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***The Evolving Policy Landscape for Technology Transfer
from Public Research Organisations in South Africa***

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A dissertation submitted in fulfilment of the requirements for the award of the
degree of Master of Philosophy

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COMPULSORY DECLARATION

This work has not been previously submitted in whole, or in part, for the award of any degree. It is my own work. Each significant contribution to, and quotation in, this dissertation from the work, or works, of other people has been attributed, and has been cited and referenced.

Signature:

Signed by candidate

 Date: 12-02-2008

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Abstract

This dissertation examines the policy environment for technology transfer in South African public research organisations (PROs), with special emphasis on pending legislation designed to regulate the protection and exploitation of intellectual property rights from publicly financed research. The context is set by defining what is meant by the term 'technology transfer'. The rationale behind the decision of governments to support technology transfer and PROs to engage in technology transfer is discussed, and some of the controversies associated with PRO technology transfer are described. Selected policy options for encouraging technology transfer which have been adopted internationally are compared. The state of technology transfer in South Africa is summarised, and relevant elements of the policy environment are highlighted, in order to provide background to and contextualise the discussion of the pending legislation. The pending legislation is assessed in some detail. Drawing on lessons learned from the literature, from experiences elsewhere and on an understanding of the South African technology transfer environment, a set of recommendations is developed, in an effort to contribute to strengthening both the policy process and the policy framework itself.

List of Acronyms

ACST	Advisory Council on Science and Technology (Canada)
ARVs	Anti-Retrovirals
AUTM	Association of University Technology Managers
BBBEE	Broad-Based Black Economic Empowerment
CSIR	Council for Scientific and Industrial Research
DBF	Dedicated Biotechnology Firm
DoE	Department of Education
DST	Department of Science and Technology
DTI	Department of Trade and Industry
IPMO	Intellectual Property Management Office
MTA	Material Transfer Agreement
NIH	National Institutes of Health
NIPMO	National Intellectual Property Management Office
NSI	National System of Innovation
OECD	Organisation for Economic Co-operation and Development
PRO	Public Research Organisation
QIPAP	Quebec Intellectual Property Action Plan
R&D	Research and Development
SMMEs	Small, Medium and Micro Enterprises
TIA	Technology Innovation Agency
TRIPS	Agreement on Trade-Related Aspects of Intellectual Property Rights
TTO	Technology Transfer Office
UK	United Kingdom
US/A	United States/United States of America
WTO	World Trade Organisation

Table of Contents

CHAPTER 1: TECHNOLOGY TRANSFER FROM PUBLIC RESEARCH ORGANISATIONS: SETTING THE SCENE	1
1.1 Introduction	1
1.2 What is Technology Transfer?	1
1.3 Intellectual Property Ownership by PROs	4
1.3.1 <i>Vis-à-vis researchers</i>	4
1.3.2 <i>Vis-à-vis government</i>	5
1.3.3 <i>Vis-à-vis licensees</i>	5
1.4 TTOs and Technology Transfer Operating Models, Strategies and Performance	6
1.5 Measuring Technology Transfer Performance: Activity and Impact	12
CHAPTER 2: RATIONALE, OBJECTIVES, SCOPE AND METHODOLOGY	16
CHAPTER 3: WHY ARE WE INTERESTED IN TECHNOLOGY TRANSFER?	23
3.1 Why is Technology Transfer (Potentially) Important?	23
3.2 Why is Technology Transfer (Sometimes) Controversial?	24
3.1.1 <i>Skewed research agenda</i>	24
3.2.2 <i>Conflicts of interest</i>	25
3.2.3 <i>Institutional divisions</i>	26
3.2.4 <i>Limitations on academic freedom</i>	26
3.2.5 <i>Value added by TTOs does not justify their expense</i>	28
3.2.6 <i>Scientific advances impeded by the increase in proprietisation of research results</i>	29
3.3 How Do These Controversies Influence the Decision of a PRO to Establish a TTO?	34
CHAPTER 4: INTERNATIONAL POLICIES GOVERNING TECHNOLOGY TRANSFER IN PUBLIC RESEARCH ORGANISATIONS	37
4.1 Introduction	37
4.2 United States of America	38
4.3 Canada	46

4.3.1	<i>Public investment in university research by federal granting agencies</i>	46
4.3.2	<i>Quebec Intellectual Property Action Plan</i>	51
4.3.3	<i>R&D funding from Crown procurement contracts</i>	53
4.4	Denmark	55
4.5	France	58
4.6	Italy	60
4.7	Concluding Remarks	61

CHAPTER 5: TECHNOLOGY TRANSFER IN SOUTH AFRICA: PRACTICES AND POLICY ENVIRONMENT

5.1	Introduction	62
5.2	Current Status of Technology Transfer Practice in South Africa	62
5.3	SA Policy Context	66
5.4	Policy Development Leading up to the IPR Framework and Draft Bill	67
5.5	The Intellectual Property Rights Framework and Draft Bill	71
5.5.1	<i>Outline of the Framework content</i>	71
5.5.2	<i>Establishment of a new government agency</i>	73
5.5.3	<i>Establishment and functions of TTOs within PROs</i>	75
5.5.4	<i>Rights and duties of PRO employees</i>	76
5.5.5	<i>Co-funded research (including collaborative and sponsored research)</i>	76
5.5.6	<i>Technology transfer</i>	77
5.5.7	<i>Government walk-in rights</i>	79
5.5.8	<i>Establishment of a patent fund</i>	79
5.5.9	<i>Regulations</i>	80
5.6	Other Key Relevant Policy and Regulatory Factors	80
5.6.1	<i>Relevant Department of Education policies</i>	80
5.6.2	<i>National intellectual property regime</i>	81
5.6.3	<i>Exploitation of biodiversity and indigenous knowledge</i>	83
5.6.4	<i>Exchange control regulations</i>	85
5.6.5	<i>Concluding remarks</i>	85

CHAPTER 6: CRITIQUE, RECOMMENDATIONS & CONCLUSION

	87
6.1 Introduction	87
6.2 Critique of the IPR Framework and Draft Bill	88
<i>6.2.1 Is legislation the right option?</i>	88
<i>6.2.2 Critique of key proposals contained in the Draft Bill</i>	92
6.2.2.1 Institutional internal policy-making authority circumscribed	92
6.2.2.2 Institutional authority to contract with external parties constrained	94
6.2.2.3 Role of NIPMO	95
6.2.2.4 Vagueness of exercise of powers by the Minister	96
6.2.2.5 Restricted commercialisation terms	96
6.2.2.6 Harmonisation of government agencies' approach to intellectual property	98
6.2.2.7 Walk-in rights and protection of the public interest	99
6.2.2.8 Failure to cater for development issues	100
6.2.2.9 Lack of incentives for firms	101
<i>6.2.3 Possible unintended consequences to consider</i>	101
6.2.3.1 'Anti-Bayh-Dole' effects	101
6.2.3.2 Disruption to current technology transfer activities	102
6.3 Recommendations	102
6.4 Conclusion	112
Bibliography	116

CHAPTER 1: TECHNOLOGY TRANSFER FROM PUBLIC RESEARCH ORGANISATIONS: SETTING THE SCENE

1.1 Introduction

This dissertation deals with the subject of technology transfer from university or government-supported research institutions (which will collectively be referred to as 'public research organisations', or PROs, for the purposes of the dissertation), focusing more specifically on an evolving set of policy interventions aimed at improving the technology transfer activity of South African PROs. In order to set the scene, the dissertation begins by introducing the technology transfer process and highlighting some of the key characteristics of institutional technology transfer objectives, policies, operating models and activities.

1.2 What is Technology Transfer?

Technology transfer from a PRO comprises a range of mechanisms whereby knowledge and technology generated in the course of research are passed on to others. These mechanisms need not be mutually exclusive. The most common form of technology transfer in the university environment is via published literature, where information is placed in the public domain and made available to anyone with an interest in it. Conference presentations serve a similar purpose, but may not reach as wide an audience. Research collaborations and sponsored research allow collaborating parties and sponsors access to research results. Academics who consult to industry pass on know-how derived from their university research. Graduates enter employment taking with them skills and knowledge gained from participating in university research projects during their degrees. But the term 'technology transfer' is often used in a narrower sense, specifically in relation to the licensing or assignment to industry of

intellectual property produced from university research. This dissertation will address the latter form of technology transfer, which sees potentially useful research results generated in PROs transferred to outside entities to exploit them commercially and/or for social benefit.

While variations are possible at each stage, the process typically proceeds broadly along the following lines. Researchers employed by a PRO are often required to assign ownership of intellectual property they generate in the course of their research to their employer (whether in terms of employment law, institutional intellectual property policies or both). On achieving a research outcome with potential application outside the institution (often simply referred to as 'developing an invention'), the researcher, or inventor, will make an 'invention disclosure' to the institution's technology transfer office (TTO),¹ describing the invention, including the problem it solves and the advantages it offers over competing technology. The TTO is responsible for evaluating the invention in an effort to ascertain whether it (a) is patentable and (b) offers good prospects for commercialisation (opportunities for social impact are increasingly being considered too). The patentability evaluation involves ensuring that the subject matter meets the legal requirements for patentability, and includes carrying out patent and literature searches. The commercial evaluation is intended inter alia to determine the extent of the potential market for the technology concerned, and the possibility of finding suitable licensees or investors to take the technology to market.

Where inventions satisfy the requirements for patentability, the TTO will instruct a patent attorney to draft a patent specification, and a patent application will be filed naming the institution as applicant, and the researchers involved as inventors. The TTO will then proceed to market the technology to potential licensees (for example, companies who use, develop, manufacture or sell similar technologies), or investigate the

¹ The names of such an office or unit vary from institution to institution. Common alternative nomenclature includes phrases such as 'technology licensing', 'business development', 'industry liaison' or 'intellectual property' in the unit names.

viability of setting up a spin-out company to take the technology to market (in which the institution and/or researcher might take an equity stake), which will require sourcing start-up capital. A researcher may take a management or advisory role in such a company. In the event that a deal for the exploitation of the technology is successfully concluded, revenue generated as a result (eg through license fees or sale of equity) is shared according to a defined formula between designated groupings within the institution (typically allocated between some central fund and the inventors' faculty and/or department) and the responsible researchers in their personal capacities.

Technologies may be licensed on an exclusive or non-exclusive basis. Where PRO technology is licensed at an early (embryonic) stage, requiring further investment from a licensee to develop a market-ready product (which is frequently the case), exclusive rights might be required to induce the licensee to make the necessary investment in the knowledge that it has some protection from competitors (Colyvas *et al*, 2002). Many policies promote non-exclusive licensing as a preferred option when this is feasible (which will typically be in the case of a 'ready-to-use' or 'off-the-shelf' technology), as this can facilitate wider practice of the technology. A TTO will assess which mechanism is likely to be more effective in bringing the technology to market, and which will best promote the use of the technology in the public interest, on a case-by-case basis. Where exclusive licenses are granted, this is generally on the condition that the licensee undertakes to practice the licensed invention diligently, encouraged through the inclusion of contractual terms dealing, for example, with minimum payments, loss of exclusivity and achievement of milestones (Council On Governmental Relations, 1993).

Factors which affect the license fees a PRO technology might attract include the type of technology, the research and development (R&D) investment to date, its stage of development, potential market size, expected profit margin, level of risk, strength of patent protection and projected cost of bringing a product to market, industry standards for

similar technologies, and the scope of the license (in respect of territories, fields of use and degree of exclusivity). The fact that PRO technologies are usually licensed at an early stage, requiring substantial investment from the licensee to develop a product to a market-ready stage (and thus an appetite for risk), means that license fees are often not very high (Council On Governmental Relations, 1993).

1.3 Intellectual Property Ownership by PROs

While alternative approaches exist, this model usually assumes ownership of intellectual property by the PRO, rather than by individual researchers, government or the licensee. This represents a growing trend. Much of the policy development in this area in different countries (as discussed in Chapter 4) has had the common goal of ensuring that ownership of intellectual property derived from publicly funded research vests in the PRO, although respective departure points for such ownership positions in different places varied significantly prior to the relevant policy changes. For example, in several European countries, professors traditionally had the right to own the intellectual property developed in the course of their university research activities. In the United States of America (USA), the federal government used to own much of the intellectual property generated as a result of federally-funded research projects. Various reasons are put forward to support the position of PRO ownership of intellectual property, as a preferred option over ownership by other participants in the technology transfer process.

1.3.1 Vis-à-vis researchers

It is believed that PROs will be more likely to ensure that the broader public interest is protected than individual researchers, who might be motivated by self-interest. Also, where there are multiple inventors, a prospective licensee would have to negotiate with each individual, who might not agree with one another, which at worst could prevent a deal from being reached, and at best would involve delays and additional transaction costs.

Individual researchers might not have the interest, capacity or resources to market their technologies. Most policies provide for release of rights to inventors in the event that the PRO does not elect to take title to the intellectual property concerned.

1.3.2 Vis-à-vis government

Industry does not generally view government agencies as good commercial partners, as they are thought to be too far removed from market needs and are associated with bureaucratic practices which are not business-friendly. Few examples exist of government agencies acting as effective transferors of technology developed by their grantees. PROs are considered to be closer to the market and less bureaucratic. Further, by granting PROs the right to own technologies and intellectual property developed from government-funded research, they can be incentivised to protect and market such technologies and intellectual property, which is believed to increase the potential for successfully bringing products and processes to market based on such technology and intellectual property.

1.3.3 Vis-à-vis licensees

While PROs generally operate as independent organisations, at the same time they continue to have a public character, which requires them to be accountable to the taxpayer for the funding they receive from the public fiscus. It is argued that this accountability can best be achieved where the PRO retains ownership of intellectual property derived from publicly funded research, as this confers greater control over setting the conditions under which commercialisation is permitted and in monitoring compliance with such conditions. The PRO can therefore protect the public interest by means of license terms which require licensees to work the licensed technology diligently, failing which the license may be terminated. This avoids sterilisation of licensed technologies. The PRO is also able to ensure that its scientists continue to have access to licensed intellectual property for further research (Council On Governmental Relations, 1993; Council On Governmental Relations, 1999).

Industry, however, has its own fairly persuasive motivations for obtaining assignment of intellectual property. Unfettered ownership of intellectual property improves opportunities of leveraging such intellectual property for additional investment or cross-licensing, and grants companies greater autonomy and freedom in their business activities which utilise the relevant intellectual property. Some policies therefore provide room for a degree of flexibility in this regard, allowing PROs to assign their intellectual property in certain circumstances, which may be at their discretion, or limited to cases where stipulated conditions are met.

While PRO ownership has come to be widely (although not unanimously) recognised as a best practice, it should be borne in mind that suitable contractual arrangements can be utilised to achieve similar ends in respect of most of the above motivations. In designing policy, due consideration ought to be given to the optimal arrangement, in view of the policy objectives, the status quo (including the costs of changing it), and the competing needs of the various stakeholders.

1.4 TTOs and Technology Transfer Operating Models, Strategies and Performance

The institutional technology transfer function is typically carried out by a TTO. The structure and specific roles of a TTO can differ quite considerably amongst organisations. For example, the technology transfer function may be carried out by a single central unit, or dispersed amongst faculties/units/departments, or a combination of central and devolved responsibilities. Even where there is not a dedicated unit, the function might be carried out by or in conjunction with one or more other existing offices, such as Sponsored Research, Development, Research Support, Contracts, Industry Liaison, etc. Some PROs set up a separate company or foundation from which their TTO operates, in order to be independent from the institution's administrative structures or to address liability issues. These are most commonly (although not exclusively) not-for-profit entities

fully-owned by the PRO concerned. TTO functions may also be outsourced to government agencies or private sector service providers, or shared between two or more organisations. In such cases, this would most likely be facilitated by a technology transfer liaison within the PRO. Reference to a 'TTO' in this dissertation incorporates all of these potential models (unless the specific context indicates otherwise).

In addition to the specific intellectual property management role of a TTO described earlier, relating to the evaluation of invention disclosures, filing, prosecuting and maintaining patent applications and patents, and marketing and licensing of PRO technologies, most TTOs will also be responsible for a broader range of functions. These will differ from organisation to organisation, but might include advising on, negotiating, and or approving intellectual property terms of sponsored research and collaboration agreements; management of material transfer agreements (MTAs, used to record and monitor the transfer of material, especially biological materials, into and out of the organisation); providing an information and advisory resource on intellectual property matters to the PRO's stakeholders; and participating in the shaping of institutional research management strategy, including policy development.

The direct intellectual property management function also includes regular reporting on intellectual property and technology transfer activity, both to internal and external bodies, tracking license agreements to confirm that licensees are fulfilling their obligations, and ensuring that income received by the PRO is allocated to the various beneficiaries in line with the institutional benefit-sharing formula. A new TTO is likely to devote substantial time to educating the research community about intellectual property matters and relevant institutional policies and procedures. The TTO must ensure that its commercial objectives do not interfere with the PRO's core missions of research, teaching and service/extension, avoid conflicts of interest and maintain ethical practices (Council On Governmental Relations, 1993).

As central agents in the technology transfer process, TTOs have the potential to occupy a pivotal role in the National System of Innovation (NSI) as 'boundary spanners' between various components of the system, moving comfortably back and forth across these boundaries, 'translating' the needs and expectations of roleplayers on either side of an interface, finding common ground between them and articulating this on an ongoing basis.

Many believe that the TTO can and should play an active role in structuring and mediating the relationships between various parties, both within the PRO and externally, seeking to achieve an outcome which is ideally both profitable and socially responsible. Consequently, a TTO becomes accountable (to greater or lesser degrees) to a range of customers and stakeholders. The US Council On Governmental Relations (1993) provides some examples of this:

- PRO management expects a TTO to bring in income for the organisation (preferably sufficient at least to cover the TTO's operating costs) and enhance the PRO's reputation (eg by contributing to regional economic development or demonstrating responsiveness to the needs of society).
- Researchers expect their TTO to assist in creating research funding opportunities for them, provide recognition, generate licensing income and ensure that their inventions and discoveries are usefully applied by society.
- Industry expects a TTO to provide access to new technologies and expertise at a cheap or reasonable price.
- Government expects a TTO to comply with relevant policies and advance government's social and economic objectives (eg create employment opportunities, contribute to regional economic development, transfer technologies which address local and national problems).

It is of course no easy feat to meet all of these diverse expectations effectively. PROs therefore need to come up with technology transfer

strategies which are aligned with organisational missions and national objectives. Feldman *et al* (2002:106) observe:

University technology transfer operations have multiple objectives as determinants of intellectual property strategy. Faculty retention, closer university-industry linkages, enhanced university prestige, and more generally enhanced and accelerated technology transfer for the social and economic benefit of the national or regional economy...

In prioritising objectives, technology transfer practitioners typically recognise three main TTO 'working models': income, service and economic development (Weeks, 2006).

The income model involves focusing on those commercialisation opportunities which show the most potential for profitable exploitation, and actively seeking out licensees who demonstrate the best ability to generate high financial returns. TTO staff must therefore have sufficient technological and commercial expertise to 'pick winners' successfully. A relatively small number of invention disclosures meet the required criteria for technology transfer. Those with low or uncertain commercial potential (including technologies which might have social benefit applications) are unlikely to be exploited.

Under a service model, the TTO emphasises service to researchers. All invention disclosures are treated equally (in theory), irrespective of their income-generating potential, which means that opportunities to maximise financial returns are likely to be reduced. A larger proportion of the research community will however benefit from the TTO's services, although the nature of the services might be less specialised, due to resource constraints.

In terms of an economic development model, the main objective is to create new spin-out companies based on PRO technologies, preferably located close to the PRO concerned, to stimulate the regional economy by creating job opportunities and generating tax revenue. This requires complex skill sets and expertise, and typically a larger staff complement to

deal with the additional functions carried out. Often, PROs take equity in such companies in lieu of upfront license fees, which reduces short-term income generation potential, but the longer-term pay-off can be substantial if the company becomes successful. These enterprises are however high risk, and many do not succeed. Only a fraction of PRO technologies present suitable platforms for company formation.

It is of relevance to emphasise that the choice of model will affect the magnitude of returns that a TTO is likely to generate, as well as the amount of time required to become profitable (well illustrated by Heher, 2005:217). In reality, most TTOs represent some mix of these models. It can be argued, though, that the strategic approach of a given PRO should involve some prioritisation of objectives, and be structured and staffed accordingly. Similarly, performance indicators should be appropriately matched to the main objectives.

Effective communication to ensure that the full stakeholder base is aware of a TTO's goals and strategy is an important aspect of managing expectations, which as shown above, can differ considerably depending on the interests of the group concerned. For example, in considering the connotations associated with the terms 'commercial outreach' and 'intellectual property' respectively appearing on university websites, Ozga and Jones (2006:13) note:

The former ['commercial outreach'] suggests collaboration, partnership and linkage with external business interests, and thus - by implication - some kind of symbiotic relationship between an HEI and a commercial organization, and a consequent blurring of boundaries between the public and private sectors. The latter term ['intellectual property'] pulls in quite a different direction, however. Here, the idea of 'intellectual property' implies that knowledge, expertise and information are owned by the university - and that the university controls the content and right to exploit this knowledge. The inference is therefore one of safeguarding the knowledge products of the public sector, rather than seeking to push them out into the private sector.

While some PROs have had notable 'big-hit' technology transfer successes which have produced substantial revenues, these are few and far between. Nonetheless, they continue to attract a great deal of attention, and in some cases have served to create unrealistic expectations of the kinds of returns that are likely to be achieved. Geiger describes this as an attempt by universities to 'rationalize serendipity by analyzing the etiology of these mega-winners' (2006:426). For the most part, though, it is now widely accepted that the net income-generating potential of PRO technology transfer activities for most PROs is modest, especially when the not insubstantial costs of running a TTO are factored in (Crown Copyright, 2003). The Canadian Expert Panel Report (ACST, 1999:2) states that 'discoveries that produce financial bonanzas are so rare that policies designed to pursue them would almost always lead to failure.' Crowell (2006:5), citing a study by Boston University's Office of Technology Development, provides the following figures:

- The median yearly income of US TTOs is estimated at below US\$500,000.
- Fewer than half of TTOs which are less than 15 years old generate a positive net return for their institution.
- Less than a third of universities whose annual research expenditure is less than US\$100 million have a profitable technology transfer operation.

