td>
<td>1.4</td>
</tr>
<tr>
<td>Canada</td>
<td>2.5</td>
<td>4.9</td>
</tr>
<tr>
<td>Mexico</td>
<td>-</td>
<td>3.6</td>
</tr>
<tr>
<td>Japan</td>
<td>0.5</td>
<td>0.7</td>
</tr>
<tr>
<td>Australia</td>
<td>1.5</td>
<td>1.9</td>
</tr>
<tr>
<td>New Zealand</td>
<td>-</td>
<td>4.4</td>
</tr>
<tr>
<td>Austria</td>
<td>1.2</td>
<td>1.4</td>
</tr>
<tr>
<td>Belgium</td>
<td>2.5</td>
<td>6.7</td>
</tr>
<tr>
<td>Czech Republic</td>
<td>-</td>
<td>0.3</td>
</tr>
<tr>
<td>Denmark</td>
<td>0.5</td>
<td>0.8</td>
</tr>
<tr>
<td>Finland</td>
<td>-</td>
<td>1.9</td>
</tr>
<tr>
<td>France</td>
<td>0.7</td>
<td>1</td>
</tr>
<tr>
<td>Germany</td>
<td>1.3</td>
<td>2.4</td>
</tr>
<tr>
<td>Greece</td>
<td>-</td>
<td>7.6</td>
</tr>
<tr>
<td>Hungary</td>
<td>-</td>
<td>1.1</td>
</tr>
<tr>
<td>Iceland</td>
<td>0.7</td>
<td>3.2</td>
</tr>
<tr>
<td>Ireland</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>Italy</td>
<td>0.6</td>
<td>2.5</td>
</tr>
<tr>
<td>Netherlands</td>
<td>0.5</td>
<td>2.5</td>
</tr>
<tr>
<td>Norway</td>
<td>2.1</td>
<td>2.8</td>
</tr>
<tr>
<td>Poland</td>
<td>-</td>
<td>9.6</td>
</tr>
<tr>
<td>Portugal</td>
<td>1</td>
<td>1.3</td>
</tr>
<tr>
<td>Spain</td>
<td>0.5</td>
<td>4.6</td>
</tr>
<tr>
<td>Sweden</td>
<td>2.5</td>
<td>2.4</td>
</tr>
<tr>
<td>Switzerland</td>
<td>0.5</td>
<td>0.7</td>
</tr>
<tr>
<td>Turkey</td>
<td>-</td>
<td>29.3</td>
</tr>
<tr>
<td>United Kingdom</td>
<td>1.7</td>
<td>2.4</td>
</tr>
<tr>
<td>Average growth rate</td>
<td>-</td>
<td>150.8%</td>
</tr>
</tbody>
</table>

(Source: OECD/DSTI data, 1999b)
Table 2: University of Ferrara, share of business enterprises funds and government funds in the University R&D areas

<table>
<thead>
<tr>
<th>Research Areas</th>
<th>Private Funds</th>
<th>%</th>
<th>Public Funds (ex 40%, ex 60%, CNR, UE, public organization s)*</th>
<th>%</th>
<th>Total Research Funds</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>HEALTH (biology, medicine, embryology, surgery, pharmaceutical science)</td>
<td>13.915</td>
<td>72.3%</td>
<td>7.368</td>
<td>51.1%</td>
<td>21.283</td>
<td>63.2%</td>
</tr>
<tr>
<td>CHEMISTRY (chemistry, cosmetics, biochemistry)</td>
<td>2.473</td>
<td>12.8%</td>
<td>1.487</td>
<td>10.3%</td>
<td>3.960</td>
<td>11.8%</td>
</tr>
<tr>
<td>ARCHITECTURE</td>
<td>331</td>
<td>1.7%</td>
<td>498</td>
<td>3.4%</td>
<td>829</td>
<td>2.5%</td>
</tr>
<tr>
<td>ENGINEER</td>
<td>915</td>
<td>4.8%</td>
<td>998</td>
<td>6.9%</td>
<td>1.913</td>
<td>5.7%</td>
</tr>
<tr>
<td>BIOMEDECIENCE</td>
<td>319</td>
<td>1.7%</td>
<td>693</td>
<td>4.8%</td>
<td>1.012</td>
<td>3%</td>
</tr>
<tr>
<td>ENVIRONMENT SCIENCE (agriculture, geology, botanics)</td>
<td>439</td>
<td>2.3%</td>
<td>765</td>
<td>5.3%</td>
<td>1.204</td>
<td>3.6%</td>
</tr>
<tr>
<td>ECONOMICS</td>
<td>240</td>
<td>1.2%</td>
<td>410</td>
<td>2.8%</td>
<td>650</td>
<td>1.9%</td>
</tr>
<tr>
<td>PHYSICS (physics and maths)</td>
<td>259</td>
<td>1.3%</td>
<td>1.432</td>
<td>10%</td>
<td>1.691</td>
<td>5%</td>
</tr>
<tr>
<td>HUMAN SCIENCE and LAW</td>
<td>0</td>
<td>0</td>
<td>775</td>
<td>5.4%</td>
<td>775</td>
<td>2.3%</td>
</tr>
<tr>
<td>WORKSHOP</td>
<td>360</td>
<td>1.9%</td>
<td>-</td>
<td>-</td>
<td>360</td>
<td>-</td>
</tr>
<tr>
<td>Total</td>
<td>19.251</td>
<td>100</td>
<td>14.426</td>
<td>100</td>
<td>33.677</td>
<td>100</td>
</tr>
</tbody>
</table>

(Table constructed from University of Ferrara data and from Consorzio Ferrara Ricerche data).
* This column synthesises the different kind of governmental research funds the university researchers can apply for. Thus, national research funds managed by the Ministry of High Education (ex-40%), local research funds managed by University of Ferrara (ex-60%), National Centre for Scientific Research funds (CNR), European Union funds (EU) and other public sector organizations funds are considered.