Heher (2005) notes that, on the basis of research and innovation value chain data from the USA, Canada, Australia and the United Kingdom (UK), TTOs with trained and competent staff in operation for at least eight years may hope to generate license income amounting to 1-2% of their institution's R&D expenditure, but cautions that this is by no means guaranteed for a particular PRO, because of the variability and skewness which characterise returns at the level of the individual organisation (Sherer and Harhoff, 2000). Boettiger and Bennett (2006) observe that, with experience, most US TTOs now see the benefits of local economic development, improved university-industry relationships and start-up company formation as of higher priority than maximising the revenue they

may generate for their organisations. This would seem to be borne out by the statement in the recent Association of University Technology Managers (AUTM) Survey Summary (AUTM, 2007a:13) that:

Most institutions would define success through the criterion of public benefit. Offices that return the charitable support from government and private resources to the public in the form of products and services that benefit the local community are held in high regard by those communities and their technology transfer colleagues.

1.5 Measuring Technology Transfer Performance: Activity and Impact

The discussion above therefore raises the complex question of how technology transfer performance can best be measured. The value and relevance of different indicators are somewhat subjective, and the respective interests and expectations of different stakeholders will inform which criteria are for them are of greater or lesser importance. Bozeman (2000:628) points out that:

... technology transfer effectiveness can have several meanings, including market impacts, political impacts, impacts on personnel involved and impacts on resources available for other purposes and other scientific and technical objectives.

The metrics which have been employed are generally a mix of quantitative input (ie activity-related) and output (ie impact-related) factors representing different stages of the technology transfer process, as well as more qualitative or intangible factors (often more difficult to measure, yet highly relevant). Commentators have also warned of the danger of measurable proxies becoming a substitute for the true policy goals and thus wielding undue influence as policy drivers, which ultimately sees the overall goals diminish in visibility and importance (Langford *et al*, 2006). While the selection of appropriate metrics and indicators continues to generate much discussion, the following lists from the US Council On Governmental

Relations (1993) contain some of those which are commonly used and recognised.

Metrics related to TTO activity include:

- Number of invention disclosures
- Number of patent applications filed
- Number of patents granted
- Number of license agreements signed
- Amount of license income generated
- Number of licensed products sold
- Number of research agreements signed (amount of research income generated)
- Number of spin-out companies formed.

Metrics related to the indirect impact of PRO technology transfer include:

- Retention of research staff
- Attraction of students (especially at graduate level)
- Institutional reputation for innovation
- Enhancement of research endeavour overall
- Marketplace impact of PRO-derived technologies.

The most longstanding instrument for measuring technology transfer activity is the AUTM licensing survey, which has been produced annually since 1991, collating data supplied by US and Canadian TTO respondents.² The structure of the survey has evolved over time, and continues to do so, but nonetheless provides what is generally considered to be a useful source of longitudinal data. In its current format, it 'captures the activities that an office engages in rather than the impact or results of licenses' (AUTM, 2007a:8) and as such primarily serves to provide benchmark data of TTO resources and activities. In the past, the AUTM survey supplied estimates of the financial contribution to the economy, jobs supported and tax revenue generated from academic licensing activity.

² Other countries and regions, including the UK, Australia and Europe, have developed survey instruments.

However, this was subsequently discontinued after the figures were disputed (Heher, 2005). The survey now contains vignettes briefly describing selected 'success stories' of technology transfer which has benefited society. In addition, in 2005 AUTM launched its Better World Project 'to promote public understanding of how academic research and technology transfer have changed our way of life and made the world a better place' (AUTM, 2007b:2). Better World Reports are periodically compiled, relating stories of companies and innovations based on academic research.

Irrespective of model or strategy adopted, in order to carry out their function successfully, it is widely held that TTOs must be located in an enabling environment, and have access to adequate and appropriate forms of support (Heher, 2005). At the institutional level, this requires appropriate support from researchers, management and governing structures. This must be underpinned by a comprehensive suite of well-aligned, coherent and consistently applied institutional policies and procedures dealing with intellectual property management and technology transfer, conflict of interest, private work, ethics and research management. Similarly, it is argued that key elements for a successful PRO technology transfer enterprise include motivating incentives (including benefit-sharing), funding, multi-skilled staff, commitment from senior management and appropriate evaluation and benchmarking to facilitate learning (Milken Institute, 2006). This dissertation asserts that at national level, a wide range of policy and regulatory measures affects the prospects for successful technology transfer. This includes interventions directly targeted at innovation and technology transfer, as well as others that shape the broader environment.

In reality, to differing degrees in different national systems (and even within different institutions in a single system), several factors usually exist which hinder optimal operation, and relevant policies, even when well-intentioned, do not always achieve their objectives. In essence, the past three decades or so of technology transfer experience internationally (especially in the USA, as discussed in more detail in section 4.2) have taught that this is a

complex, cross-cutting, multidimensional, long-term activity. In most places, this is a fairly new institutional function and fledgling 'profession'. While certain practices have become somewhat standardised, it is generally recognised that different contexts call for alternative approaches, as a consequence of which no single set of 'best practices' exists. The needs of different stakeholders do not always coincide, which results in the expectations of at least some being disappointed. TTOs are often under-resourced, whether in terms of skills and capacity, or financial support, or both. Efforts continue to construct appropriate metrics for accurately and effectively tracking PRO technology transfer performance and impact. Technology transfer is therefore the subject of ongoing debates on topics ranging from whether it ought to be done at all, to how it ought to be done and what it ought to achieve.

In the chapters which follow, this dissertation will examine these issues and assess their relevance in the contemporary South African context, where policymakers are grappling with an appropriate policy design.

CHAPTER 2: RATIONALE, OBJECTIVES, SCOPE AND METHODOLOGY

Academic study of university technology transfer is of growing interest. The topic extends into and across a variety of academic disciplines and fields of endeavour, and can therefore be tackled from numerous different angles. Scholars from a wide range of disciplines (including economics, management strategy, business, law, science studies, political science, history, sociology and education) have approached the topic from diverse perspectives, using a variety of methodological and analytical techniques.³ Technology transfer practitioners, reflecting on the impact of their work, have also contributed to the discourse. A large proportion of the existing research is based on data from the USA, as the place with the longest tradition of university technology transfer practice. Good information on university-industry relationships more generally in Europe is also available, and data from other countries and regions is increasingly being gathered and analysed (Mowery and Shane, 2002). But overall, although increasing, the body of knowledge remains somewhat limited, and the differing approaches have produced material which is at times disjointed and does not always easily lend itself to comparative study. As Bozeman comments in his wide-ranging review article on technology transfer and public policy (2000:627): 'In the study of technology transfer, the neophyte and the veteran researcher are easily distinguished. The neophyte is the one who is not confused'.

When developing countries are considered, including South Africa, information is especially scarce. One reason for this is that, apart from a handful of exceptions, university technology transfer activity has only recently been taken up, if at all. But as developing countries, especially those with acknowledged innovative capacity, seek ways to harness innovation effectively for development, attention has been directed at how

³ This is illustrated to some extent by a scan of the Bibliography for this dissertation, which shows the vast array of journals and other publications cited, spanning several of these disciplines.

to increase the returns from the public investment in R&D by ensuring that laboratory research is translated into useful products, processes and services capable of enhancing quality of life, creating jobs and wealth and improving international competitiveness. This is true of South Africa today, where targeted policy interventions in this area are under development (see Chapter 5). However, difficulties in applying the existing data for developed countries to the local environment, coupled with the dearth of developing country-specific data, arguably stand in the way of effective policymaking.

One objective of this dissertation is therefore to attempt to begin to fill in the gaps, by collating and discussing some of the key literature and examining policy approaches and practical experiences of other countries, with a view to extracting policy lessons which can be tested against the South African situation. This is done with specific reference to the South African Intellectual Property Rights from Publicly Financed Research Framework (the IPR Framework) (Department of Science and Technology, 2005/6), and the recent Intellectual Property Rights from Publicly Financed Research Bill: Draft (the Draft Bill)⁴ based upon it.

Since the Framework document bibliography lists few peer-reviewed papers and other scholarly sources, and almost no South African data whatsoever,⁵ the literature which is discussed and/or cited throughout the dissertation provides an alternative body of information which can be used as a basis for evaluating policy proposals and stimulating further discussion on appropriate policy by South African stakeholders. It is well-known by those familiar with the field that the costs and benefits of technology transfer are the subject of extensive and ongoing debate. However, as will

⁴ Intellectual Property Rights from Publicly Financed Research Bill: Draft (Gazette 29950, Notice 719), 8 June 2007, available at <http://www.info.gov.za/documents/bills/draft2007.htm> (accessed 3 February 2008).

⁵ It is acknowledged that there is not a lot of relevant South African data, but it is by no means as rare as the two non-substantive references to South African material listed in the bibliography would seem to indicate. (These are for one government website and one law firm website respectively, both of which contain fairly routine information rather than substantive content.)

be argued in Chapter 6, the Framework document fails to deliberate on most of the major concerns. It is submitted that stakeholder discussion on the promise and the risks of the endeavour is required, and that explicit responses to these issues are an essential element of any comprehensive policy process on technology transfer - all the more so for South Africa, since many of the issues have particular relevance for development. This omission is addressed at least partially by the relevant material in the dissertation. Chapter 3 discusses the benefits of a technology transfer system functioning optimally, and raises some of the controversies and caveats associated with PRO technology transfer.

Chapter 4 provides some examples of technology transfer policy approaches adopted by other countries. No discussion of this topic would be complete without examining the US Bayh-Dole Act, deemed to be the key catalyst in spurring technology transfer activities in US universities. A handful of other countries were also selected for discussion. These include Canada (as an example of a country with an established technology transfer system that is not regulated by legislation), Denmark (representing a country which introduced legislation in order to shift ownership of intellectual property from academics to PROs), France (exemplifying the use of legislation aimed at strengthening PRO-industry linkages and stimulating the development of spin-out companies based on PRO technologies) and Italy (where legislation served to transfer ownership from employing institutions to individual researchers, counter to the predominant trends elsewhere).

Some of the key Canadian documents are examined in some detail. The policy initiatives and reviews which have taken place in Canada over the years have generated an enormous amount of reports and background documentation.⁶ Although similar debates have taken place in the USA, they have not been captured in policy documents in the same way as they have been in Canada. It was therefore deemed useful to take a deeper

⁶ Riddle (2004) catalogues a large amount of relevant documentation.

look at selected documents. Less English language literature is available for the European countries discussed. Furthermore, most of the relevant policy developments have been fairly recent. As a result, the policy analysis presented in relation to these countries is necessarily less detailed.

While it would have been desirable to include developing countries in this chapter, the paucity of available data would have rendered any discussion fairly superficial. As a result, a decision was taken to focus on the selected developed countries, which lent themselves to a richer discussion.

It should be clarified that this section does not constitute a comprehensive review of international policies. Nor are the featured countries intended to be representative of best practice. This sample is nonetheless useful to illustrate a variety of different policy objectives and approaches, necessitated by different circumstances prevailing at the time of the relevant developments in the countries concerned. The focus is on policy changes and their impact, rather than on the legal minutiae of the respective policy and legislative instruments of each country.

The relevant South African policy environment pertaining to the IPR Framework and Draft Bill is then discussed in Chapter 5, in order to provide sufficient context for the policy critique which follows in Chapter 6. A brief overview of technology transfer in South African PROs is given, based mainly on personal observation of and participation in the system, before looking at the policy history leading up to the release of the IPR Framework, and the subsequent Draft Bill. The key provisions of these documents are summarised. Other selected policy and regulatory developments which impact on technology transfer, or have the potential to do so, are also mentioned. This is done with relative brevity, and does not claim to cover all potentially relevant South African policies and developments comprehensively, due to space constraints and a decision to focus here in greater depth on the specific policy under consideration, namely the policy on intellectual property rights from publicly financed

research. Further, while it is explicitly acknowledged that the broader innovation policy environment will of course impact directly on the success or failure of any technology transfer interventions, it is noted that this has been examined in detail elsewhere, (notably in the 2007 OECD review of South Africa's innovation policy (OECD, 2007), as well as in Kraak (2007)). Nonetheless, it is suggested that by highlighting a handful of other relevant policy issues which may lead to misalignments with the IPR Framework, the importance of a holistic approach by policymakers can be emphasised.

The critique of the IPR Framework and Draft Bill in the concluding chapter (Chapter 6) deals generally with the motivation for following a legislative route as opposed to employing other policy instruments, and specifically with particular provisions that are proposed. The analysis draws on the literature and on the approaches of other systems, as well as on personal experience as a technology transfer practitioner in a South African university and science council, which has provided a personal view of, and hands-on exposure to, the South African technology transfer system, and afforded opportunities to interact with local, African and other international practitioners, academics and policymakers in the field, via conferences, workshops, professional organisations and other fora). Where observations made in this dissertation are informed by personal experience, this may be likened to assuming the role of an anthropological 'participant-observer' (while acknowledging that this is carried out in a less systematic and rigorous manner than anthropological research methodology would more typically demand).

The Draft Bill is examined with a view to determining the policy implications of its provisions, using the IPR Framework as a reference to assist in ascertaining the intentions of the drafters. As such, this assessment does not constitute a detailed legal analysis. It is noted that the Draft Bill contains what appear to be a number of drafting inconsistencies or errors, but it is not deemed necessary to point these out in the critique, on the assumption that they will be corrected in subsequent drafts.

The penultimate section of Chapter 6 draws together the general discussion on technology transfer, the comparative review of policy approaches adopted by different countries, and the prevailing conditions which characterise the South African environment, in order to develop a set of tentative policy recommendations. These are designed, from the perspective of both an academic and a practitioner, to offer some realistic and practical alternatives and enhancements to the current framework, better informed by evidence and thus more firmly grounded. It is suggested that these proposals might be applied more broadly than in this dissertation alone. In addition to providing insights to guide and inform policymakers, they might also serve to enrich the public debate and assist in increasing legitimacy in the eyes of stakeholders, ultimately improving the prospects for a successful policy intervention.

It is acknowledged that at the time of writing, the relevant South African policy landscape is in flux, with the draft legislation under review (and the expectation that substantial redrafting is underway).⁷ As such, writing the dissertation is to some extent an exercise taking place in 'real-time'. On the one hand, this makes the subject matter especially timely and topical, but it also means that the relevance of this section may be superseded to some extent as further policy developments unfold. Nonetheless, it is argued that the contextual material can provide useful background for researchers undertaking empirical studies on technology transfer, and that the tentative recommendations made here should carry some value for policymakers and other South African stakeholders irrespective of the timing and final form of the legislation (or alternative policy interventions), whether as input into the current policymaking process, to assess the appropriateness and success of promulgated legislation or to lobby for change. Many of the issues raised will also potentially be of interest to international scholars studying technology transfer and seeking comparative perspectives, as well as to policymakers, especially those from other developing countries, bearing in mind the scarcity of information

⁷ This expectation is based on informal communication from government officials.

available on developing country technology transfer policy and practice. As such, it is hoped that this will also be a useful contribution to the growing body of literature on PRO technology transfer, advancing the field by viewing the data and experiences emanating overwhelmingly from the developed world through a developing country lens.

Source materials consulted in the course of writing this dissertation include peer-reviewed books and journal papers (from both the natural and social sciences), commissioned reports, South African and international government documents (including policies, strategies and legislation), instructional and informational materials, and articles from the mainstream and specialist press.

Because the South African policy covers both universities and other public research organisations, the dissertation encompasses both types of institution, collectively referred to as 'public research organisations' or 'PROs'. However, it is expressly noted that much of the literature deals specifically with universities, and some of the key issues which arise are of particular pertinence to universities and their role in an innovation system. The dissertation therefore distinguishes universities from other PROs, where the source material does so and where the context demands this.

The dissertation aims to bring new insights to bear on the material presented and in so doing, advance the stakeholder discourse. It contributes to fulfilling the Organisation for Economic Co-operation and Development (OECD) recommendation that innovation policy be subjected to a 'rigorous but comprehensive rationale' (OECD, 2007:18). It is interdisciplinary, interpretive and integrative, trends characteristic of what Boyer describes as the 'scholarship of integration', which operates 'at the boundaries where fields converge' (1990:19) and involves 'making connections across disciplines, placing the specialties in larger context, illuminating data in a revealing way, often educating nonspecialists, too' (1990:18).

CHAPTER 3: WHY ARE WE INTERESTED IN TECHNOLOGY TRANSFER?

3.1 Why is Technology Transfer (Potentially) Important?

Interest in the role of PROs as producers of R&D for innovation in a NSI, in the past overshadowed by emphasis on the role of firms, is now growing (Godin and Gingras, 2000). In the context of economic growth in the global knowledge-based economy, many argue that PROs can - and indeed should - make a valuable contribution to the NSI and to their local and national economies through their research endeavours, even as they debate the nature of such contribution (Etzkowitz *et al*, 2000; Etzkowitz, 2004; Mazzoleni and Nelson, 2007; Mowery and Sampat, 2005; Nelson, 2001; Rosenberg and Nelson, 1993).

At the same time, it is also recognised that the research performed by PROs does not always have as much of an impact on the economy as it might, because it is not sufficiently relevant or accessible to companies or communities who might benefit from the results of such research. While the relevance issue will generally depend on a combination of funding sources and institutional research management strategy, the technology transfer function is designed to enhance accessibility, by ensuring that research results which are capable of being usefully applied are more appropriately protected, packaged, marketed and transferred to agents outside the PRO who are interested and able to exploit them, whether commercially or for social impact.

By working on solutions to address local problems and by developing innovative new products, PROs can be a source of new technology for companies and potentially assist in enhancing health, quality of life and competitiveness. The formation of new companies and the development of new product lines facilitated by technology transfer aids job creation and generates increased tax revenue. Moreover, as recipients of public funds

which support their research, PROs need to show a return on investment to taxpayers and demonstrate their relevance and responsiveness to the community, in order to justify continued support from government. Successful technology transfer programmes can be a means for doing so. A further motivation for PRO technology transfer is the opportunity for PROs to share in the profits of commercialisation partners who take the PRO technologies to market. These can then be ploughed back into PRO research activities and shared with innovative researchers as part of broader incentive and reward schemes.

Thus, a well-functioning technology transfer system can catalyse a virtuous cycle wherein a sustainable research base is well-supported over time, and continues to produce outputs which are useful and relevant in the wider economy. This 'best-case scenario' is captured by Remington (2005:17), who comments that: 'Universities' inventions yield products and processes that save lives, diagnose diseases, reduce pain and suffering, improve health, make people see and smile. The net result is patient cures, jobs, a vibrant economy, and continuing innovations.'

3.2 Why is Technology Transfer (Sometimes) Controversial?

Unfortunately, the 'ideal' outcome represented by the virtuous cycle described above is neither immediate nor assured, and it is by no means universally accepted that the technology transfer function is necessary or even beneficial for many PROs, particularly universities. Some of the arguments raised by detractors in this regard are therefore now discussed.

3.2.1 *Skewed research agenda*

One objection stems from the concern that the imperative to perform technology transfer skews the research agenda by encouraging researchers to focus unduly on commercial opportunities, especially those which offer a financial incentive, at the expense of fundamental research and academic integrity. However, there is little clear evidence to support

this assertion (Nelson, 2001; Mowery *et al*, 2001), with studies showing that the proportion of research which can be classified as basic research is not decreasing (Thursby and Thursby, 2003), that the motivation for undertaking research projects which produced commercialisable results was not primarily financial (Colyvas *et al*, 2002), and that the potential for patenting does not influence the choice of research project (Agrawal and Henderson, 2002). Sources and terms of research funding play a stronger role in influencing the types of research project undertaken. The rise of support for biomedical research, which often fits into the category of 'use-inspired basic research',⁸ has been mentioned as one contributing factor which has led to increased patenting opportunities for upstream research results derived from fundamental research which tackles practical problems, and may therefore yield commercially valuable outcomes (Colyvas, 2007; Mowery *et al*, 2004) (see also section 3.2.6). Sobolski *et al* (2005) however introduce a caveat, noting that due to the plentiful availability of funding for basic research in the USA, researchers do not need to prioritise income-generating projects in order to support their research activities. In other countries, that might not be the case. This merits further investigation, bearing in mind that the sources cited here all examine data from the USA.

3.2.2 *Conflicts of interest*

There are also fears that conflicts of commitment and conflicts of interest might arise (Blumenthal, 2003; Crespo and Dridi, 2007; Daza-Cambell and Slaughter, 1999; Erlich and Gutterman, 2003; Kneller, 2001; Nelson, 2001; Press and Washburn, 2000), as PRO employees focus on commercial opportunities at the expense of their teaching and research obligations, behave unethically in respect of financial interests (eg by failing to disclose pertinent information), or bias results (perhaps unwittingly) in favour of a commercial partner. These are acknowledged risks, which must be managed and monitored actively and continuously, highlighting the

⁸ This description is used by Stokes in *Pasteur's Quadrant* (2007).

importance of appropriate, well-enforced policies on conflict of interest, as well as private work, consulting and ethics (Etzkowitz, 2006).

3.2.3 *Institutional divisions*

Another concern is that technology transfer may function as a divisive force within institutions. Opportunities for technology transfer are more common in some areas of research than others, which means that certain departments and researchers are likely to benefit more than others, creating disparities amongst individuals and departments in the same organisation and generating resentment. Slaughter and Leslie (1997:141) describe the emergence of 'a new hierarchy of prestige and privilege' in universities, with those professors in fields close to the market being best positioned to benefit. Researchers in disciplines which offer few opportunities for technology transfer might feel that it is inequitable that their peers in other fields earn additional income through an institutional formula for sharing licensing income. Conversely, 'inventing' researchers and departments are often not happy that the institutional share of licensing income might be distributed at least partially in support of 'non-inventing' researchers or departments. The humanities might be even further marginalised, if research funding is redirected towards projects which show greater potential for commercialisation.

Establishment of an institutional benefit-sharing formula goes some way towards addressing this problem, if crafted so as to achieve an appropriate balance of rewards, taking into account the circumstances of the institution concerned, and the impact of the PRO's technology transfer policy on different institutional constituencies.

3.2.4 *Limitations on academic freedom*

Prioritisation of commercial criteria might also compromise academic freedom, for example by requiring publication restrictions or delays, where premature publication or disclosure of certain data might jeopardise the chances of patenting or commercialisation. While a survey of four countries (USA, Japan, Germany and the UK) commissioned by the

American Association for the Advancement of Science found that the need to protect scientific work may in certain instances lead researchers to delay publication, to publish incompletely or not to publish at all (Directorate for Science and Policy Programs, 2007), data from several studies suggests that patenting and entrepreneurial behaviour on the part of researchers on the whole does not detract from their overall research output, and very often 'serial patenters' will also be highly published and/or cited. For example, Agrawal and Henderson (2002) found that for the vast majority of researchers in their study, publications remain far more important than patents, and that for those researchers who were patenting, this was more likely to be as a complementary activity to basic research rather than as a substitute. Furthermore, on the basis of a positive correlation between patent counts and citations of publications, they tentatively concluded that patent counts may serve as an indicator of research impact. Lowe and Gonzalez-Brambila (2007) showed that faculty entrepreneurs in their study were generally more productive researchers than peers who were not involved in starting up new companies, based on average number of publications and publication citations, and moreover, that the publication activity of such faculty entrepreneurs typically does not decrease even after setting up a firm. Stephan *et al* (2007) noted a positive correlation between numbers of patents and publications, while at the same time failing to find any evidence of a trade-off between commercialisation and publication. In addition, the Milken Institute (2006) has observed a correlation between institution-wide research activity (measured by publications) and licensing income in an international study investigating technology transfer in the field of biotechnology.

Here too, institutional policy, including that governing the types of contractual terms a PRO might agree to, can play a role in regulating the conditions under which information is placed in or kept out of the public domain. Depending on a particular institution's mandate and research culture, policies could grant individual researchers greater or lesser autonomy in respect of publication decisions. So, for example, it might be expected that universities allow their researchers greater latitude in making

decisions on publications than other PROs. In this vein, it is of interest to note that a Canadian Expert Panel, in the context of making recommendations for national policy (see section 4.3), explicitly recommended that university researchers retain the option to choose to put their research results into the public domain rather than to pursue commercialisation (ACST, 1999).

3.2.5 Value added by TTOs does not justify their expense

Another criticism of TTOs at PROs is the expense of operating them, and the transaction costs they are sometimes perceived to add. While some hold the impression that TTOs present a good opportunity for income generation, experience shows that this is generally the exception rather than the rule (as discussed in section 1.4) (ACST, 1999; Crown Copyright, 2003). Substantial investment is required to staff them adequately with individuals having the requisite mix of formal qualifications, skills and experience as well as to cover legal, patent and marketing costs. Even TTOs with successful licensing programmes tend to take several years before they are able to break even by generating sufficient licensing income to cover their own operating costs, and some apparently fail to do so at all (Crowell, 2006; Heher, 2005). As such, a TTO is generally an institutional cost centre rather than a profit centre (Geiger, 2006), which leads some to question whether the institutional investment in technology transfer activities might not be better redirected to support research directly.

Notwithstanding the TTO's 'boundary spanning' potential mentioned earlier, stakeholder perceptions of the value that a TTO contributes to the technology transfer process can be negative, and the oversight role that the TTO plays is not always welcomed. TTOs are often unappreciated by some of their customers, with certain PRO researchers and/or their industry licensees believing that they are better equipped to negotiate directly with each other, viewing the TTO (as well as the policies and processes they are obliged to follow and enforce) as obstructive to concluding a transaction (Valentin and Jensen, 2007). The extent of the

problem in a particular PRO will depend *inter alia* on the capacity of the TTO to offer specialised expertise and to respond timeously, the degree of bureaucracy inherent in the PRO's administration more generally, and the level of trust between the TTO and the research community (which in turn will depend upon there being in place enough of a shared vision of the technology transfer enterprise). Some industry research sponsors believe that stronger emphasis on ownership of intellectual property rights by universities presents a barrier to collaboration (Lorentzen, 2007). Where commercial licenses are involved, arguably the time taken to negotiate a good contract which accurately represents the understanding between the parties is worthwhile and is likely to reduce the possibility of legal disputes occurring down the line. The degree to which such negotiations are likely to be productive will depend on the competency to conduct the negotiations of both parties as well as on the points at issue between them. In the absence of a TTO, companies would generally have to negotiate directly with PRO researchers. Particularly where multiple researchers are involved, this is unlikely to reduce the transaction costs of accessing the desired technology.

3.2.6 Scientific advances impeded by the increase in proprietisation of research results

A concern which has received considerable attention is the potential impact of technology transfer activity on restricting possible research opportunities or choices, arising from the increase in patenting of PRO research results which typically occurs with the establishment of a TTO. This has the effect of making proprietary, and thus less accessible, information and materials which might otherwise have been available in the public domain. Where early stage research results and research tools become the subject of patents (which is particularly the case for biotechnology and biomedical research, as pointed out in section 3.2.1 above), the risk of restricting downstream research by others becomes an issue. Descriptive terminology has been employed to highlight the potential dangers. Heller and Eisenberg (1998) warn of the possibility of a 'tragedy of the

anticommons',⁹ while the concept of a 'patent thicket' is similarly evocative, describing 'a dense web of overlapping intellectual property rights that a company must hack its way through in order to actually commercialize new technology' (Shapiro, 2001:1).

Heller and Eisenberg's theory (1998) suggests that the creation of an anticommons would hold back the progress of scientific research, by forcing researchers to navigate a fragmented landscape in order to gain access to a variety of upstream intellectual property rights held by multiple parties and required as inputs for future research. This would multiply transaction costs, as negotiations must take place with each patent holder. Moreover, because the potential pool of patent holders as well as users consists of various public and private organisations with differing objectives and agendas, negotiations with different parties would be likely to require different approaches and access agreements would be likely to be subject to different kinds of terms. At least some rights holders might be expected to over-estimate the value of their technologies, which would exacerbate the situation. Cumulatively, these factors seem to indicate a strong possibility for negotiations to break down at one or another stage, which would delay or even completely block off certain research avenues. A possible consequence of this in the field of biomedical research might be lost opportunities for the development of life-saving drugs. Debate continues about the validity of these concerns.

Related to this is the role of MTAs, as a common instrument to govern the transfer of biological materials (which may or may not be patented) for use as research tools or reagents: do they raise transaction costs by requiring complex negotiations, or do they facilitate the exchange of material by providing a clear legal framework which protects the interests of both parties (Mowery and Ziedonis, 2007)? MTA terms may vary considerably, from allowing the recipient organisation a high degree of freedom in how it

⁹ This alludes to the concept of the 'tragedy of the commons', which refers to the overuse of public resources. The 'tragedy of the anticommons' is the obverse of this, referring to the under-use of fragmented, privately-held resources.

uses the material concerned and full ownership of any intellectual property developed through use of the material, to restricting use narrowly and building in 'reach-through' rights which grant the owner of the material certain rights in intellectual property created by the recipient (ranging from full or joint ownership, to exclusive license rights, or a non-exclusive license).

Streitz and Bennett (2003) document some of the contentious terms university researchers must negotiate when attempting to access materials under an MTA (especially where companies are the material providers). These include securing the right to disseminate research results, the right to own research results developed with use of the covered materials, the possibility of taking on conflicting legal obligations in respect of the provider and other parties (eg a research funder), restrictions on the university's ability to carry out its public interest mission, and the option of receiving fair consideration in the event that the company uses the university's research results commercially. Although observing that 'overall, the transfer of materials between researchers has been getting more difficult' (2003:13), and that on the basis of their experience, they find that companies often assign a low priority to material transfers to PROs, as they do not stand to gain much from them, they also note that in most cases, solutions which meet the needs of both parties are possible.

In an effort to address some of these concerns, the US National Institutes of Health (NIH) has issued Principles and Guidelines for Recipients of NIH Research Grants and Contracts on Obtaining and Disseminating Biomedical Research Resources (Department of Health and Human Services, 1999), intended to promote the widespread availability of research tools developed on NIH funding, while at the same time recognising the need for limited restrictions as an incentive for commercial development. The principles call for academic freedom and publication to be ensured, appropriate implementation of Bayh-Dole (see section 4.2) to be facilitated, administrative impediments to academic research to be minimised, and dissemination of research resources developed with NIH

funds to be assured, and are supplemented with implementation guidelines.

For the most part, those who have investigated the anticommons concern (eg Buckley, 2007; Directorate for Science and Policy Programs, 2007; Mowery *et al*, 2001; Seide and MacLeod, 1998; Walsh *et al*, 2003; Walsh *et al*, 2005; Walsh *et al*, 2007) have found only limited (although not negligible) evidence of research projects which have had to be redirected or which have not gone ahead for this reason. Delays to research were encountered on occasion, but were for the most part neither sufficiently frequent nor lengthy to present an insurmountable barrier to conducting the research concerned.

One case study, recounting attempts to develop a database collating genetic information held by multiple scientists around the world, describes the development of an anticommons (Maurer, 2006). However, while this account is instructive as an illustration of some of the anticommons conditions at work, it must be noted that patented technologies were not involved, and various other factors also contributed to the failure of the initiative.

At the other end of the spectrum, a biotechnology industry study asserts that the existence of an anticommons cannot be supported (Buckley, 2007). This paper posits that if a 'tragedy of the anticommons' was indeed occurring, we would be seeing a decline in R&D, fewer potential innovative drug therapies being tested and industry stakeholders calling for a public policy remedy. On the contrary, however, data (albeit it somewhat limited in scope) is provided to demonstrate R&D and venture capital investment growth in biotechnology companies, as well as an increase in the numbers respectively of original Investigational New Drug submissions and of biological compounds entering preclinical trials. On the basis of the position of the industry stakeholder organisation for whom the study was carried out, it is further averred that biotechnology companies are satisfied that the patent system is supporting rather than hindering innovation.

In a direct response to Heller and Eisenberg (1998), Seide and Macleod (1998) state their belief that the degree of fragmentation of which Heller and Eisenberg warn has been overstated, with the potential numbers of intellectual property owners and blocking patents respectively being lower than Heller and Eisenberg assume. They further note that in practice, institutional researchers on average pay little attention to the patent status of materials they are using for non-commercial research (in effect, assuming that they may use these under a research exemption) and moreover, successful precedents exist for negotiating necessary licenses in the field of biotechnology.

Walsh *et al*'s 2003 study appears to lend support to these views. Interview respondents from industry reported that, although a large number of patents relevant to particular work were often initially identified, only a small subset of these would generally claim subject matter for which a license would be required. They also found that both firms and PROs adopted various 'working solutions' to facilitate their research, including use of research exemptions, entering into license agreements, inventing around patented technology, use of public research tools and challenging patent validity by means of litigation. As a result, they concluded that intellectual property protection of research inputs was not unduly restricting biomedical research.

More recent studies (Walsh *et al*, 2005; Walsh *et al*, 2007) yielded data indicating that as a rule, patents do not pose a significant barrier to the acquisition by biomedical scientists to the knowledge inputs they require for their research. One reason for this is that academic researchers were found to have little awareness of relevant third party patents in their field, even subsequent to the 2002 US *Madey v Duke* court decision (which held that no general research exemption against infringement applied in respect of university researchers).¹⁰ These studies did however observe

¹⁰ *Madey v Duke University*, 307 F3d 1351 (Fed Cir 2002).

impediments faced by researchers when they attempt to access tangible research materials from other parties. Refusals to requests for material were experienced by a significant minority of respondents in the sample under study, and such refusals appeared to be on the increase. The reasons for refusals were attributed more to factors such as scientific competition, commercial interests and the time and effort needed to fulfil requests, rather than to the materials in question being patented.

Anticommons concerns are flagged as an issue which merits ongoing monitoring, and the possibility that this might become a bigger problem in the future is not ruled out (Directorate for Science and Policy Programs, 2007; Mowery *et al*, 2001; Walsh *et al*, 2003). Suggestions for tackling the concerns include the establishment of patent pools or administrative law arbitration processes to assign value to various upstream contributions and determine the distribution of benefits accordingly (eg Boettiger and Bennett, 2006; Kesselheim and Avorn, 2005; Merges, 1996). However, as the recent work of Walsh and his colleagues shows (Walsh *et al*, 2005; Walsh *et al*, 2007), overcoming restrictions on access to biomedical research inputs will require moving beyond debates about the effects of patenting, and taking into account the prevailing practices and norms in this area of research more broadly.

3.3 How Do These Controversies Influence the Decision of a PRO to Establish a TTO?

In spite of the criticisms and concerns discussed in section 3.2 above, it is submitted in this dissertation that a TTO in some form has become an essential unit for PROs. At least some of the functions of a TTO, such as those associated with structuring the intellectual property terms of sponsored research and collaboration agreements, are crucial elements of good research management irrespective of a PRO's interest in

commercialising its technology or not, and are increasingly becoming a prerequisite for accessing research funding from certain sources (Wolson, 2004), which often requires careful balancing of a slew of different interests, in order to comply with both the funder's (sometimes very detailed) requirements and relevant internal policies. It is therefore argued that the more useful question for a PRO to examine is the appropriate form and function of a TTO capable of meeting its particular needs, rather than whether or not a TTO is required and/or desirable at all.

The complexities highlighted in section 3.2.6 in particular indicate the importance to any PRO engaged in biomedical research of being able to negotiate access to research tools owned by others, as well as being able to make appropriate decisions as to how to protect and disseminate optimally those research tools it develops itself. As such, it might be argued that the problem of restricted access to research tools demands an effective TTO. Whether or not regulated by guidelines such as those of the NIH, TTOs can be selective about the technologies they choose to patent, as well as in respect of the terms under which they make their patented technologies and tangible research materials available to others. TTO decisions with regard to patenting are likely to be influenced by the fact that where others are patenting prolifically in a particular space, a decision not to patent oneself could restrict one's own freedom-to-operate in that space. But the TTO can always then issue licenses on favourable terms for research purposes.

Nonetheless, the impact of the associated transaction costs should not be underestimated, not least because it is likely to be amplified for under-resourced and inexperienced TTOs, which will for example be less well-equipped to conduct the necessary intellectual property due diligence. This has implications for policy, which should be designed wherever possible to reduce transaction costs.

It can therefore be suggested in conclusion that the concerns discussed above can for the most part be addressed by examining the policies,

practices and choices of TTOs and the PROs in which they are located, and the environment in which they operate. It is further maintained here that wise policy guidance and proactive, strategic management can help ensure that technology transfer activities are carried out in alignment with institutional, sectoral, regional, national and/or broader development needs, as appropriate. This dissertation therefore supports as a corollary that the challenge for government policymakers is to craft policy instruments which will create the right balance of private incentives and public benefits, and to permit enough flexibility to allow approaches at the institution level to be tailored to their particular needs and environment. Chapters 4 and 5 which follow will therefore explore different government policy approaches, both internationally and in South Africa.

CHAPTER 4: INTERNATIONAL POLICIES GOVERNING TECHNOLOGY TRANSFER IN PUBLIC RESEARCH ORGANISATIONS

4.1 Introduction

This chapter provides examples of technology transfer policy approaches adopted by various countries. No discussion of this topic would be complete without examining the US Bayh-Dole Act, deemed to be the key catalyst in spurring technology transfer activities in US universities. A handful of other countries were also selected for discussion. These include Canada (as an example of a country with an established technology transfer system that is not regulated by legislation, despite various policy processes undertaken over a period of several years), Denmark (representing a country which introduced legislation in order to shift ownership of intellectual property from academics to PROs), France (exemplifying the use of legislation aimed at strengthening PRO-industry linkages and stimulating the development of spin-out companies based on PRO technologies) and Italy (where legislation served to transfer ownership from employing institutions to individual researchers, counter to the predominant trends elsewhere). Less English language literature is available for the European countries discussed. Furthermore, most of the relevant policy developments have been fairly recent. As a result, the policy analysis presented in relation to these countries is necessarily less detailed.

It should be emphasised that this section does not constitute a comprehensive review of international policies. Nor are the featured countries intended to be representative of best practice. This sample is nonetheless useful to illustrate a variety of different policy objectives and approaches, necessitated by different circumstances prevailing at the time of the relevant developments in the countries concerned.

4.2 United States of America

Although some US universities have a history of technology transfer activity predating the Bayh-Dole Act,^{11,12} the upsurge of TTOs in US universities is owed primarily to Bayh-Dole, a 1980 statute enacted to promote the transfer of technology developed with use of federal funds by universities and other non-profit and small business grantees (and subsequently extended to all recipients of federal research grants) (Henderson and Smith, 2002).¹³

The character of the US R&D system in the second half of the twentieth century was heavily influenced by Bush's *Science, The Endless Frontier* report (1945), which called for substantial support for basic science, on the assumption that this would provide the 'starting material' for technological innovation, which would logically ensue downstream. This view, delineating separate roles for basic and applied research at different ends of the spectrum, is captured in the report (1945:12):

Basic research is performed without thought of practical ends. It results in general knowledge and an understanding of nature and its laws. This general knowledge provides the means of answering a large number of important practical problems, though it may not give a complete specific answer to any one of them. The function of applied research is to provide such complete answers. The scientist doing basic research may not be at all interested in the practical applications of his work, yet the further progress of industrial development would eventually stagnate if basic scientific research were long neglected.

While Bush continues to be acknowledged as a visionary, this linear model has been criticised as an incomplete and/or inaccurate depiction of the

¹¹ Patent and Trademark Law Amendments of 1980 (PL 96-517).

¹² For further information on pre-Bayh-Dole technology transfer mechanisms in the US, see for example Colyvas *et al*, 2002; Colyvas, 2007; Mowery *et al*, 2001; Mowery *et al*, 2004; Sampat, 2006.

¹³ Technology transfer in federal laboratories is governed by another 1980 statute, the Stevenson-Wydler Act (PL 96-480). Over the years, the initial statutes have been amended and supplemented by additional legislation, regulations, and other instruments. Reference to Bayh-Dole in this dissertation will for the most part allude to the collective documents of relevance, unless the context indicates otherwise.

relationship between science and technology, and of government's role in the system.¹⁴ One way of viewing Bayh-Dole, then, it might be suggested, is as an intervention necessitated by a failure in Bush's model, which did not lead to the envisaged degree of 'conversion' of basic research into innovative technologies.¹⁵

One of the key changes brought about by Bayh-Dole in the US was to give grantees a blanket right to own the intellectual property in their federally-funded technology. Previously, this was in many cases owned by the government, which had a poor record of successful exploitation of the thousands of patents it held.¹⁶ In other cases, some federal agencies allowed certain university grantees to hold title to intellectual property under Institutional Patent Agreements, negotiated between a particular university and agency respectively, applying to all research funded by that agency at the university concerned (Mowery *et al*, 2001). Policymakers believed that the impact of taxpayer-supported federal research funding would be increased by providing a uniform framework which incentivised universities to become actively involved in the commercialisation of their technology by having the right to elect to own it, and incentivised industry to invest in further development for the manufacture and sale of goods by allowing companies to acquire exclusive licenses. This was expected to lead to useful new products on the market, job creation and the establishment of new businesses, which could contribute to economic development and provide a far higher return to taxpayers on their investment in the federal

¹⁴ One apposite critique is put forth in Stokes's *Pasteur's Quadrant* (1997). While recognising that basic research might involve a quest for fundamental understanding without considering how that knowledge might be used ('pure basic research'), and that applied research might be 'guided solely by applied goals without seeking a more general understanding of the phenomena of a scientific field' (1997:74) ('pure applied research'), Stokes identifies a category of 'use-inspired basic research', carried out with the aim of extending the boundaries of understanding, yet at the same time inspired by considerations of use (as exemplified by the work of Louis Pasteur). A linear model with separate defined roles for basic and applied research respectively cannot accommodate research of this nature.

¹⁵ Interestingly, though, Sampat (2006) reports that although *The Endless Frontier* is silent in this regard, Bush was a strong supporter of the premise of contractor ownership of intellectual property.

¹⁶ The observation made in Mowery *et al* (2001:103) should however be noted, namely that most of these patents did not emanate from university research, but rather from private contractors who chose not to take title.

research enterprise (Council On Governmental Relations, 1999; Wolson, 2005).

Bayh-Dole applies to all research carried out in terms of a federal funding contract, even where the work may be only partially government-funded. Grantees take on certain obligations when they elect to retain title to intellectual property developed under such a contract. These obligations include reporting to the relevant federal funding agency, filing a US patent application, taking active steps to commercialise the invention concerned, sharing any income generated from exploitation with inventors and using the balance of such income for research or educational purposes. Grantees may licence the technology concerned to industry on an exclusive or non-exclusive basis, but may not assign ownership rights to third parties other than invention management companies.

In an effort to ensure a balance between private and public interests, the US government is entitled to a non-exclusive, non-transferable, worldwide, royalty-free right to practise the invention, and may additionally exercise 'march-in' rights to take ownership of the technology, or to require that a third party be granted a licence, where this is in the public interest (eg for health or safety reasons, or if the invention has not been commercialised within a reasonable time). In addition, manufacture of products under a licence governed by Bayh-Dole must take place substantially in the USA, and preference must be given to small business licensees, unless it can be shown that they lack the capacity to bring the invention to market, or unless a large company contributed to the research under which the invention was developed (in which case the co-sponsoring company would be entitled to a license) (Council On Governmental Relations, 1999; Valoir, 2000; Wolson, 2005). A contractor may lose patent rights on an invention developed with federal funds for failing to comply with Bayh-Dole reporting requirements (Locke & Guttag, 2005). Where circumstances might require this, an agency may make a determination of exceptional circumstances which would allow ownership of intellectual property to vest in the federal government rather than in the grantee. This would be done prior to

entering into a funding agreement (Council On Governmental Relations, 1999).

Overall implementation of Bayh-Dole (including the granting of exceptions) is overseen by the Department of Commerce. The General Accounting Office conducts reviews on different aspects of Bayh-Dole implementation from time to time. While a national inter-agency database exists, enabling grantees to enter reporting data directly, individual federal agencies are responsible for monitoring their grantees' Bayh-Dole compliance (Council On Governmental Relations, 1999).

It has been recognised that Bayh-Dole did not mark the beginning of technology transfer efforts by US universities.¹⁷ Furthermore, the increase in university patenting and licensing activity seen post-1980 must also be viewed in the context of other concurrent developments of the day. These include the burgeoning of areas of biotechnology and software research and availability of new techniques, yielding results of special interest to industry, increased emphasis in US policy on strong intellectual property protection, and judicial rulings (beginning with the Supreme Court judgment in *Diamond v Chakrabarty* in 1980)¹⁸ which effectively expanded the scope of patentable subject matter, particularly biological material, leading to increased opportunities for patenting arising out of university research. Some commentators therefore believe that Bayh-Dole served to 'accelerate and magnify trends that already were occurring' (Colyvas *et al*, 2002:62; Mowery *et al*, 2001; Mowery *et al*, 2004) and that its influence in increasing university patent activity has thus been overstated. Nonetheless, there is no doubt that Bayh-Dole was the major catalyst for the introduction of TTOs in US universities, with most institutional technology transfer programmes having been set up between the mid-1980's to the mid-1990's (AUTM, 2007a). The legislation gave rise to the need for a dedicated function to enable institutions to exercise the rights and fulfil the obligations conferred by it.

¹⁷ Refer to footnote 12.

¹⁸ 447 U.S. 303 (1980).

While it remains relatively new in South Africa, technology transfer as an activity and as a profession is therefore now well-entrenched in the US academic system. Passman *et al* (2005:4) assert that delegation to grantee institutions of authority relating to patenting and licensing decision-making has improved the quality of such decisions, on the assumption that grantees 'are typically more cognizant of private-sector activities in a given field of technology and, thus, better able to assess the commercial potential of inventions'. To illustrate some of the impact of US technology transfer activity, the 2006 US AUTM Licensing Survey reports that in the period from 1998 to 2006, 4,350 new products emanating from academic technology transfer activity were introduced onto the market (697 in 2006), and that 5,724 new spinoff companies were launched in the period from 1980 to 2005 (553 in 2006), each based on an academic technology platform (AUTM, 2007a).

Concerns about the impact of Bayh-Dole and the technology transfer enterprise it has created are expressed from time to time. One of the main criticisms of the Bayh-Dole framework is that by insisting that research institutions own all intellectual property arising out of research that has received any federal support, collaborations with industry are discouraged, as companies would generally prefer to own rather than license such intellectual property. This is conceivably borne out by the relatively low percentage of industry-sponsored research at US universities, hospitals and research institutes, ranging from 7-10% of total research expenditure in the ten-year period from 1996-2005 (AUTM, 2005). In congressional testimony on the Bayh-Dole Act, a company representative stated that 'companies are finding that research partnerships with foreign universities offer a distinct advantage with regard to intellectual property use' (Butts, 2007:6). But despite the fact that the proportion of industry-funded research at US universities remains low overall, it is worth taking into

account that it has increased (between double and fivefold according to different estimates) since the inception of Bayh-Dole (Valoir, 2000).¹⁹

Some critics object to licensee companies (and licensor universities) appropriating and profiting from taxpayer investments in research, particularly in the pharmaceutical sector, where the taxpayer may be seen to be 'paying twice': firstly for the research and subsequently for the product developed in the course of such research (cited in Remington, 2005). Other criticisms cover much of the ground discussed in section 3.2 above, many of which revolve around a perceived imbalance between the private incentives created by the Act, and the wider public interest.

The Bayh-Dole Act is subject to congressional oversight (Remington, 2005), and over the years, hearings have been held from time to time before congressional committees to assess the effectiveness and impact of Bayh-Dole. But for the most part, the predominant view appears to be that the legislation continues to achieve its objectives.²⁰

Nonetheless, it is generally accepted that Bayh-Dole operates in a challenging environment, and its long-term survival will not be assured if it fails to respond adequately. Remington (2005) describes some of the challenges he identifies. Federal funding for basic research is stagnating, as well as being redirected towards defence and homeland security. Inadequacies in the patent system's ability to achieve an appropriate balance between private incentives and public benefit are being acknowledged, and controversial attempts to reform the patent law are being disputed. Calls for the federal government to exercise march-in rights are made periodically.²¹ Attempts by certain federal agencies to

¹⁹ It is however noted that it is beyond the scope of this dissertation to assess or review the role of Bayh-Dole, if any, on this increase.

²⁰ This view is endorsed for example in the statements submitted by a panel of witnesses representing different stakeholders for an oversight hearing held by the Subcommittee on Technology and Innovation of the House Science and Technology Committee, on 17 July 2007, available at:

http://science.house.gov/publications/hearings_markup_details.aspx?NewsID=1918

²¹ Since march-in rights are a key element of Bayh-Dole and an important prong in the attempt to balance public versus private interests, it might be questioned why Remington

bypass Bayh-Dole appear to be increasing (although permitted for some categories of defence research expenditure, there are indications that civilian agencies are also finding ways of making use of exceptions to increase their flexibility in contracting). Proposals for legislative reform are brought from time to time (usually in an attempt to ensure reasonable pricing for drugs developed with federal research support or to increase the rights and/or benefits accruing to federal agencies) (Remington, 2005).

Recommendations have been made for amendments to Bayh-Dole. For example, some believe that federal agencies should be given greater discretion under Bayh-Dole to determine that certain results of publicly-funded research be placed in the public domain (Rai and Eisenberg, 2003). In a case study documenting the first (ultimately unsuccessful) petition to the federal government to exercise its march-in rights under Bayh-Dole, Bar-Shalom and Cook-Deegan (2002) make four suggestions for revising Bayh-Dole so as to address some of these concerns. They call for the march-in provisions to be revisited, for a research exemption from patent infringement to be created, for patent re-examination procedures to be introduced and for provision to be made for greater transparency in licensing practices. In a similar vein, Boettiger and Bennett (2006), in an article entitled 'Bayh-Dole: if we knew then what we know now', identify four partly overlapping issues which they believe, if incorporated into the law, or at least uniformly adopted by federal agencies and grantees, could address the misalignment between public and private interests which has developed under Bayh-Dole in respect of certain technologies and certain TTO practices. These are provision for a research exemption to allow researchers to continue to use licensed intellectual property for non-commercial research; ensuring access to research tools; concrete steps to

(2005) regards petitions calling on government to exercise this right are considered a challenge to the Act. The argument would be that, since such an exercise would signal a limitation on or curtailment of the rights of an exclusive licensee, it might deter other companies from licensing PRO technology, which would reduce the effectiveness of the legislation. March-in petitions have not to date met with success. Many Bayh-Dole proponents believe that this stance has contributed to the success of the Act, while many detractors see this as evidence that application of the provisions is skewed in favour of private interests. This is discussed further in section 6.2.2.7.

restrict the anticommons effect caused by the fragmentation of intellectual property rights partly created by the increased tendency towards patent filing encouraged by Bayh-Dole (eg through patent pooling, open access license terms and clearing house mechanisms); and provision for humanitarian use where appropriate.

Even while many stakeholders continue to call for legislative changes, in the absence of these, there remains some room under Bayh-Dole for flexibility in the practices adopted by US TTOs and federal funding agencies. As noted by Boettiger and Bennett (2006:320):

Many of the issues that are identified today as negative consequences of Bayh-Dole can be traced to the institutional policies structured to optimize institutional benefits and income, rather than to the Act itself.

While they believe that legislative amendments are probably necessary to bring about uniform system-wide behaviour changes by US TTOs within a reasonable timeframe, they acknowledge that most of the suggestions that they offer to preserve the public benefits of publicly funded research could, with the necessary political will, instead be implemented by other means.

It is likely that Bayh-Dole will remain in the spotlight of both supporters and detractors, and that debate will continue about whether or not it continues to attain its goals, as well as about whether or not those goals remain relevant. It is interesting to note that even the mainstream business press has jumped into the fray, with a 2005 *Fortune* article taking a critical view, dubbing Bayh-Dole 'The Law of Unintended Consequences' (Leaf, 2005), in stark contrast to a 2002 piece in *The Economist*, describing it as 'possibly the most inspired piece of legislation to be enacted in America over the past half-century' (The Economist, 2002). In spite of the controversies and unresolved issues associated with it, Bayh-Dole remains a precedent-setting piece of legislation, and US PROs continue to have some of the most productive technology transfer operations. As such, it is therefore submitted that no country seeking to develop or enhance its own technology transfer policies will embark on this process without a thorough examination of the US experience under Bayh-Dole.

4.3 Canada

In contrast to the US approach, where legislation applying across-the-board to all federal research funding was introduced, Canada has addressed the issue of commercialisation of federally-funded research through non-legislative policy interventions, at times distinguishing between different sources of funding which have had different conditions attached. The policy initiatives and reviews which have taken place in Canada over the years have generated an enormous amount of background documentation.²² Some of the key documents are discussed here in some detail, in order to illustrate the range of issues considered and the extent of the various debates. While Bayh-Dole and many of its proposed and actual provisions have been the subject of debate both before and after its promulgation (as discussed in section 4.2 above), these debates were not captured in policy documents in the same way as they have been in Canada.

4.3.1 Public investment in university research by federal granting agencies

An Expert Panel on the Commercialization of University Research was established by the Prime Minister's Advisory Council on Science and Technology (ACST) with a mandate to 'present a vision and implementation strategy to maximize the economic and social returns to Canada from public investments in university research' (ACST, 1999:v). Background papers were commissioned and written submissions solicited from interested parties before a draft report was compiled. After broad stakeholder consultations, a final report was submitted in 1999 (ACST, 1999) (Panel Report).

The Panel Report proceeded from the starting point that universities occupy a unique position to drive economic growth and social wellbeing. It recognised the three core functions that Canadian universities carry out,

²² Riddle (2004) catalogues a large amount of relevant documentation.

namely teaching, research and community service, and stressed that commercialisation activities should not be pursued at the expense of these, but suggested that innovation ought to be incorporated into these, or explicitly identified as a fourth mission. It examined the innovation process and the university competencies required in an optimal process of commercialisation of research results. These can be summarised as follows:

- Building commercialisation infrastructure - commercialisation offices or TTOs should act as a central point of entry for companies wishing to license university technologies and a single point of contact for university inventors
- Recruiting and retaining highly qualified personnel - appropriate training and incentives must be provided
- Development of innovation policies and strategies - specific policies are needed to regulate intellectual property ownership, conflict of interest, benefit-sharing, and annual innovation strategies and evaluations of past performance are called for by the Panel. These must be properly communicated to stakeholders
- Facilitation of access to research funding - from both government and industry
- Identification of discoveries with commercial application - commercialisation offices are urged to take a proactive approach in seeking out suitable inventions from their researchers' laboratories, and in forging ties at an early stage with potential licensee firms, especially small, medium and micro enterprises (SMMEs)
- Intellectual property protection - intellectual property management strategies should go further than merely filing patent and other intellectual property applications, and collaborations, portfolio building and intellectual property bundling are encouraged
- Adding value to intellectual property - this might entail drawing up scientific development and/or business plans, conducting market research and feasibility studies, or prototype development, preferably in conjunction with private sector partners who have relevant expertise

- Commercialisation of the most promising discoveries - technology transfer, including selection of the most appropriate pathway (eg licensing to a spin-out company set up especially for the purpose of taking the licensed technology to market, or to an existing company), valuation of the contribution made by the university, and in some cases seeking investment from the financial sector
- Maximising the value of the public research investment - the emphasis should be on maximizing the value of licensee companies rather than of the returns to the TTO, which requires universities to provide adequate support to their licensees over an extended period, which can take various forms, including technical assistance, access to university-owned science park or incubator facilities, or later stage investment in a licensee in which the university holds an equity stake. Successful endeavours should be visible to all parties.

The Panel Report provides an assessment of the innovation performance of Canadian universities. While noting the need for better data, the Panel concluded that there was significant unmet potential for this activity to contribute to strengthening the national economy. The factors impeding universities from reaching their full potential are then examined.

The absence of a coherent university intellectual property policy was identified as a major obstacle. The Granting Councils did not claim ownership of intellectual property developed in the course of research which they supported, nor did they require disclosure of such intellectual property. Some universities had policies of university ownership, and some allowed researchers to own intellectual property, which may or may not have been subject to an obligation to disclose the creation of intellectual property to the university. Some universities had not adopted explicit intellectual property policies at all, in which case individuals owned the intellectual the intellectual property they created in the course of their university research. This was believed to have led to the loss of commercialisation opportunities and the failure to capture value for Canada. Limited capacity and resources of universities for

commercialisation, uncompetitive business conditions and low levels of investment in university research were identified as additional barriers.

The proposed Action Plan made six recommendations:

- The federal government should require its grantees to commit to achieving 'the greatest possible benefit to Canada', when research results derived from federally-funded research are commercialised.
- Universities should implement intellectual property policies incorporating stipulated principles, in order to be eligible for federal commercialisation support and for their researchers to qualify for federal research funding. Such policies would be confined to intellectual property with commercial potential, developed with use of federal funding. (Scholarly books and journal articles would be excluded.) The listed principles include an obligation for researchers to disclose relevant intellectual property to the university, and for the university in turn to make disclosures to the federal government, an obligation for researchers to assign intellectual property to their employing university, an undertaking by the university to make reasonable efforts to commercialise intellectual property with innovative potential, by transferring technologies, by means of licensing or assignment, to local or national companies (where possible to Canadian firms or Canadian subsidiaries of foreign companies, or with a commitment to value-added for Canada where foreign licensing is the only feasible option, and prioritising small businesses where appropriate) providing incentives to encourage researchers to create intellectual property (including benefit-sharing and recognition in promotion and tenure policies), and setting up organisational capacity and responsibility for innovation activity arising from the institution's research. University researchers would retain the right to make decisions about publishing their research results, and could therefore choose to put these into the public domain rather than following a commercialisation route, even where commercialisation opportunities might exist.
- The federal government should dedicate a new stream of funding, in an amount equivalent to 5% of its university research investment, to be

earmarked for support of university commercialisation activities, and in addition to existing support. Universities would qualify for such funding by implementing policies in compliance with the recommended principles, reporting annually on commercialisation activity and submitting an annually updated innovation strategy, as a means of ensuring accountability. It was recommended that the Granting Councils jointly administer these funds to avoid unnecessary additional bureaucracy, and that the program be revisited after a time period, after which competitive support might be considered.

- Universities should commit to build capacity and strengthen the commercialisation skills base, making use of the federal commercialisation funding it receives. The Granting Councils should complement these efforts by assisting in the establishment of regional and national networks to share knowledge, expertise and best practice in the field.
- Business conditions should be improved, through a review of tax policy.
- Government should increase its support for university research, including taking into account the indirect costs of research, to ensure an ongoing innovation pipeline.

The Granting Councils were encouraged to report annually to the public on the economic and social benefits to taxpayers of the public investment in university research.

The Panel Report was not very well-received by many academics (see Kondro, 1999). A study commissioned by ACST in 2004 to investigate Canadian universities' commercialisation strategies (Riddle, 2004) reports that the recommendations of the Expert Panel were not taken up as a formal position of the federal government, although certain elements were adopted. The recommendation on intellectual property policies proved especially contentious. In public consultations on the Panel Report, stakeholders warned that any attempt to enforce a uniform policy of intellectual property ownership by universities would not be effective if it did not have the full support of academic researchers.

The study reports on a multitude of Canadian policy documents, statements and positions put forward by different stakeholders. Substantial attention is devoted to private sector views. Various reports from the USA, the UK and Australia are also reviewed. The ownership of intellectual property was one factor considered, amongst a wider range of issues affecting the university-industry interface. The overarching view captured in the study was that while improvements in the system were required, the issue of intellectual property ownership was not considered to be a major obstacle to technology transfer. The study states (2004:69):

Although a common policy for IP [intellectual property] ownership is favoured by most government and industry studies, retaining and building upon the good-will of university researchers is even more important. Simply put, although it is desirable, institutional ownership of IP is seen by the private sector as neither a necessary nor a sufficient condition for success. Of greatest importance is the need for unity of ownership at the point of commercialization, and in this regard the Québec policy on IP is viewed as a good model. Rather than waiting for government action, universities might exert greater efforts to document best practices and demonstrate their contention that diversity of ownership is not an impediment when inventors and their institutions are actively engaged in commercialization.

The Quebecois intervention, singled out in the study as an example of best practice, merits further discussion.

4.3.2 Quebec Intellectual Property Action Plan

The Quebec Intellectual Property Action Plan (QIPAP) (Government of Quebec, 2002) was an outcome of the provincial science and innovation policy. It acknowledges the benefits of a harmonised approach to intellectual property, while at the same time recognising the importance of stakeholder buy-in (2002:5):

The way forward lies in building consensus among all partners. The Action Plan is to become the instrument for such consensus building. An effective system for commercial development must rest on clear, agreed-upon

guidelines. In the current circumstances, implementation of the Action Plan will largely depend on support from all players in research, commercial development, and innovation.

Compliance is strongly encouraged, but nonetheless voluntary, although it is reported that at least one provincial funding council requires adherence to the Action Plan as a condition for disbursing funding (Riddle, 2004).

The QIPAP is based on six fundamental values:

- Academic freedom - researchers have the right to decide whether or not they wish to commercialise their research results
- Respect for the fundamental missions of institutions - intellectual property policies must make teaching and research easier to pursue
- Public interest - may require a limited restriction on academic freedom (eg a publication delay voluntarily agreed to by the researcher involved, to facilitate prior patenting as a condition for commercialisation)
- Commercial development begins with the researcher - but the researcher must also recognise the different intersecting roles and interests of several other participants in the process
- Intellectual integrity - researchers and institutions must be governed by the principles of ethics in carrying out their research activities
- Transparency and accountability - on the part of all roleplayers in the commercialisation process, in respect of the research community, government and the public.

Five principles of action are then defined:

- Responsibility of all stakeholders to transfer research findings to society - this begins with the disclosure of inventions to the institution by any researcher who intends to pursue commercialisation
- Obligation of the institution and its commercial development partners to respond speedily and effectively - rights should be released to the researcher in the event that the institution chooses not to exploit the intellectual property concerned
- Exclusive ownership of intellectual property once the commercial development process has begun - the starting point is joint ownership of

intellectual property by the institution and responsible researchers, with the expectation that once the institution makes a commitment to commercialisation, the researchers will assign their rights to the institution to simplify negotiations by avoiding the involvement of multiple parties. Researchers retain the right to share in any benefits generated from commercialisation. Conversely, where rights are released back to the inventor, the institution will then be expected to cede its rights to the inventor, to enable the inventor to manage the process, on terms agreed in advance. Under certain circumstances, exceptions might be permitted.

- Partnership between researchers and institutions - ideally, neither party should dominate the other, as both play crucial roles in the process
- Fairness - all intellectual contributions throughout the process should be recognised (including in scientific publications, patent applications, revenue-sharing, and equity shares in spin-out companies). A rule of thumb is established for 50% of net revenues to be distributed to the institution and 50% to the researcher/s, with the proviso that specific benefit-sharing agreements may be individually structured.

Responsibilities of the various parties and timelines for their implementation actions are set out. It is observed that practices evolve quickly in this field, which makes it difficult to lay down all rules in advance. It is therefore acknowledged that changes might become necessary. Provision is thus made for a review process.

4.3.3 *R&D funding from Crown procurement contracts*

Crown procurement contracts represent a subset of Canadian government funding for PRO research. The policy review process of the intellectual property terms of such funding which took place is therefore discussed here. In respect of Crown procurement contracts, Canada departed from a previous situation of ownership by the federal government of intellectual property developed out of federally-funded research, as was the case in the USA prior to Bayh-Dole, but adopted a different approach in doing so: a policy route was followed rather than legislation (OECD, 2003).

A 1991 Policy on Title to Intellectual Property Arising under Crown Contracts, acknowledging that the private sector is best placed to commercialise intellectual property, allowed contractors to own the intellectual property they generated in the course of carrying out Crown procurement contracts (especially, but not limited to, R&D contracts), subject to a range of exceptions. Implementation was however accompanied by various difficulties, associated with uncertainty as to the overall scope of the policy. This was a consequence of ambiguous interpretations of the exceptions, inconsistent application by different government departments and perceived conflicting objectives with other policies. This led to a review of the policy (set in motion by a 1995 evaluation of the status of the policy), in terms of which three options were considered:

- Retaining the 1991 policy, but providing assistance and training with regard to its implementation
- Introducing legislation along the lines of Bayh-Dole
- Revising the 1991 policy so as to retain its key principles, while addressing its weaknesses and removing its ambiguities (OECD, 2003).

The third option was subsequently selected, as the one best able to accommodate the flexibility required by different government departments as well as the needs of contractors. This resulted in the 2000 Policy on Title to Intellectual Property Arising under Crown Contracts, which clarified the scope and application of the policy, as well as the exceptions to contractor ownership, in addition to introducing certain other provisions (eg preference for commercialising within Canada and/or within a certain time frame, monitoring and reporting obligations) (OECD, 2003). Concern has however been expressed that even the revised policy has not been fully embraced, and for some stakeholders, legislation is the preferred approach (Clarke, 2000, revised 2005).

The Canadian approach is notable for several reasons: the underlying research commissioned and the consultations held in the course of the

policy development process; the importance assigned to the support of researchers as critical stakeholders, as well as to stakeholder buy-in more generally; and receptiveness to a more flexible voluntary approach rather than a strictly prescribed one. The absence of legislation to date, despite comprehensive policy processes spanning several years, appears to be at least to some extent a consequence of stakeholder resistance (implied by some of the events and processes chronicled in Riddle's 2004 ACST study). Nonetheless, while some might argue that the policy mechanisms ought to be improved (eg Clarke, 2000, revised 2005) many Canadian PROs have thriving technology transfer operations, which would seem to indicate that legislation is not a prerequisite for effective technology transfer.

4.4 Denmark

Probably the main focal point for Danish policy interventions on PRO technology transfer was to shift ownership of intellectual property developed at universities from individual researchers to the university. Prior to 2000, Danish university researchers (although not researchers in other PROs) were permitted to own intellectual property they developed in the course of their university research. This was part of a 'teacher's exception' applying specifically to university lecturers and researchers, and departed from the general legal position of employer-owned intellectual property. As a result, few Danish universities had TTOs. University scientists rarely applied for patents in their personal capacities, although in some cases assigned their rights to industry research sponsors or collaborators (OECD, 2003).

The situation changed with the introduction of the Act on Inventions at Public Research Institutions in 2000, intended to ensure that publicly funded research results would 'be utilized for the Danish society through commercial exploitation' (Valentin and Jensen, 2007:260). The new legislation gave PROs the right to take ownership of their researchers'

inventions, as well as of inventions derived from collaborative research with industry, unless the university agreed to waive this right in advance.

The legislation requires PRO researchers to disclose all relevant inventions (those which are patentable or capable of utility model protection) to their employing institution, which then has a period of two months in which to decide whether or not it wishes to claim title to the relevant invention. If the institution chooses not to take up rights, the inventor is entitled to exploit the invention independently, subject to sharing net income with the PRO. If the institution does take title, the inventor is entitled to share in the financial benefits accruing to the PRO from successful commercialisation of the invention concerned. While the legislation permits PROs to take equity in a licensee company in lieu of some or all license fees, universities and national laboratories are not permitted to spin out companies themselves (although hospitals are not subject to this limitation) (OECD, 2003).

The Act which eventually passed was of somewhat reduced scope compared to what was initially proposed, after an earlier draft met with strong disapproval from universities and other stakeholders. In particular, the scope of the legislation was limited to inventions that could be protected by patents or utility models (instead of applying to all 'intangible rights'), and the period in which an institution must elect to take title of relevant intellectual property was reduced (to two months) (OECD, 2003).

To facilitate implementation, a working group was set up, consisting of experienced technology transfer practitioners from national laboratories with established TTOs and representatives from universities and hospitals, with observers from stakeholder government departments. The working group developed standard forms, processes and lists of elements to consider in relevant agreements, while allowing for some degree of institutional flexibility in adopting these in a manner consistent with individual institutional culture and structures. Assistance for implementation was made available via parliamentary grants, accessed on an application basis, to cover external costs such as patenting fees and

marketing costs, but could not be used to support the costs of setting up or running a TTO (OECD, 2003).

Initially, many PROs merely assigned an administrator to carry out technology transfer functions, but over time, the need for well-staffed dedicated offices became apparent, and larger TTOs were set up in many PROs, mainly funded internally, but sometimes in conjunction with some government support (OECD, 2003; Valentin and Jensen, 2007).

A recent study set out to examine the effects of the Act, by comparing inventorship on both industry-owned and university-owned patents of Danish and Swedish university researchers, before and after the introduction of the legislation (Valentin and Jensen, 2007). Sweden's policy permitting university researchers to own intellectual property rights in their research results closely resembles the Danish situation prior to the enactment of the law, so the Swedish data can serve as a type of control in this comparative approach.

The enquiry focused on dedicated biotechnology firms (DBFs) specialising in drug discovery, an industry sector in which university collaborations are common, and which shares a similar history and structure in the two countries. It was found that Danish university-industry collaborations in drug discovery declined after the Act came into force, with fewer Danish university researchers being named as inventors on DBF patents. This was accompanied by evidence of substitution of non-Danish university scientists as participants in Danish DBF inventor teams. No corresponding shift was apparent from the Swedish data, and the authors could find no factor other than the Danish legislation to account for the different behaviour observed in the two countries. While some increase could be seen in inventorship of Danish academic researchers on university-owned patents, this was not high enough to compensate for the decline experienced in academic contributions to the industry patents. The authors therefore conclude that significant academic inventive potential, previously

manifested in participation in industry patents, has been rendered inactive by the new Danish legislation.

This would appear to be an unintended consequence of the Danish Act which, if it was meeting its goals, would have resulted in this inventive capacity being channelled into university patents. As such, the new law is deemed to have had detrimental effects on this type of collaboration, and to have impeded domestic academic researchers' contributions to industry patents. The authors do however qualify their findings, pointing out that they apply specifically to university-industry collaborations involving early-stage, exploratory research, where outcomes are uncertain. It therefore becomes a risky decision for either party to agree in advance to assign ownership of intellectual property to the other, as the potential value of such intellectual property remains impossible to calculate at that stage. For research projects occurring further downstream along the R&D value chain (ie situated closer to the market), they acknowledge that there is evidence that the legislative framework has been more successful.

While the Danish experiences under the new framework are still fairly recent, lessons can be extracted from the policy process followed in introducing the legislation, which was relatively responsive to stakeholder input, and which allowed for stakeholder participation in shaping implementation. The Valentin and Jensen study provides a cautionary tale of potential unintended consequences in at least one industry sector, while tentatively suggesting that there might be value in examining the use of different approaches for different types of technologies.

4.5 France

France provides an example of a country which introduced legislation with a somewhat different emphasis: namely, to address structural weaknesses identified in their innovation system, which were identified as responsible for preventing more effective technology transfer from taking place

between PROs and industry. According to French law, inventions developed by salaried employees are generally owned or required to be assigned to the employer, unless completely unrelated to the employer's business. Provision is made for inventors in specified categories to receive additional remuneration under certain circumstances, according to certain decrees. Since PROs owned the intellectual property arising from publicly funded PRO research even before the legislation came into force, the ownership question was not addressed (OECD, 2003).

The Law for Innovation and Research²³ which took effect in 1999 aims to strengthen linkages between PROs and industry and encourage the establishment of innovative start-up companies based on technologies developed by PROs. The legislation allows for greater mobility of researchers, by allowing them to work for companies which are further developing their research, while retaining their position as PRO researchers for a certain time period, provided that permission is obtained from the PRO prior to establishment of the company. The legislation further provides for the setting up of incubators by PROs, providing equipment, space and other support for fledgling companies, particularly technology-based companies of PRO researchers. Other provisions cover the establishment of TTOs, especially at universities, which prior to 1999 did not have such functions. (One reason for this is that most intellectual property developed in French universities at that time was generated in joint research laboratories - ie a partnership between another PRO and a university - where the other PRO would control such intellectual property.) A range of enabling fiscal and legal measures was also introduced by the legislation (OECD, 2003).

While the legislation tackled various legal constraints, it was recognised that cultural barriers to implementation had to be surmounted. Bearing in mind that universities and their researchers did not have experience in the protection and exploitation of intellectual property, an early priority in

²³ Law No 99-587 of 12 July 1999.

implementing the legislation was the drawing up of detailed recommendations for institutional intellectual property management and industry partnerships, by representatives of government, industry and PROs. These recommendations, which appeared in 2001, were designed to guide PROs in the development of their own policies (OECD, 2003).

Recognising the need for additional complementary measures to increase support for R&D in France and to foster innovative companies, an Innovation Plan was unveiled in 2003 as a joint initiative of the ministries of Industry and Research respectively. The Innovation Plan introduced a series of tax incentives (for business angels, innovative small companies and R&D by firms in general); simplification of innovation incentive schemes; incentives for patenting, public-private R&D collaboration; support for incubators and start-up companies; measures to attract students to science and technology careers; and the establishment of centres of excellence for strategic industrial R&D (OECD, 2003 and <http://www.insme.org/page.asp?IDArea=1&page=financings&action=detail&IDObject=20&IDObjectType=11>, accessed 10 February 2008).

The French legislation, supplemented with the implementation recommendations and the Innovation Plan, demonstrates a targeted approach aimed at addressing specific structural weaknesses. Implementation by means of flexible guiding recommendations, drafted in a collaborative effort by representatives of all stakeholders, rather than by means of rigid mandated rules, appears to have been an appropriate route to follow. The Innovation Plan filled an important gap by focusing (mainly) on industry needs.

4.6 Italy

Italy is briefly mentioned as an example of a country which has departed from the predominant trend of policy convergence towards PRO ownership

of intellectual property. 2001 legislation²⁴ gave academic inventors the right to own the intellectual property they develop in the course of their research (Cesaroni and Piccaluga, 2005; Milken Institute, 2006; OECD, 2003). The rationale underlying this change was based on the assumptions that this would function as an effective incentive to encourage PRO scientists to engage in technology transfer activities, and that inventors, due to intimate knowledge of their technologies, are best-placed to identify potential applications and commercial partners. Under this model, the inventors are generally responsible for commercialisation costs, including patenting fees. Researchers may however enter into agreements with their employing institutions, in which the PRO takes on commercialisation responsibilities. This may or may not entail assignment of intellectual property to the PRO, but will involve benefit-sharing. One study reports that there is no evidence of an increase in inventor-owned patent applications since the passage of the law (Cesaroni and Piccaluga, 2005).

4.7 Concluding Remarks

This chapter has attempted to provide a brief outline of the policy approaches of the selected countries, highlighting those aspects deemed to be of greatest relevance to the subject matter of this dissertation, and extracting some potential lessons for South African policy, discussed further in Chapter 6. As such, this does not constitute a comprehensive or detailed review. It is nonetheless hoped that this chapter succeeds in illustrating the diversity of policy approaches adopted in the handful of countries examined, and thus in conveying the message that there is no single accepted approach to policy PRO technology transfer globally. The multitude of available options can in theory assist in informing the development of policy well-suited to a country's particular national needs.

²⁴ National Law No 383.

CHAPTER 5: TECHNOLOGY TRANSFER IN SOUTH AFRICA: PRACTICES AND POLICY ENVIRONMENT

5.1 Introduction

The relevant South African policy environment pertaining to the IPR Framework and Draft Bill is discussed in this chapter, in order to provide sufficient context for the policy critique which follows in Chapter 6. A brief overview of technology transfer in South African PROs is given, based mainly on personal knowledge and observation of, and participation in, the system, before looking at the policy history leading up to the release of the IPR Framework, and the subsequent Draft Bill. The main features of these documents are summarised. Other selected policy and regulatory developments which impact on technology transfer, or have the potential to do so, are also mentioned. This is done with relative brevity, and does not claim to cover all potentially relevant South African policies and developments comprehensively, due to space constraints and a decision to focus here in greater depth on the specific policy under consideration, namely the policy on intellectual property rights from publicly financed research. Further, while it is explicitly acknowledged that the broader innovation policy environment will of course impact directly on the success or failure of any technology transfer interventions, it is noted that this has been examined in detail elsewhere, (notably in the 2007 OECD review of South Africa's innovation policy (OECD, 2007), as well as in Kraak (2007)).

5.2 Current Status of Technology Transfer Practice in South Africa

In South Africa, a handful of TTOs were established in the late 1990's, at the initiative of the institutions themselves, who recognised the need and were willing to devote some resources to the activity. These PROs included certain science councils and some of the more research-intensive

universities.²⁵ This pre-dated active government involvement in promoting technology transfer from PROs, which began shortly thereafter. Other PROs have more recently set up technology transfer operations, sometimes at the urging of and/or in partnership with a government agency, while some PROs have yet to put in place a TTO.

Currently, not all South African universities have explicit intellectual property policies, and where policies are in place, these are not uniform across institutions. In some cases, intellectual property is owned by individuals (unless specifically assigned, for example as a condition for the award of certain funding), and in other cases, by the university, depending on internal policies, conditions of employment and student rules. Rights to ownership of student intellectual property varies widely, even for universities with clear policies which provide for institutional ownership of staff intellectual property. Where rights are assigned to the university, proceeds generated from the exploitation of intellectual property are generally shared between the institution (typically divided amongst multiple entities within the institution, such as research grouping, department, faculty and/or centrally) and the individual inventor/s concerned, according to a formula set out in the intellectual property policy. The institution frequently assigns rights to a funder in exchange for research funding. This occurs both in respect of certain public sector and private sector funders, and may or may not include an obligation on the part of the assignee to share any future benefits derived from the exploitation of the intellectual property concerned with the institution (Wolson, 2007).

While several TTOs have by now accumulated some degree of experience and expertise, and while it is acknowledged that they generally adhere to professional standards and follow good practice, the perception prevails,

²⁵ Six PROs participated in a technology transfer assessment exercise in 2003. These were: Council for Scientific and Industrial Research (CSIR), Medical Research Council, Northwest University, Stellenbosch University, University of Cape Town and University of Pretoria (who at the time, carried out their technology transfer activities in a joint venture with the CSIR).

both within organisations themselves and externally, that South African TTOs are not performing as well as they ought to be.

Little quantitative data is available on the technology transfer performance of SA PROs, and the information that does exist (usually made available on an informal, collegial basis rather than as part of a systematic data-gathering exercise) is generally not comparable across institutions, who do not uniformly track the same internal metrics.²⁶ The small sample size compounds the problem (Wolson, 2007). It is thus difficult to quantify performance meaningfully, or to attempt to benchmark against other systems internationally. This is therefore an area ripe for further research.

Heher (2005) has made some tentative projections on the kind of returns that South African universities might collectively expect to generate once their technology transfer activities reach a level of maturity, using a dynamic model he has constructed based on international technology transfer benchmarking data. He suggests that (2005:222):

If South Africa were to attain an innovation performance similar to comparable institutions elsewhere, the entire South African higher education research system would be expected to generate 200 to 300 invention disclosures per annum - when operating at international norms of efficiency (ie trained staff are in place). After seven to ten years this should lead to a portfolio of around 500 active licences, two of which would be likely to be generating revenue of greater than \$1m per annum, and with total revenue of R20 to R40m per annum. Furthermore, the distribution of returns will almost certainly be skewed, even amongst the five or six major research universities, let alone the fifteen smaller institutions. A few institutions are likely to perform relatively well, while the majority are likely to operate at a net loss, even after ten or fifteen years. Furthermore, the skewness and variability of returns means that it is not possible to predict who is likely to succeed and who is likely to 'fail'. Given the financial constraints that exist in higher education institutions, the continuation of

²⁶ For the past three years, PROs have been required to report to a national agency on their technology transfer activity, but this data has not been made public in raw or aggregated format. It is understood, from personal communication with agency officials, that it is intended that at least national level data will eventually be made public.

institutional support for technology transfer is likely to be at risk, unless external support or stimulus is provided.

Irrespective of the dearth of specific data, however, few will dispute that the returns generated from technology transfer activities by South African PROs to date remain relatively low. Various contributing factors can be identified. Some of these are described in Wolson (2007). The pipeline of invention disclosures is thin. Since the number of potential disclosures is related to institutional R&D expenditure (Heher, 2005), a smaller system is likely to yield fewer disclosures. Furthermore, researchers are often reluctant to make disclosures, whether due to lack of interest or incentive, or scepticism about the academic technology transfer endeavour. The costs of patenting are high, and many institutions do not have adequate budget to pursue international filings. While there is a growing cadre of technology transfer practitioners, capacity remains limited, as do capacity-building opportunities. Finally, licensing opportunities are scarce. Domestic firms will often not have the markets or distribution channels to ensure viable exploitation, and marketing to overseas companies can be difficult without a track record or personal contacts to facilitate meaningful linkages, not to mention costly. At the same time, start-up opportunities for new businesses are few and far between, as finance is not easily raised from risk-averse financial institutions and venture capitalists. Angel investors are few and far between.

Concerns also exist about the 'leakage' of intellectual property which although developed in South African PROs, gets exploited overseas, without due benefits being realised. Some believe that examples of this are widespread. Although this was investigated in a Lost Technology Commercialisation Opportunities study undertaken by the Department of Science and Technology (DST), the study has not been made publicly available (Department of Science and Technology, 2007a).

The tentative nature of the observations made in this section is noted, and further research is required to confirm them and elaborate on them.

5.3 SA Policy Context

While on the one hand, certain PROs are reflecting on and reassessing their technology transfer strategies, and on the other hand, evidence suggests that industry does not appear to rely much on PROs as a source of innovation (Department of Science and Technology, 2007b), government has proposed new legislation on Intellectual Property Rights from Publicly Financed Research in an effort to address this situation. In early discussions, this was touted as a 'South African Bayh-Dole Act'. Without derogating from the inspiration provided by Bayh-Dole, or the applicability of certain Bayh-Dole provisions which may be adopted, it is submitted that the elimination of the 'Bayh-Dole' descriptor from the current South African discourse is appropriate, bearing in mind differences in the prevailing conditions and rationale, and significant departures from Bayh-Dole in the current policy and legislative documents.

The pending South African legislation (discussed in more detail in section 5.5) proposes that all institutions which receive public financing for research have a TTO (referred to as an 'Intellectual Property Management Office' or 'IPMO'), and in addition prescribes a range of requirements for the functions of such offices, internal institutional policies and permissible technology transfer practices, as well as conferring certain rights on the State in respect of intellectual property covered by the statute. At the same time, a range of other policies and programmes are impacting upon the effective harnessing of the benefits of publicly funded research for economic and social development.

The following section 5.4 provides a very brief overview of the relevant policy history leading up to the development of the IPR Framework and Draft Bill. A snapshot of selected documents is presented, in which those aspects most pertinent to the IPR Framework and Draft Bill are highlighted, in order to set the context. Key provisions of these documents are then described in section 5.5 (without in-depth comment, as a critique follows in Chapter 6). Other selected policy factors of relevance to the objectives of

the IPR Framework and Draft Bill are mentioned in section 5.6, in an effort to demonstrate the need for considering the broader context, without attempting to provide comprehensive coverage of all relevant policies or policy considerations. While acknowledging the importance of such a review, it is deemed to be beyond the scope of this dissertation.

5.4 Policy Development Leading up to the IPR Framework and Draft Bill

The 1996 White Paper on Science and Technology (Department of Arts, Culture, Science and Technology, 1996) established the concept of a National System of Innovation for South Africa and created the framework for key enabling policies and strategies to inform the strategic development of science and technology in the country.

The National R&D Strategy (Department of Science and Technology, 2002) was drawn up in 2002 in order to improve the impact of the White Paper by identifying strategic interventions to address identified weaknesses, in an effort to ensure that the vision articulated in the White Paper is sustained. It is based on three pillars, namely: innovation (achieving mastery of technological change in the economy and society), human capital and transformation (increasing investment in South Africa's science base) and alignment and delivery (creating an effective government science and technology system). The R&D Strategy commits government to increase its share of spending on research, development and innovation, and provides the over-arching framework for several other interventions. These include the National Biotechnology Strategy,²⁷ the National Nanotechnology Strategy, the Advanced Manufacturing Technology Strategy, and R&D tax incentives.²⁸

²⁷ This is discussed in some detail in Wolson (2005).

²⁸ See www.dst.gov.za.

Particularly relevant to the development of the IPR Framework is the concept of an 'innovation chasm', introduced in the R&D Strategy to describe the gap which exists between the knowledge generators (especially PROs) and the market. Despite the presence of some strong linkages between industry and PROs, local innovation has apparently had little impact on economic growth, with South African technology-led companies commonly accessing their technology from abroad. Legislation aimed at improving the protection and management of intellectual property from publicly financed research is one of the mechanisms mooted in the R&D Strategy to assist in bridging the innovation chasm, together with the establishment of a fund to finance the costs of obtaining intellectual property protection in certain circumstances.

Another element of the R&D Strategy of interest to the IPR Framework and Draft Bill is the recommendation that a core agency be set up for the stimulation and intensification of technological innovation, by aligning, co-ordinating and providing a single point of strategic direction for a range of existing and anticipated innovation support instruments. Support for this proposal can be found in the review of South African innovation policy undertaken by the OECD (2007). The review highlights the absence of holistic governance of the components of the innovation system as a weakness in the South African innovation system and suggests that a high level government agency to integrate research and innovation policies and instruments across government departments would be beneficial.

Moves are underway to give effect to the R&D Strategy's recommendation in this regard, through the drafting of a Technology Innovation Agency Bill²⁹ and the development of a business case. It is intended that the Technology Innovation Agency (TIA)³⁰ be established in 2008, pending promulgation of the legislation and approval of the business case by Cabinet. However, initially at least, it is proposed that the TIA house only

²⁹ Bill 49 of 2007.

³⁰ While the R&D Strategy refers to the proposed agency as the 'Foundation for Technological Innovation', it has since been renamed the 'Technology Innovation Agency'.

those 'TIA building blocks currently administered by the DST or the DST family of public institutions' (Department of Science and Technology, 2007a:39), implying that innovation support measures falling under other departments, primarily the Department of Trade and Industry (DTI) will not be brought under the TIA umbrella. As such, it is submitted that the TIA's capacity to integrate innovation efforts across multiple government departments, as recommended by the OECD review (2007), is likely to be constrained.

DST also brought out a Ten-Year Innovation Plan in 2007 which aims to 'help drive South Africa's transformation towards a knowledge-based economy, in which the production and dissemination of knowledge leads to economic benefits and enriches all fields of human endeavour' (Department of Science and Technology, 2007c:iv). This document contains proposals directly relevant to the objectives of the IPR Framework and Draft Bill. One of the four drivers identified to make progress in this regard is 'enablers to address the "innovation chasm" between research results and socioeconomic outcomes' (the other three being human capital development, knowledge generation and exploitation via R&D, and knowledge infrastructure) (2007c:8). In addition, five 'grand challenges' are proposed, to exploit existing advantages, encourage multidisciplinary approaches, respond to existing questions and develop new products.³¹ Core projections for 2018 are outlined. Amongst these is the goal of substantially increasing patents and patent applications originating from South Africa, both at the South African patents office and in major patent offices internationally.

The Innovation Fund, established almost a decade ago, is one of the main agencies responsible for the implementation of the R&D Strategy, and is

³¹ The five grand challenges are: From Farmer to Pharma: life sciences and health; Expanding the limits of space science and technology; In search of energy security; Science and technology in response to global change; and Human and social dynamics.

likely to become the agency responsible for implementing and administering the legislation ultimately enacted in terms of the IPR Framework. It describes its mission as 'catalys[ing] technology innovation for the social and economic benefit of all South Africans', which it carries out by funding near-market and end-stage research for the production of new intellectual property and companies, the expansion of existing industrial sectors, and the promotion of South Africa's economic competitiveness. Its current structure includes a Research and Development Funding Unit, which provides R&D funding for approved projects in response to applications submitted to it, an Innovation Fund Commercialisation Office, which assists with the commercialisation of Innovation Fund projects (eg strategy development, due diligence, deal-structuring), and the Intellectual Property Management Office, which administers funding instruments to promote the patenting of intellectual property by PROs, SMMEs and Techno-Entrepreneurs.

Innovation Fund project support usually requires that any eventual commercial proceeds resulting from the funded project are shared by the recipient (typically a consortium) with the Innovation Fund. Further, Innovation Fund secures itself a right to take ownership of project intellectual property, together with the right to obtain a license for use of relevant background intellectual property³² held by the recipient, in the event that the recipient fails to commercialise the intellectual property within a stipulated time period (usually three to five years).³³ The Innovation Fund's Intellectual Property Management Office is expected to take on the role of the agency proposed to be established under the IPR Framework and Draft Bill (acting as a national intellectual property office), as discussed in section 5.5.

³² 'Background intellectual property' refers to intellectual property owned by a grantee that pre-dates the funded project, but is relevant to the project field.

³³ Certain other government agencies sometimes impose similar conditions eg the Biotechnology Innovation Centres (see Wolson, 2005).

5.5 The Intellectual Property Rights Framework and Draft Bill

As shown in section 5.4 above, concrete efforts have been underway for a couple of years on the part of DST to give effect to the R&D Strategy's call for a clear approach to address the situation of inadequate protection and management of intellectual property from publicly financed research, via legislation. These efforts culminated in the Intellectual Property Rights From Publicly Financed Research Framework (IPR Framework) (Department of Science and Technology, 2005), which was drawn up and circulated for discussion by stakeholders at a series of public consultations which took place around the country in 2006, to precede the drafting of legislation. A marginally revised Framework (Department of Science and Technology, 2006) was subsequently presented to and approved by Cabinet in 2007, together with a Draft Bill,³⁴ which was in turn released for public comment.³⁵

The Draft Bill was not well-received by stakeholders. At the time of writing, DST had indicated that fairly substantial re-drafting might occur, in response to comments received. It is however not clear whether this will be at a substantive level (noting that many of the comments submitted in response to the IPR Framework were not taken into account in the drafting of the Draft Bill), or whether this will mainly address certain ambiguities, use of language, unclear definitions, and potential conflicts with other legislation which appear in the Draft Bill. The discussion which follows in this section attempts to focus on the higher level substantive issues and underlying principles, rather than on the finer drafting details.

5.5.1 Outline of the Framework content

The first chapter of the Framework deals with contextual issues. The Framework asserts 'an urgent need for the creation of a proper framework and enabling legislation for the effective management of intellectual

³⁴ Intellectual Property Rights from Publicly Financed Research Bill: Draft (Gazette 29950, Notice 719), 8 June 2007.

³⁵ Except where specified to the contrary, reference to the Framework is made in relation to the first 2005 Framework document.

property arising from publicly financed research' (page 8), in order to prevent leakage of such intellectual property overseas, to give government 'walk-in' rights to utilise such intellectual property and to harmonise institutional approaches to the management of such intellectual property. It is underpinned by the belief that increased levels of patenting will lead to more effective exploitation of publicly financed research, by the private sector or, in certain cases, for public use.

The scope of the Framework (and the future legislation to be based on it) (page 9):

... is focused on and limited to Intellectual Property (ie patents, copyright, designs, plant breeders' rights and indigenous knowledge, etc) protecting inventions made through work financed by public research funding. It deals with issues of ownership, benefit sharing from licensing and use of the patents and accountabilities of different role-players in the system of innovation.

In the second chapter, the Framework seeks to compare South Africa's patent performance against international norms. While it may be argued that the data is investigated on a fairly superficial basis, there is sufficient evidence provided to show that participation of South African organisations and inventors in the international patent system is not only low, but also somewhat static, having failed to show any significant increase in the last decade or so.³⁶ Reference is made to the relevant sections of the R&D Strategy in the third chapter and existing South African intellectual property legislation and treaties are listed in the fourth chapter.

Some current interventions and practices in this arena are briefly mentioned in the fifth chapter. The steps taken by some PROs to implement intellectual property policies are acknowledged, while noting that these are not uniform amongst institutions, and the protracted negotiations which often accompany the setting up of inter-institutional collaborations

³⁶ Further evidence of this is provided in a more recent study undertaken by the Innovation Fund, entitled 'The State of Patenting in South Africa: Special Report 2007' (Innovation Fund, 2007).

are ascribed to this lack of a uniform approach to intellectual property issues. Interestingly, the Framework does not attempt to provide any assessment of current South African PRO technology transfer performance.

While some motivation is provided for the establishment of legislation in the sixth chapter, on the basis that this is the route followed by most developed countries, and increasingly by emerging economies, other alternatives are not explicitly considered.

The seventh chapter discusses the importance of the Framework for its various stakeholders. The Framework then concludes in the eighth chapter with some details of substance to be incorporated into the legislation. The key elements of these recommendations are identified and discussed in the sections which follow, and compared with the proposed legislative approach actually taken in the Draft Bill.

5.5.2 Establishment of a new government agency

According to the Framework, government will be responsible for 'provid[ing] incentives for the processes of creation, protection and use of patents arising from publicly financed research' (page 32). An agency will have to be designated to manage this policy, a function which the Framework proposes be taken on by the Innovation Fund, in order to take advantage of existing infrastructure. This agency will provide assistance to institutions in implementing the policy, promote good governance of intellectual property management in PROs, develop and maintain a database of PRO intellectual property management and technology transfer activity, offer financial support to institutions and individuals to incentivise patenting, and engage in capacity-building (sections 8.7.1 and 8.10).

The Bill refers to the establishment of a National Intellectual Property Management Office (NIPMO), to be managed by an entity appointed by the Minister. NIPMO is to be given widespread functions, ranging from general administration of the legislation, to oversight of and support for the system

overall, to day-to-day intellectual property management (whether in conjunction with PROs or in respect of intellectual property owned by the State under the statutory provisions) (sections 7 and 8). It is anticipated that the Innovation Fund's Intellectual Property Management Office will become the 'NIPMO', located within the TIA structure.

The Bill further provides for the establishment of a Patent Fund administered by NIPMO to provide financial support to PROs for obtaining statutory intellectual property protection on stipulated terms (section 16).

5.5.3 Establishment and functions of TTOs within PROs

The Framework states that PROs, as recipients of public research funding, will be obligated to seek patent protection for inventions developed from such funding, irrespective of the form that the funding takes. Institutions will therefore have to set up central TTOs, build capacity to manage obligations under the legislation and put in place a written intellectual property policy which meets minimum legislated standards. Provision is made for the national agency to step in to assist those institutions without their own technology transfer services (sections 8.1.1 and 8.7.2). Invention declarations will have to be registered with the national agency (section 8.7.5).

Revenues received as a result of successful exploitation of intellectual property developed from publicly financed research will accrue to the publicly financed institution concerned, and be used to support TTO and institutional R&D activities, as well as shared with inventors (section 8.7.4). A set of principles for the allocation of revenues is outlined, and originally a fixed formula was proposed, which would have required all PROs to share proceeds according to a stipulated ratio (ie 30% to the inventor, shared equally in the case of multiple inventors; 30% to the business/operational level of the institution for research stimulation and support; 30% to the executive level of the PRO for new research stimulation and support or additional support to the TTO); and 10% to the TTO to cover costs and allow for staff incentives (sections 8.1.3 and 8.11). The prescribed formula

was however only mentioned as an example in the final Framework document presented to Cabinet, which makes reference to empowering the Minister to enact Regulations (sections 8.1.3 and 8.11 respectively of the document presented to Cabinet).

Nine public research institutes and 22 higher education institutions are listed as publicly financed institutions covered by the legislation in a Schedule to the Bill. Under the proposed legislation, these PROs will be given a period of six months from the Act taking effect to set up a TTO (or 'IPMO' - ie Intellectual Property Management Office - according to the language of the Draft Bill), unless determined otherwise by the Minister in conjunction with any other Minister to whom the PRO might report (eg Minister of Education in respect of universities) (section 5). Specific qualifications and expertise required for IPMO staff are set out (interestingly, no analogous criteria are suggested for NIPMO officials) and IPMO functions are listed (section 6). The latter include the development of relevant policies, handling invention disclosures, filing applications for the protection of intellectual property, screening all publications for 'potential intellectual property that through publication may lose protection' under the patent law, managing and sharing revenues generated from technology transfer activity, and interfacing with NIPMO. The relationship with NIPMO includes a requirement to report annually to NIPMO on 'all matters related to intellectual property at the Institution', and an obligation to refer any intellectual property to NIPMO in respect of which the TTO elects not to seek statutory protection within fourteen days of such decision (section 9).

Under the Draft Bill, benefit-sharing of the proceeds of commercialisation with PROs and PRO inventors in their personal capacity will apply even where the intellectual property concerned is registered in the name of the State. (The Bill is silent on the question of whether the State itself will share in such revenues.) A minimum percentage set by the Minister in Regulations would accrue to inventors, while the institution would have discretion to distribute the remainder as it chooses, with the expectation

that a 'reasonable portion' be directed to the research unit responsible for the invention and to the TTO (section 11).

5.5.4 Rights and duties of PRO employees

According to the Framework, individuals who utilise public research funding would be under the obligation to declare to their employing institution any inventions developed in the course of their research, which inventions are assigned to their institution (sections 8.1.1, 8.7.6 and 8.9). All individual qualifying inventors whose intellectual property generates 'economic benefits' for their institution or 'a client of the institution' (page 33) stand to share in these benefits (sections 8.1.3 and 8.11).

The Draft Bill stipulates that employees will be deemed to have assigned their intellectual property to their employing PRO (section 3), that they will be obligated to disclose inventions, discoveries and improvements within thirty days to their institution (section 10) and that inventors will be entitled to receive a 'minimum percentage' to be set by the Minister in Regulations (section 11).

5.5.5 Co-funded research (including collaborative and sponsored research)

According to the Framework, where the research leading to the generation of relevant intellectual property involves more than one party, a single partner will take the role of Designated IP Institution/Holder and be responsible for managing the intellectual property on behalf of all partners (sections 8.7.6 and 8.8). In cases 'where business institutions, or international groups participate in research with public funding' (page 38), the Designated IP Institution will have to be a South African PRO or the national agency, although special provisions will apply where such partners co-finance the research concerned. The Framework lists several principles relating to the co-financing of research, in an effort to assist in determining ownership of intellectual property developed in the course of such research.

The Draft Bill does not explicitly deal with the question of ownership of intellectual property where more than one PRO might be involved, but implies that joint ownership would not be prohibited, and does not appear to restrict PROs with a shared interest in any intellectual property from negotiating this issue between themselves.

In respect of research funding from 'private entities and enterprises', the Bill distinguishes between 'project-specific' funding, and projects funded on a full-cost model on the one hand, and 'non specific', 'of a general nature or partially general nature' on the other. In the case of the former, the funder may acquire ownership of the project intellectual property, provided that the funding agreement allows for benefit-sharing of royalties derived from exploitation of the intellectual property concerned. In the case of the latter, the funder may be a co-owner of the relevant intellectual property where such company 'is best placed to manage and commercialise the intellectual property in the national interest, or there has been a significant contribution of resources, including background intellectual property' by the company concerned (section 21).

5.5.6 Technology transfer

The Framework recognises licensing as the most important mechanism for technology transfer from the university to industry (section 8.2). Start-up companies are regarded as vehicles for commercialisation of technology where 'there is no immediate licensee in view' (page 33), and licensing of intellectual property is considered preferable to assignment. The Framework expresses a preference for non-exclusive licensing in order to ensure wider availability, but acknowledges that in some cases, where substantial further development is required to take a technology to market, exclusivity may be permitted, with the prerequisite that performance clauses are in place (section 8.3). The Framework calls for institutions to make 'reasonable and demonstrable' (page 34) efforts to license technology within South Africa, on the basis that this will maximise the impact on local economic development and create commercialisation opportunities for South African industry. Where local licensees cannot be

found, institutions will be obligated to ensure that other benefits accrue to local business (eg manufacturing rights, preferential pricing, support for R&D) (section 8.4). The Framework proposes that SMMEs and Broad-Based Black Economic Empowerment (BBBEE) enterprises should benefit preferentially from opportunities to exploit intellectual property from publicly financed research, and that TTOs will have to demonstrate that they have made efforts to facilitate this, and report accordingly (section 8.5). It is stated that international licensing will be permitted 'when licensing is not possible in South Africa' (page 35), in order to increase foreign direct investment and technology partnerships for the country, provided this would not be in conflict with international treaty obligations or national security (section 8.6).

The Draft Bill sets out in detail conditions to govern the exploitation of publicly financed intellectual property. PROs are required to determine license terms in consultation with NIPMO (section 12), which has the effect of introducing NIPMO as an additional participant at the negotiating table, even when NIPMO is not a party to the contract. Non-exclusive licenses are preferred. Exclusive licenses may be granted only if the licensee is able to prove that (a) it will not be economically feasible to exploit the licensed technology non-exclusively and (b) there is 'no overriding State interest that militates against granting of an exclusive license'. The duration of exclusive licenses is limited to five years, after which the PRO licensor and NIPMO are required to reassess 'the need' for exclusivity. 'Where feasible', exclusive licensees are required to 'manufacture, process and otherwise utilise' the licensed invention in South Africa. NIPMO is given the power to suspend and/or revoke licenses in the case of a licensee's failure to comply with these and other conditions, including failure to 'exploit or fully exploit' a license 'to the benefit' of South African citizens, if not satisfied with reasons provided for such failure (section 12). PROs are required to give preference to BBBEE companies and SMMEs as licensees (section 13). NIPMO must be informed of any intention to 'dispose of' (ie assign ownership rights rather than license) intellectual property and 'the benefits that will accrue to the State' as a result of such

disposal must be provided. NIPMO must also be informed of any intention to license or dispose of intellectual property off-shore, which may only take place 'when South Africa does not have capacity to develop or exploit the Intellectual Property', and subject to Reserve Bank Exchange Control regulations and approvals. The PRO licensor bears the onus of proving the lack of capacity nationally and will have to ensure that benefits 'accrue to South Africa' from the relevant transaction. Commercial exploitation of intellectual property must further be 'in accordance with the existing economic policies of the government' (section 15).

5.5.7 Government walk-in rights

According to the Framework, government will be given specified 'walk-in' or 'step-in' rights to be able to use inventions derived from publicly financed research in times of 'national emergency and similar times of great national need' (page 36, section 8.7.3).

Under the Draft Bill, these so-called 'walk-in' rights would entail the forfeiture of patent rights to the State and/or the revocation of an exclusive license, where the invention which is the subject of such patent and/or license were not being adequately exploited or utilised without satisfactory reason being shown (section 18). Any Minister of State also has the right to call for a particular patent to be assigned or exclusively licensed to the State where acquisition of the invention concerned is 'necessary for the Republic's health, security and other needs in the opinion of the Minister of State' (section 19). The Minister may revoke a license agreement or intellectual property assignment from a PRO to a company should the licensee/assignee fail to comply with the statutory conditions incorporated into the license or intellectual property assignment (section 20).

5.5.8 Establishment of a patent fund

The Framework notes that a dedicated fund to cover the costs of securing patent protection 'when this is in the national interest' should be established under a dedicated agency (page 19), and further mentions a new role taken on by Innovation Fund, to provide financial incentives for

high quality PRO-owned patents, and co-finance for PRO patents (page 26).

The Draft Bill proposes the establishment of a Patent Fund to be managed by NIPMO, incorporating the Innovation Fund's existing Patent Support Fund, to cover the costs of NIPMO and State-owned patents (section 16), and cost recovery for PRO patents according to terms set down by NIPMO (section 17).

5.5.9 Regulations

It is proposed in the Framework that the legislation to be drafted will set out key principles based on good international practice and aligned with the Framework, and will empower the Minister of Science and Technology to make regulations for implementation of the principles enshrined in the statute, to allow for greater flexibility (section 8.12).

The Draft Bill empowers the Minister to make regulations which s/he deems necessary to ensure the proper implementation of the legislation (section 23).

5.6 Other Key Relevant Policy and Regulatory Factors

While a comprehensive discussion is beyond the scope of this paper, a snapshot of selected intersecting policy and regulatory issues is presented, in order to provide a broader context for the subsequent critique of the potential impact of the IPR Framework in Chapter 6.

5.6.1 Relevant Department of Education policies

Since the Department of Education (DoE) plays a prominent role in shaping a variety of policies and practices in the university environment, including those related to research, its failure to promote university-industry linkages actively or explicitly, as observed by Kraak (2007) is conspicuous. More specifically, the DoE has been largely silent on the question of technology

transfer, and some of its policies could even be viewed as discouraging technology transfer activity. As an example, the distribution of subsidy to universities made by DoE according to a complex formula is an important driver of behaviour. While peer-reviewed publications are an important parameter of the formula calculations, patents and other outputs relating to the successful deployment of university research results in society are not considered in the research subsidy formula. Publications therefore tend to carry greater weight in university reward systems, which typically fail to provide suitable incentives to encourage patenting and technology transfer. Consequently, this remains a marginal activity.

The restructuring of the national higher education system undertaken by the DoE has seen 36 higher education institutions reduced to 22 as a result of a series of mergers aimed at addressing the fragmentation and inefficiencies of the apartheid-era system, in an effort create non-racial universities, achieve economies of scale and scope, and streamline structures (see Council on Higher Education, 2000). However, it can be argued that as the transformation process continues, research and research management capacity and institutional culture, both historical and of the newly-created institutions born of the merger process, will influence the prospects for different universities to engage effectively in technology transfer activities. Moreover, it is generally acknowledged that five of the universities account for a significant proportion of both research expenditure and outputs (Kraak, 2007; Kruss, 2005), while a handful of others have some research and innovation capacity, at least in certain areas, or are attempting to build such capacity. But the substantially lower R&D budgets at the majority of South African universities cannot but lead to lower research outputs, including that subset of the total which offers potential for technology transfer.

5.6.2 National intellectual property regime

South Africa has for many years had relatively strong intellectual property legislation, closely based on British law (and more recently, the European Patent Convention), and substantially compliant with the Agreement on

Trade-Related Aspects of Intellectual Property Rights (TRIPS).³⁷ While the national patents office, the Companies and Intellectual Property Registration Office (CIPRO) is a non-examining registration office, with very limited capacity, the courts have traditionally tended to uphold the rights of intellectual property holders. As a consequence, South Africa is for the most part viewed as a country which respects intellectual property rights. There are however indications that the government may begin to explore more creative policy options (as it has already done on the question of access to medicines),³⁸ as awareness increases of the impact of intellectual property on development and domestic innovation (eg WTO Doha Declaration, the Development Agenda tabled at the World Intellectual Property Organisation). Some constraints exist because of obligations under various multilateral and bilateral trade agreements, but in more recent negotiations, South African negotiators appear to be taking a stronger stance than in the past against intellectual property demands which are not deemed to be in the country's best interests.

While intellectual property policy, legislation and administration (through CIPRO), as well as international trade, are DTI competencies, DTI does not appear to have made much input into the IPR Framework and Draft Bill. There is certainly no evidence of DTI's trend towards a more 'pro-development' intellectual property policy position captured in the Framework.

³⁷ TRIPS is a 1995 World Trade Organisation (WTO) agreement which sets out minimum standards of intellectual property protection to be adopted by all WTO member states. The South African intellectual property legislative framework pre-dates TRIPS and only relatively minor changes were needed to bring South African law substantially into compliance with TRIPS.

³⁸ A 2001 legislative amendment aimed at permitting parallel importation of patented drugs received world attention when it led to 39 international pharmaceutical companies instituting legal proceedings against the South African government, claiming that the move violated South Africa's obligations under TRIPS. The lawsuit was ultimately dropped after international condemnation of the companies' position, which was seen to be obstructing the availability of cheaper antiretrovirals (ARVs) for a country with one of the highest incidences of HIV/AIDS infection in the world. Several pharmaceutical companies have subsequently entered into voluntary licensing agreements with South African manufacturers for ARVs.

As dealt with in the IPR Framework in some detail, and confirmed in a recent study undertaken by the Innovation Fund (2007), patenting activity by South African organisations is weak. Apart from one or two exceptions,³⁹ South African PROs exhibit a particularly low tendency to patent their research findings (Lubango and Pouris, 2007).

5.6.3 *Exploitation of biodiversity and indigenous knowledge*

South Africa is considered a 'megadiverse' country as a result of the wealth of unique plant biodiversity found in the country, and is in fact the only country in the world which contains an entire floral kingdom (the Cape Floral Kingdom) within its borders (Department of Environmental Affairs and Tourism, 2005). Efforts to realise value from this biodiversity through bioprospecting are therefore receiving attention and several PROs are engaging in research based on indigenous biological material. In many cases, this is enhanced by access to indigenous knowledge associated with applications of the biological resources concerned. This avenue of research offers enormous potential particularly in the field of drug development and has been highlighted as a priority area through inclusion in one of the grand challenges outlined in the DST Ten-Year Innovation Plan, 'From Farmer to Pharma' (Department of Science and Technology, 2007c).

In line with the need to fulfil international treaty obligations and follow ethical practices, South Africa has recently introduced legislative and policy instruments to recognise and protect biodiversity and indigenous knowledge, which impact upon the management and performance of the research, as well as on the prospects for ultimately generating exploitable outputs. The Biodiversity Act,⁴⁰ which falls under the auspices of the Department of Environmental Affairs and Tourism, creates a framework for bioprospecting, which requires anyone wishing to carry out bioprospecting activities to enter into appropriate MTAs and/or benefit-sharing agreements

³⁹ Notable in this regard is the Council for Scientific and Industrial Research, which for several years has consistently featured as one of the most active South African patenting organisations.

⁴⁰ National Environmental Management: Biodiversity Act, Act No 10 of 2004.

with stakeholders who provide access to indigenous biological material and/or knowledge associated with such resources, which will be used in the bioprospecting work.

Regulations relating to bioprospecting, access and benefit-sharing are pending under the Biodiversity Act, to operationalise the statutory framework. Draft Regulations released in 2007⁴¹ propose a permitting system for research and bioprospecting on and export of indigenous biological resources, and stipulate the contents of, and criteria and requirements for benefit-sharing agreements and MTAs, which are mandated under the Act where researchers gain access to knowledge and/or materials from other stakeholders, such as indigenous communities. The draft Regulations have been through a process of public consultation and comment and amended Regulations are now awaited.

While there is broad support for the objectives of the legislation, some concern exists regarding the feasibility of effective implementation and inadvertent consequences which may arise. Broad definitions mean that the Regulations would apply very widely in respect of research on indigenous biological material, even at a very early stage. Moreover, requirements for export permits might limit the types of research collaborations South African organisations can enter into with foreign partners (even though such collaborations are considered essential for the success of the DST proposed Farmer to Pharma grand challenge). Considerable administrative expertise is called for in order to implement the draft Regulations effectively and there are fears that bureaucratic delays could lead to loss of patenting opportunities, pose a risk to biodiversity and jeopardise research funding or collaboration opportunities. There are also concerns about possible retrospective effect, which could affect existing contractual obligations.

⁴¹ Regulations on Bio-Prospecting, Access and Benefit-Sharing, Notice 329 of 2007, *Government Gazette*, No 29711, 16 March 2007.

Further regulatory developments regarding the use of indigenous knowledge are anticipated as implementation progresses on DST's 2004 Indigenous Knowledge Systems Policy (Department of Science and Technology, 2004), which might include the creation of new *sui generis* rights to protect indigenous knowledge.⁴² The regulatory framework which is eventually put in place will determine the extent to which benefits can be effectively harnessed.

5.6.4 *Exchange control regulations*

South African Exchange Control Regulations place restrictions on the export of capital, by requiring Treasury permission in advance for 'any transaction whereby capital or any right to capital is directly or indirectly exported' from the country. Case law has determined that patents and the right to benefit from royalties fall within the statutory definition of 'capital'. This means that South African patent holders may not assign or license their patents to foreign entities without obtaining the necessary exchange control approval. This requirement therefore imposes a significant limitation on partnering with foreign companies. While not necessarily insurmountable, the additional transaction costs incurred (including delays in being able to finalise agreements) are a disincentive to such deals.

5.6.5 *Concluding remarks*

The policy issues highlighted in section 5.6 illustrate some of the areas of potential misalignment with the proposed IPR Framework. Furthermore, it is acknowledged here that a host of other policy initiatives exist which are also likely to impact on the ultimate success of the Framework, although it is beyond the scope of this dissertation to cover these comprehensively. These include several DTI offerings relating to BBBEE, small business development and support, and technology and innovation; new tax incentives for R&D; as well as initiatives at the level of provincial and local

⁴² One relevant development in this regard was brought about by a Patents Amendment Act (Act No 20 of 2005) to the Patents Act (Act No 57 of 1978). The recently implemented provisions introduce a 'disclosure of origin' requirement, in terms of which patent applicants must disclose 'information relating to any role played by an indigenous biological resource, a genetic resource or traditional knowledge or use in an invention'.

government. This section therefore serves to sound a cautionary note to policymakers, by emphasising the importance of a holistic approach.

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CHAPTER 6: CRITIQUE, RECOMMENDATIONS & CONCLUSION

6.1 Introduction

This chapter begins with a critique of the IPR Framework and Draft Bill, divided into three sections. The first part will examine whether or not legislation is an appropriate, necessary and/or desirable instrument for achieving the objectives of the IPR Framework. The second section will assess some of the specific provisions and their potential impact against the Framework goals, as well as point out provisions which ought to have a place in such a policy framework. The third part will speculate on some of the general consequences which might ensue if the Draft Bill were enacted into law. This analysis will draw on the earlier discussion on lessons learned from technology transfer studies and from other countries, and on the prevailing South African policy environment and technology transfer practices and experience.

The second part of the chapter attempts to draw together the general discussion on technology transfer, the comparative review of policy approaches adopted by different countries, and the prevailing conditions which characterise the South African environment, in order to develop a set of tentative policy recommendations. These are designed, from the perspective of both an academic and a practitioner, with the intention of offering some realistic and practical alternatives and enhancements to the current framework, better informed by evidence and thus more firmly grounded. It is suggested that these proposals might be applied more broadly than in this dissertation alone. In addition to providing insights to guide and inform policymakers, they might also serve to enrich the public debate and assist in increasing legitimacy in the eyes of stakeholders, ultimately improving the prospects for a successful policy intervention.

Finally, a concluding discussion completes the dissertation.

6.2 Critique of the IPR Framework and Draft Bill

6.2.1 *Is legislation the right option?*

In calling for an intervention to improve management of intellectual property from publicly financed research, the R&D Strategy presupposes the need for legislation to bring this about, without a rationale to support this view. The IPR Framework attempts to motivate (although with little supporting evidence) for the need for legislation on the basis that this has been the preferred route for most other countries. However, as the discussion in Chapter 4 shows, (and which is in fact explicitly acknowledged in the Framework), the main objectives of such legislation have been quite different from one country to another. For example:

- In the USA, Bayh-Dole was enacted in order to shift ownership of intellectual property from the federal government to grantees, and permit exclusive licensing to industry, in order to incentivise technology transfer.
- In Denmark, legislation conferred ownership of intellectual property on PROs, where in the past this was owned by individual researchers.
- French legislation was aimed at improving weak relationships between PROs and industry, and at encouraging the establishment of start-ups based on PRO intellectual property.
- Italy took an approach which bucked the trend of PRO ownership, by moving away from this to a position in which inventors are permitted to own intellectual property.

The case of Canada was also discussed, where legislation was eschewed in favour of a voluntary approach, supplemented with a targeted policy for one category of funding, aimed at changing ownership of intellectual property from federal government to contractors, and achieving consistency across government departments.

Since in South Africa, for the most part ownership vests in grantee organisations rather than government funding agencies, and at present there are no restrictions on exclusive licensing, some of the main

objectives of Bayh-Dole do not apply. Most South African PROs own intellectual property developed by their employees in the course and scope of their employment, rendering the Danish approach unsuitable as a precedent. It is unlikely that South Africa would consider the Italian approach of individual inventor ownership, in light of overwhelming movement in the opposite direction in most policy approaches (OECD, 2003). Of the examples supplied here, some of the objectives of the French legislation appear similar to our own, yet the content and focus of the Draft Bill are significantly different. The Canadian decision to allow a *laissez-faire* system to continue for the most part also merits further investigation.

It is instructive to take heed of the recommendation of the UK *Lambert Review of Business-University Collaboration* (Crown Copyright, 2003) that the UK not adopt Bayh-Dole-type legislation, because of the different prevailing conditions in the UK at that time. While lack of clarity with respect to ownership of intellectual property in collaborations between universities and industry was identified as a constraint, the need to allow for flexibility in such relationships was deemed to be more important, and the view was expressed that the introduction of similar legislation 'would present greater risks to existing collaborations than it would bring benefits by improving clarity in negotiations for new projects' (2003:53). Instead, it was proposed that a protocol be developed as a starting point for negotiations between universities and industry. A further recommendation suggested that model contracts be developed in order to assist the negotiation process. These were envisaged to cater for different types of relationship, and would be adopted voluntarily by the parties to govern collaborations. The recent Sainsbury Review reports that a series of model agreements have since been drawn up to govern intellectual property issues for different scenarios of collaborative and contract research, and have been adopted by a number of organisations, while a further set of model contracts for research consortia is under development (Crown Copyright, 2007).

While the IPR Framework specifically cites the OECD *Turning Science into Business* report (OECD, 2003) in its motivation for a statutory approach, the OECD report actually emphasises that legislation is not the only means for stimulating intellectual property protection and commercialisation by PROs, and highlights the value of the use of alternative instruments, such as codes of practice or guidelines (2003:102). The report also comments on the fact that legislation alone is not sufficient to promote successful technology transfer, noting that a change of mindset and culture is often necessary and must be achieved through other interventions (2003:103).

The South African policy documents contain no evidence of any consideration having been given to alternative, non-legislated approaches, such as the use of policy instruments, guidelines and/or contractual arrangements. Interestingly, though, there are examples of such approaches being implemented in practice. For example, research funding agreements emanating from DST and some DST agencies now in fact incorporate provisions giving effect to many of the principles articulated in the IPR Framework. This would seem to provide at least a *prima facie* indication that alternatives to legislation could play an effective role in encouraging desirable practices.

The Framework (page 31) acknowledges that effective interaction between all stakeholders will be critical in order to obtain the benefits expected to stem from the proposed legislation. It is stated that there will be a need for:

...a level playing field, clear minimum requirements and a balance of incentives and regulations to ensure that this is achieved. International best practice suggests that simplicity, clarity and transparency greatly enhance the success of policy frameworks. Over-elaboration, overly prescriptive requirements and a dominance of regulation over incentives, will limit our ability to capture value for our nation.

While these are laudatory observations, they do not however seem to have been adequately captured in drawing up the Draft Bill, which has a strong prescriptive flavour. Moreover, stakeholder involvement has been limited to commenting on documents (whether in person or in writing) in a 'one-

way' process. The importance of stakeholder participation is illustrated by the Canadian, Danish and French experiences (noting in particular that the Danish process was almost derailed, and the policy scope subsequently scaled down, due to insufficient consultation initially). This is further reinforced by the OECD report, which notes the value of a consultation procedure early in the process to find an appropriate balance between the various interests of different players (2003:103).

Turning to the literature, cautionary statements from scholars about difficulties associated with emulating legislation such as the Bayh-Dole Act in a different context bear further investigation. Mowery and Sampat (2005:232) point out that such emulation may in fact be counterproductive if it fails to recognise alternative channels for technology transfer and exploitation:

Inasmuch as patenting and licensing are rated by industrial R&D managers as relatively unimportant for technology transfer in most fields, emulation of the Bayh-Dole Act is insufficient and perhaps even unnecessary to stimulate higher levels of university-industry interaction and technology transfer. Instead, reforms to enhance interinstitutional competition and autonomy within national university systems, as well as support for the external institutional contributors to new-firm formation and technology commercialization, appear to be more important.

Focusing specifically on developing countries, Sobolski *et al* (2005) suggest that the substantial investment required to support technology transfer activity could perhaps have a greater impact on building technical know-how and scientific expertise if spent on education and improving interactions between the public and private sectors, and that undue emphasis on licensing as a vehicle for technology transfer and fostering economic growth may yield disappointing results.

Finally, we would do well to remember the legislative history leading up to the promulgation of Bayh-Dole. It was preceded by intensive debate over several years (dating back to the Kennedy administration in 1963), and several early drafts, which allowed various issues of concern to different

stakeholders to be raised and at least some of these taken into account in the final version of the act. Similarly in Denmark, the statute initially proposed had to be re-drafted in response to strong objections from a wide range of stakeholders.

6.2.2 Critique of key proposals contained in the Draft Bill

Irrespective of whether legislation or other policy instruments are ultimately invoked, the IPR Framework and Draft Bill convey information about the types of behaviour that DST is attempting to establish in and by PROs. It is therefore instructive to evaluate some of the main proposals in order to determine their potential impact.

Many of the concerns elaborated on here centre on the highly prescriptive nature of the Draft Bill on the one hand, and the strongly interventionist, 'gatekeeper' role proposed for government on the other, which when taken together could serve as a strong disincentive to PROs, researchers and private sector investors to engage in technology transfer. It is somewhat encouraging to note that these could potentially be easily remedied through the adoption of a more consensual process, with the necessary political will. Other criticisms concern elements that have been omitted, the absence of which could perhaps (although not necessarily) be an indication that insufficient consideration has been given to certain important factors.

6.2.2.1 Institutional internal policy-making authority circumscribed

The Draft Bill severely restricts institutional autonomy of PROs in a number of spheres. Opportunities are circumscribed for different types of PROs to craft institutional policies and structures which are tailored to their particular situations. It can be motivated that where PROs already have policies and procedures in place which are broadly compliant with the underlying principles of the legislation, requiring changes to these policies to comply with specific details set out in the legislation can lead to inequitable situations, where employees are treated differently depending on whether they developed intellectual property before or after the legislation takes effect. Unnecessary administrative costs will also be entailed.

Of the South African PROs with TTOs, it is observed that most if not all are attempting to conduct their intellectual property management and commercialisation activities in line with the broad principles expressed in the Framework, although probably not in full compliance with the detailed provisions. The question is therefore whether compliance to the prescribed requirements will improve their technology transfer performance.

Those PROs without TTOs are for the most part institutions with a small research base. The question for them, it can be argued, is whether setting up TTOs and instituting relevant policies, as required by the legislation, will be likely to yield sufficient technology transfer opportunities to make the efforts worthwhile, and to make a meaningful contribution to the national system.

It is submitted that insufficient evidence is available to provide positive answers to either question. In respect of the first situation, obliging TTOs to put changes to internal policies and procedures of little substantive effect through institutional structures is likely to be a bureaucratic process which distracts TTO staff, already spread thin, from their technology transfer activities. In respect of the second, it would seem that the costs of implementation of the proposed interventions must be quantified against the potential benefits to be achieved. This will require an examination of the nature and size of the research endeavour at relevant PROs. Arguably, such institutions would be better served if they could choose to set up structures tailored according to their specific needs, which might be 'lighter' than those proposed under the draft legislation. Such TTOs could then potentially grow as capacity is built and the need for their services increases. It is noted that the Draft Bill makes allowance for the relevant Minister to issue exemptions to the requirement to set up a TTO, but there does not appear to be scope for PROs to implement the stipulated functions in a partial fashion.

The provision in the Draft Bill which requires TTOs to screen all publications for novelty-destroying data which would preclude patenting if published prior to filing a patent application is likely to face significant opposition from many university researchers, who will view this as a restriction on their academic freedom. Because of very strong views of academics in this regard in Canada, both the Expert Panel Report (ACST, 1999) and subsequent proposals (Riddle, 2004) stressed that the right of an individual researcher to make this decision should not be tampered with. Prohibiting publication of information that a researcher wants to put into the public domain and expressly does not wish to patent is likely to produce a backlash, at least in those PROs which have traditionally allowed researchers a high degree of independence in this regard. Good practice would dictate that a process should be in place within institutions to avoid inadvertent publication of patentable subject matter. However, it is not obvious that review by the TTO is an optimal or even feasible way of achieving this - this depends amongst other things on the extent of the PRO's publishing activity and the capacity of the TTO. It would be desirable for PROs to be able to determine the most appropriate manner of dealing with this issue, in alignment with institutional culture and other policies and structures. TTO educational programmes should raise awareness amongst researchers. The TTO could in any event be available to provide advice on request.

6.2.2.2 Institutional authority to contract with external parties constrained

Little flexibility will be permitted to PROs in structuring intellectual property terms of sponsored research and research collaboration agreements, which is likely to deter at least some potential funders and collaborators. Foreign entities might resist compulsory terms which could differ from or even conflict with their own national laws or policies, while South African companies might find it easier to partner with research organisations overseas, if fewer restrictions apply. Because the industry share of research funding at PROs is significantly higher than in many other countries (OECD, 2007), and because of the growing importance of

international R&D collaborations, any substantial withdrawal of these sources of support and partnership would have an adverse effect not only on institutional capacity to undertake technology transfer, but also on the quality and quantity of the overall institutional research enterprise. As the OECD report cautions (2003:105): 'IP [intellectual property] policies and IP management should reduce rather than increase transaction costs and so increase the scope for international co-operation in S&T [science and technology] and innovation.' This is ignored at our peril. The Danish experience, which saw a decrease in university-industry collaborations in certain sectors after the introduction of similar legislation (despite no legal bars on the universities' freedom to assign rights to industry if they chose to do so), with Danish researchers replaced by foreign researchers, also sounds a cautionary note (Valentin and Jensen, 2007). Statements that the intellectual property ownership restrictions imposed by Bayh-Dole have made it more attractive for US companies to collaborate with overseas companies tell a similar story (Butts, 2007).

Finally, it can be noted that while the Draft Bill confers some authority on South African PROs to make patenting decisions, NIPMO has a say in licensing decisions, again inhibiting PROs' freedom to contract.

6.2.2.3 Role of NIPMO

The functions proposed to be carried out by NIPMO are overly broad. Technology transfer skills and experience in South Africa, while growing, remain limited. NIPMO will have to be very well-staffed in order to play its envisaged role effectively. The requirement that NIPMO be an active participant in the commercialisation process for all intellectual property covered by the Bill is likely at the least to delay the process, and in many cases, could result in obstructing it altogether. A real risk exists that NIPMO, rather than providing an enabling influence on the technology transfer process, may instead introduce an additional layer of bureaucracy and potentially impede technology transfer. It is not obvious that NIPMO will have better capacity than a TTO in this regard, especially since the Draft Bill prescribes certain qualifications for PRO TTO staff, but not for

NIPMO staff. By insisting that both PROs and government must be involved in all licensing decisions, the efficiency of the process is likely to be eroded, and in the event of disagreement between them, prospective licensing deals might not materialise at all. It is therefore preferable that one party be empowered to make licensing decisions, which should logically be the party owning the intellectual property (ie the PRO, where it has elected to take title of such intellectual property).

6.2.2.4 Vagueness of exercise of powers by the Minister

The authority conferred on the Minister to revoke intellectual property assignments and licenses under certain circumstances creates an environment of uncertainty, thereby increasing risks for contracting parties entering into transactions covered by the legislation.

6.2.2.5 Restricted commercialisation terms

The Draft Bill prescribes several very detailed requirements to govern commercialisation and technology transfer (as discussed in section 5.5.6). However, these requirements are not necessarily appropriate to all technologies and all deals. In some cases, meeting these requirements will just not be feasible. It can be argued that it is necessary to permit sufficient flexibility to enable parties to adapt to the circumstances of a particular case. The Draft Bill seems to rest on the assumption that technology transfer is a simple, linear process which follows a single trajectory towards a single 'best possible outcome'. However, experience shows that this is often not the case. Different areas of technology and application in different industry sectors can call for very different routes to market, some of which will inevitably be closed off if the Draft Bill proposals prevail. Completing a deal can be a complex, time-consuming, painstaking endeavour, which involves balancing a slew of interests.

The Draft Bill seeks to ensure that the broader public interest is considered, in addition to the interests of the contracting parties (typically a PRO licensor and firm licensee). It does so by introducing concepts such as the 'national interest' and 'the benefit of the citizens of the Republic of South

Africa', but fails to define these terms, which are potentially subject to different interpretations and may in fact encompass within them a range of interests, some of which may even compete with one another. For example, are the interests of South African citizens better advanced by a PRO licensing an invention to a multinational company with a manufacturing track record and established distribution networks, capable of ensuring that a technology which improves quality of life reaches a wide market and generates substantial tax revenue for the fiscus, or by creating a new BBBEE SMME, which might create a handful of new jobs, but whose chances of penetrating the market are somewhat unpredictable? There would appear to be benefits to allowing individual cases to be evaluated on their merits.

While the importance is acknowledged of taking advantage of every available opportunity to grow South African high-tech industry, the strict limitations on licensing to overseas companies can be questioned, when taking account of the small size of the local market, few companies waiting in the wings and expressing interest as prospective licensees of PRO technologies, and the difficulty of attracting venture capital to set up spin-out companies or facilitate the expansion of existing companies.

In reality, it is difficult (and frequently futile) to attempt to quantify future benefits upfront, as well as to assess accurately after the fact what benefits may have been generated had an alternative route been followed, in an effort to predict which deal would be 'the best' (Colyvas *et al*, 2002). Bearing in mind the difficult landscape and limited opportunities for technology transfer which prevail in South Africa, setting the bar for permissible transactions too high and requiring too wide a range of criteria to be met, is likely to be counterproductive.

Particular motivation may be offered for the five year initial term limit on exclusive licenses to be reconsidered. The amount of time that a licensee will require to develop an early stage PRO technology to the point of market readiness, and to recoup its investment once a product is

commercialised, will vary considerably, depending amongst other things on the nature of the technology, the stage of development when it is licensed and the costs of further R&D carried out by the licensee. This provision could therefore deter a company from licensing embryonic PRO inventions which require substantial further R&D and investment. It is worth noting that one of the few amendments which has been made to Bayh-Dole since it came into force was the scrapping of term limits on exclusive licenses (Council On Governmental Relations, 1999).

6.2.2.6 Harmonisation of government agencies' approach to intellectual property

The IPR Framework expressed the intention to harmonise the diverse approaches to intellectual property issues adopted by public financing instruments and funding agencies. Such harmonisation would be expected to bring benefits. The uniform situation in respect of title to intellectual property created by Bayh-Dole in relation to US federal funding agencies is acknowledged as one of the greatest strengths of Bayh-Dole (Council On Governmental Relations, 1999; Passman *et al*, 2005). However, the proposed provisions of the Draft Bill will not necessarily achieve the same effect in South Africa, unless this issue is further addressed in regulations. Some of the institutions listed as PROs in the Schedule to the Draft Bill actually function as funding agencies, at least some of the time. However, those institutions would qualify as PROs when funding research at a PRO, even when not performing any of the funded research, and would thereby stand to own the intellectual property arising out of the relevant project if the funding agreement provided for this. The incentive to the PRO carrying out the research of owning the intellectual property developed by its researchers on public funding would thus potentially fall away. The PRO and funding organisation could potentially enter into negotiations to share the intellectual property concerned, but this would entail transaction costs, including the likelihood of delays, and thereby quite possibly defeat the purpose of harmonisation by requiring individualised solutions to be negotiated.

6.2.2.7 Walk-in rights and protection of the public interest

The Draft Bill's efforts to deploy publicly financed intellectual property, on the one hand to promote industrial development, and on the other to achieve social benefits, create an implicit tension. Any policy intervention in this area must of course attempt to strike a balance in this regard, and it is acknowledged that it is no easy feat to do so. The current proposals, however, raise some questions. For one thing, no guidance is provided for weighing up the competing objectives, and the risk is run that neither objective will be attained. One way of framing the question may be to ask whether the primary aim of the policy is to promote entrepreneurship and economic development (which will require government's rights to be of more limited scope in order not to deter private sector investors or licensees), or to ensure social benefits (in which case a stronger, more proactive role for government is appropriate)?

Furthermore, although the Bayh-Dole march-in rights were the inspiration for the 'walk-in' rights contained in the Draft Bill, it must be noted that these have never been exercised by the US government or any of its agencies. While some might argue that this renders the provision toothless, others believe that its existence effectively deters licensees from the behaviours (or omissions) that could trigger marching in. Some in fact attribute much of Bayh-Dole's success to the restraint exercised by the US government in this regard, as it has provided licensees with some degree of certainty that their rights in their licensed technology will not be unduly or arbitrarily affected.

Nonetheless, the US march-in rights remain contentious, and it can be questioned whether a provision which has been in force for almost thirty years, yet never used, is an appropriate precedent for South Africa. Bar-Shalom and Cook-Deegan (2002), in a case study involving an unsuccessful march-in petition to the NIH, refer to an analysis by an NIH official of inherent difficulties in the march-in provision. One of the main problems identified is that it forces research agencies to make business judgements they might not be qualified to make. Most march-in petitions

which have been attempted have been in connection with the pricing of drugs. In rejecting march-in requests, agencies such as NIH have relied amongst other things on legislative history referring back to the intention of the drafters of the statute, and determined that consideration of pricing issues is the responsibility of other agencies, dealing with issues such as competition (Remington, 2005).

South Africa must therefore pay careful attention to the way that its proposed walk-in rights provision is formulated, and perhaps also look into alternative mechanisms for balancing private versus public interests, whether as a substitute or complement to walk-in rights. In one context, the concept of such rights has already been partially institutionalised, as research funding agreements from DST and DST agencies typically now contain contractual provisions which give DST the right to take ownership of project intellectual property, should the PRO not commercialise such intellectual property within a specified time period. To date, no cases of DST having exercised such rights have come to light, although it is probably too early to draw any conclusions from this, as the time periods concerned have probably not yet elapsed. Policy statements indicate that government intends to exercise its walk-in rights actively.

6.2.2.8 Failure to cater for development issues

In light of the fact that the Draft Bill contains various provisions intended to promote public interest objectives, it is surprising that the Bill (and before that, the Framework on which it is based) makes no attempt to locate intellectual property in any sort of development context, despite this being a major focus internationally in several bilateral and multilateral fora. The Draft Bill makes no mention of socially responsible licensing, humanitarian use licensing or global access imperatives. The Bill also fails to deal with issues of open source and open access, and it does not make provision for donating technologies where this may be appropriate. These are some of the tools which progressive organisations and TTOs overseas are exploring in their efforts to leverage intellectual property for the public good, and which arguably could be usefully applied in South Africa. Cook-

Deegan's message (2007:154) has particular resonance for developing countries: 'Science is not just about creating knowledge, it is also about making it widely available and making it useful. Deliberate policies to promote open access and low-cost use enable some social benefits that profit-driven R&D cannot.'

6.2.2.9 Lack of incentives for firms

Finally, an overarching issue of concern relates to the 'technology push' focus, which emphasises the role of PROs and pays scant attention to that of firms, which are intended to be the vehicles for taking the PRO-developed technologies to market. This appears to reflect a more widespread problem: the OECD Innovation Review (2007) identifies overemphasis on PROs and insufficient attention paid to firms as R&D performers as a general shortcoming of South Africa's innovation policy. The recent Innovation Survey (Department of Science and Technology, 2007b) showed that firms assigned low importance to PROs as sources of innovation. The restrictive conditions laid down for technology transfer by the Draft Bill are likely to exacerbate this. It might thus be suggested that the policy framework requires a better balance between 'supply-side' (PRO) and 'demand-side' (firm) interventions. The IPR Framework acknowledges that SMMEs especially generally lack capacity to manage intellectual property effectively, yet the Draft Bill neglects to make any provision for addressing this, despite the fact that SMMEs are to receive preference as licensees. The OECD report on PRO patenting and technology transfer (2003) stresses the importance of aligning intellectual property policies with broader innovation policy. The proposed interventions do not appear to do this adequately.

6.2.3 Possible unintended consequences to consider

6.2.3.1 'Anti-Bayh-Dole' effects

While in the USA Bayh-Dole sought to shift intellectual property ownership from the federal government to grantees, in order to incentivise PROs to transfer their technologies, and gave them the necessary autonomy to do so, the Draft Bill greatly strengthens government's rights in publicly

financed intellectual property, and confers upon government ownership rights that it has not previously enjoyed, while diluting PROs' rights in such intellectual property. As such, there is a danger that the Draft Bill, if enacted, might result in an outcome in South Africa which emulates the supposedly stagnant pre-Bayh-Dole situation in the USA more closely than the dynamic post-Bayh-Dole environment of vibrant technology transfer activity.

6.2.3.2 Disruption to current technology transfer activities

Both the IPR Framework and the Draft Bill appear to pay little attention to the fact that there is an existing South African technology transfer system, albeit a fledgling one, as a result of which their proposals seem to be aimed at setting up the relevant institutional infrastructure from scratch. No data is provided which indicates that efforts have been made on the part of the policymakers to understand properly the strengths and weaknesses of current operations, or to gauge the possible impact of the proposed changes. These could therefore be an impediment to the growth of the current system, by requiring a redirection of policies and processes.

6.3 Recommendations

The recommendations made here call for us to take a step back and reassess what is (a) needed and (b) feasible for a robust South African technology transfer system. It is submitted that by gathering data to fill in the informational gaps, and making room for more active participation by stakeholders representing different constituencies in the policy process, a solid foundation for future policy efforts can be constructed.

➤ Postponement of promulgation of legislation

The discussion in section 6.2 suggests that legislation at this stage might be premature. It is therefore recommended that the legislative process is put on hold, at least for the time being, to allow for more participatory consultations to take place and for more evidence to be gathered to inform

appropriate policy choices, as well as to avoid bringing into effect a regime which might unintentionally constrain development of the South African technology transfer system and lead to unintended consequences.

While a persuasive argument for the necessity of legislation has yet to be supplied, in the event that this approach continues to be pursued, a broad enabling statute, as envisaged in the Framework, could avoid many of the potential pitfalls which have been discussed. This would require that its scope be limited to setting out broad principles, while allowing sufficient flexibility to institutions to manage their internal affairs according to their own policies, procedures and institutional culture. The legislation can then be usefully supplemented with guidelines of good practice, which can be taken up by institutions to the extent that this is appropriate, together with a package of incentives to reward institutions which follow the preferred government approach. Government's role in the process should be to enable and assist, rather than to prescribe.

➤ **Introduction of a more consultative, inclusive and consensual process**

Many stakeholders perceive the IPR Framework and the Draft Bill as 'top-down' initiatives of government. While assurances from DST⁴³ to the effect that extensive redrafting is taking place are encouraging, no dialogue has been reopened with stakeholders since comments on the Draft Bill were submitted, and it is not clear whether a broader perspective, taking into account a greater variety of policy options, is being considered.

One suggestion for bringing stakeholders into the process could be via revisiting the merits of a policy process in which a Green Paper and a White Paper precede the introduction of legislation.⁴⁴ This route was typically followed in the second half of the 1990's, when a plethora of new

⁴³ Via personal communication from DST officials.

⁴⁴ A Green Paper would typically be a consultative document setting out policy proposals for discussion by stakeholders, while the White Paper would contain firm recommendations for action, based on responses to the Green Paper proposals. The recommendations would finally be incorporated into legislation.

policies was formulated to guide South Africa's transformation under the new democratic non-racial government, but more recently has become an exception to the rule. The process allowed debate on a suite of policy options presented in the Green Paper to inform the recommendations incorporated into the White Paper for implementation via legislation and other instruments. While it is believed that significant further work is needed to craft an appropriate policy and that taking this approach would greatly assist in the process, it is nonetheless acknowledged that it is highly unlikely that DST would be willing to be seen to 'go back to the drawing board' in this way, at this relatively advanced stage of the process.

Other options for consensus-building can however be considered, which facilitate the combination of knowledge, experience and perceptions of different stakeholders. It is worth taking note of the Danish decision to establish a working group of practitioners to develop guidelines for implementation of the legislation. If DST were to adopt a similar approach, the prospects for buy-in by South African PRO TTOs are likely to improve. Similarly, detailed recommendations in France, which were compiled by representatives of government, industry and PROs, served to assist with implementation by providing guidance to PROs as they developed their own policies. Ideally, different government agencies and departments, technology transfer practitioners and industry would be represented in a South African working group. A suitable DST agency could provide a secretariat and co-ordination support.

➤ **Collection of data to support the proposed policy positions**

With the exception of the information presented on South African patenting performance,⁴⁵ the IPR Framework does not contain data to support its proposals. While the series of background reports commissioned by the Canadian Expert Panel to inform its work provides food for thought (ACST,

⁴⁵ Even this data was subject to questions about its interpretation during the public consultations in 2006.

1999),⁴⁶ apparently South Africa is not alone in this respect, taking into account the OECD (2003:10) observation that 'the lack of empirical data has clouded the policy debate'. As the earlier discussion demonstrates, though, better information could serve to lend authority to policy proposals, and to ensure that interventions are linked to real needs. It is thus proposed that an inventory of existing data be drawn up, and studies commissioned to fill in the gaps. While not intended to be an exhaustive list, some suggestions of areas for research to shed light on relevant issues might include:

- Technology transfer activity and performance - both quantitative⁴⁷ and qualitative (eg case studies)
- The nature of the research enterprise in different PROs - including the type of research taking place, expenditure on R&D, the funding mix and research partners
- Researcher attitudes - including an assessment of the impact of existing and potential behaviour drivers, incentives and disincentives
- The nature and extent of PRO-industry linkages - on the one hand, industry provides high levels of support for university research (OECD, 2007), while on the other, firms do not consider PROs an important source of innovation (Department of Science and Technology, 2007b). This apparent anomaly deserves further investigation
- Inventories of public and private funding sources for different stages of technology transfer - and an assessment of funding gaps
- Stakeholder surveys
- Skills assessment - what is available and what is needed
- Case studies.

⁴⁶ Amongst other things, these reports provided data on university technology transfer performance, stakeholder views, best practices, comparative approaches, program inventories, as well as a literature review.

⁴⁷ PRO annual reports to the Innovation Fund should contain relevant data in this regard, although it is noted that the format of the reports is unwieldy, which might make detailed analysis difficult.

➤ **Definition, prioritisation and/or segmentation of objectives**

Once a better understanding of existing conditions has been obtained, the policy objectives could then be revisited. Once a list of objectives has been agreed, a prioritisation exercise could take place. It has already been pointed out (section 6.2.27) that tension is created by trying to balance commercial and public interest or development objectives. It is therefore likely that trade-offs will be required. These will have to be carefully considered.

Divergent policy trajectories could potentially be explored for different types of technology. Where issues such as health, food security and poverty elimination are concerned, a more 'pro-development' focus might be justified. Opportunities exist to develop technology transfer models, in which PROs and government agencies partner with industry, multilateral bodies and philanthropic foundations, to ensure that the transferred technologies are made accessible and affordable to the end users. For example, creative use of open source innovation models could be explored, humanitarian use licensing assured, or patent pools and clearing houses set up (Boettiger and Bennett, 2006).

Where technology transfer opportunities fall more squarely into the commercial domain, provisions could be framed in such a way as to give licensees some assurance that their rights in the licensed technology will not arbitrarily be taken away or unduly diluted. Justifiable grounds for doing so can be stipulated in the applicable license agreements (eg failure to reach milestones, non-working of the licensed technology), and criteria under which government may exercise march-in or other rights should preferably be clearly spelled out upfront. In the latter situation, the public interest will be advanced through successful and sustained exploitation of PRO-derived technology by companies which contribute to the fiscus, create employment opportunities and enhance the competitiveness of local industry. As the Canadian Expert Panel notes in its discussion on maximizing the value of public investment in research (ACST, 1999:14):

“Commercialization offices should ... endeavour to maximize the value of the companies they create. If they are successful in maximizing their clients' value, universities will maximize the economic and social returns to Canada as well as to themselves.”

Another alternative would be to consider sectoral technology transfer strategies. Valentin and Jensen's (2007) argument for a more nuanced approach in respect of the Danish experience should not be forgotten, namely that different fields of research and technology favour different strategies. Kaghan and Barnett (1997) similarly argue against a 'one-size-fits-all' model, observing that the typical technology transfer model is founded on a linear understanding of the innovation process and that not all types of intellectual property are a good fit for this model.

A couple of sectors might be selected to pilot tailored technology transfer strategies. The proposed DST grand challenges (Department of Science and Technology, 2007c) or funding agencies with a sectoral remit could be a good starting point in this regard.

➤ **Drafting of voluntary and consensual best practice guidelines**

Best practice guidelines, developed by consensus of the proposed stakeholder working group, could be a valuable tool not only to shape preferred technology transfer practices, but also to ensure stakeholder buy-in, such stakeholders having contributed to the development of the guidelines. Guidance in this regard could be sought from similar documents developed elsewhere, including the QIPAP, the 'Nine Points to Consider in University Licensing' (2007), drawn up by leadership of 12 US universities,⁴⁸ and the UK model contracts (Crown Copyright, 2003 and 2007). It is proposed that sufficient flexibility be built in to such guidelines to accommodate differences in existing PRO policies and practices which conform to the guideline principles.

⁴⁸ Available at http://www.autm.net/aboutTT/Points_to_Consider.pdf (accessed 11 February 2008).

To ensure that voluntary guidelines are not merely ignored, active encouragement of PROs to adopt the guidelines is likely to be necessary. NIPMO could play a vital role in providing implementation assistance to PROs by agreement. Eligibility for certain categories of funding might be tied to compliance. Compliance can also be governed by the terms of a funding agreement. Annual technology transfer activity reports from PROs should provide reasons for any deviations from the guidelines and chronicle both positive and negative experiences associated with the recommended practices. Furthermore, reviews of the effectiveness of the guidelines could be undertaken periodically and adjustments made when circumstances require this.

➤ **Agreement on technology transfer goals and appropriate benchmarks to monitor performance**

Once consensus is reached on technology transfer goals, appropriate indicators to track progress towards those goals can be determined. As discussed in section 1.5, this is not a trivial matter, and efforts will have to be made to avoid prioritising what is measurable over what is important. The development of a proper survey instrument that lends itself both to ease and uniformity of reporting and to data analysis could assist information gathering exercises. A central system that could be directly accessed by all PROs could be considered. TTOs could be required to report at regular intervals (probably annually).⁴⁹ Based on these reports, a survey report could be produced regularly and disseminated to stakeholders and the general public, and raw data could be made available for research on innovation and technology transfer.

➤ **Structuring of TTOs according to particular PRO needs**

Bearing in mind the diversity of PROs, different institutions will have different technology transfer needs. For example, it is difficult to justify the costs of setting up a 'full-service' TTO in a university with a small research base. But arguably all PROs will require some level of technology transfer

⁴⁹ Benchmark data and guideline compliance data could be combined in a single report to streamline the reporting process for TTOs.

capacity to facilitate contract negotiations, funding applications, MTAs, freedom-to-operate concerns, etc. Alternative models to provide the relevant service could be investigated, including a 'pre-licensing' model, which would focus more on upstream institutional support than on invention disclosures, patenting and licensing (Wolson, 2004), shared resources with other institutions, outsourcing or some combination of these. A rural university with close ties to the community, for example, might focus on technology transfer for social good rather than on high-tech patenting opportunities.

At the same time, it is suggested that different policy and procedural provisions should be permitted, provided these do not depart too far from the best practice guidelines.

➤ **Further consideration of the question of intellectual property ownership**

The respective advantages of uniformity versus flexibility need to be weighed up. As the comparative country data in Chapter 4 showed, different positions have been taken in this regard. It is important to recognise at the outset that the ownership question has multiple dimensions, and should therefore be considered in turn in respect of government funders, researchers and industry. It is acknowledged that the predominant trend supports PRO ownership vis-à-vis government funding agencies and vis-à-vis researchers, offering consistency and simplicity. Although no directly comparable data is available in this regard, it is posited that vis-à-vis industry, there are many advantages in retaining the flexibility to negotiate according to the circumstances.

To ensure that the benefits of uniformity are realised, true harmonisation across all government research funders will be important. The policy of certain agencies to insist on sharing the proceeds of successful technology transfer endeavours and to have approval or veto rights on commercialisation decisions should also perhaps be reconsidered. While these are not unreasonable or unique requirements in principle, they serve

to dilute the incentivising effect of PRO ownership. Bearing in mind that few funded projects are likely to generate significant returns, the costs of enforcing these rights might outweigh the benefits overall. Exceptions might be appropriate for technologies that offer special public interest benefits, where a more interventionist role for a funding agency might be justified. (In such cases, though, licensing income would typically be negligible.) Irrespective of the ownership and/or benefit-sharing rights of the funding agency concerned, NIPMO could be available to assist PROs by invitation. In a consensual system, partnerships in which expertise is pooled would be common.

Concerning researchers, ownership of intellectual property at most South African PROs vests in the employing institution. There seem to be no obvious factors at play which would motivate towards changing this by adopting the Italian approach. The question then is whether the minority of PROs which give individuals ownership rights should be compelled to conform to the majority position. It is submitted that a consistent approach across all PROs would be desirable, as it would provide industry partners with certainty and reduce the risk of negotiations with a party who is not authorised to enter into the transaction concerned.⁵⁰ If strong resistance were to be experienced, however, this might be reconsidered. The Canadian system is proof that despite dissatisfaction from some quarters with its *laissez-faire* approach, technology transfer may nonetheless proceed reasonably effectively without consistent rules. It is of interest to take note of an observation reported by Garduno (2004) that one of the few South African universities which did not claim ownership over its researchers' intellectual property (and which did not have a TTO at the time), in fact had one of the most successful track records in establishing spin-out companies. Further investigation of this could shed further light on the importance of the ownership debate.

⁵⁰ Most PROs deal from time to time with 'renegade' academics who enter into agreements with third parties (whether in defiance or ignorance) despite lacking the authority to do so. This can raise serious liability issues for the PRO.

As regards industry, the argument to retain flexibility has been put forward. While the guidelines may stipulate preferences, and require justification from departing from them, the bar to concluding a deal should not be set too high, as this could lead to loss of commercialisation opportunities. If rights are assigned to a company, it is strongly suggested that the PRO reserve a research exemption or a non-exclusive royalty-free license to practice the technology concerned for teaching and research purposes.

➤ **Assessment of the human resource needs for sustaining the technology transfer system**

While there is general acknowledgement that South African is desperately short of technology transfer skills, appropriate capacity-building programmes are not easy to design, and as requirements change over time, even customised courses and curricula might become redundant. Many of the technology transfer 'pioneers' overseas received no formal training, learning 'on-the-job'. Hands-on experience remains one of the most useful forms of learning, but more formal training opportunities are now available, including degree programmes and short courses. The Innovation Fund has launched internships for technology transfer practitioners and trainee patent attorneys, in conjunction with business and academic partners. The South African Research and Innovation Management Association and the Licensing Executives Society present courses from time to time. Internationally, AUTM's meetings and courses are well-established,⁵¹ and a multitude of other organisations offer their own programmes. As the South African technology transfer system matures, needs will change. If these are monitored on an ongoing basis, timely and appropriate responses can be facilitated. Mentorship and networking are invaluable tools and could be actively nurtured.

➤ **Inclusion of other key government departments as active participants in the process**

⁵¹ See www.autm.net.

Interventions which are the responsibility especially of the DoE and DTI respectively are crucial to the success of technology transfer activities. A more holistic approach to policy-making is therefore called for, capable of spanning across departments and overcoming the 'silo effect'. Active involvement of DoE and DTI representatives will be necessary for the development of a robust and effectively integrated policy framework.

6.4 Conclusion

The IPR Framework has been an important development in the process of raising awareness of the role of PROs in the South African NSI. It introduces some important principles, including the benefits of PRO ownership, the need to provide incentives to PRO researchers, the imperative to strike a balance between public and private interests, and perhaps most importantly, communicates strong government endorsement, and promises sustained government support, for PRO technology transfer.

It has also served to open the public debate, although it is submitted that this is by no means exhausted, and ought to be continued. The OECD *Turning Science into Business* report (2003) observes that one of the main benefits of a legislative approach over alternatives is its effectiveness in cultivating awareness of the issues associated with technology transfer within PROs. In the South African situation, it could be argued that the IPR Framework and Draft Bill have to a large extent already achieved this particular goal. While recognising that there will be an ongoing need for appropriate policy measures to maintain the momentum (and by no means asserting that 'the work is now done'), these could just as constructively take the form of smaller-scale, targeted, non-legislated programmes capable of responding with greater agility to specific needs, which might not remain constant over time.

Broadly speaking, the main concerns with the Draft Bill, as discussed in section 6.2, relate to its unintended potentially disincentivising impact on

technology transfer. While it ostensibly aims to incentivise PROs and PRO researchers by empowering them to share in the proceeds of profitable commercialisation of their intellectual property, for the most part, this merely confirms the status quo, rather than introducing new benefits. Furthermore, the added obligations and strictures placed on PROs by the Draft Bill raise transaction costs and erode institutional autonomy. The Draft Bill does not provide incentives to industry to pursue the commercialisation of new technologies developed at PROs, and could have the effect of removing some of the existing flexibilities available to negotiate ownership rights to intellectual property with PROs. Limitations on license term and exclusivity which appear in the Draft Bill, coupled with the powers of the State to revoke patents and license agreements, greatly increase the risk for potential licensees wishing to access PRO intellectual property or technology.

It can be argued that the limitations proposed by the Draft Bill might be justified if the policy framework were located more clearly in a 'pro-development' context, and if it aimed more explicitly to promote development objectives, prioritising technology transfer for social good over economic development, through the inclusion of specific provisions instead of the ill-defined yet wide-ranging general powers conferred on government. However, as discussed in section 6.2.2.8, this is not explicitly motivated in the policy discussions or documents.

So, while the envisaged legislation might succeed in improving the patenting activity of PROs, thereby ensuring that PRO intellectual property is better protected (and even this will require overcoming various obstacles), it is not clear that it is able to provide for the more effective transfer of this intellectual property to industry, to develop it into products and services to generate wealth, create jobs and enhance quality of life.

This dissertation suggests that the potential risks posed by the draft legislation could be averted with relative ease, by adopting a more cautious process, in which policy recommendations are informed by evidence, and a

more consensual approach, taking into account the wide range of views, interests and experience of different stakeholders. As such, it is hoped that DST's efforts to legislate in this sphere will be reconsidered, or at the very least, that the scope be significantly reduced. An alternative approach could consist of incorporating the principles and proposed practices enshrined in the Draft Bill (preferably with modifications to take into account some of the criticisms) into Guidelines of Good Practice. NIPMO could then collaborate with PROs to implement the appropriate changes, monitor the progress and amend the guidelines where this is called for. Incentives (such as access to certain forms of funding) could be offered for compliance. Success stories could be shared and lessons learned from unsuccessful efforts. Different approaches could be considered for different industry sectors. This would provide a strong platform for implementing better informed legislation in the future, or other means of policy reform.

As discussed earlier in this chapter, without a better understanding of the strengths and weaknesses of current South African PRO technology transfer efforts, policy measures run the risk of being misguided or misdirected. Methodologically sound studies commissioned by DST could generate the necessary quantitative and qualitative data on technology transfer actual, perceived and desired performance, to validate or disprove some of the unsubstantiated assumptions underlying the current policy, to clarify and either prioritise or segment objectives, and ensure that a revised policy can stand on a more stable foundation and be more responsive to real needs.

Most important too, is not to lose sight of the fact that technology transfer is just one modality for strengthening linkages in the NSI, and without concurrently addressing other constituents of the system, the impact even of well-structured initiatives will be negligible.

Ultimately, for a policy of this nature to succeed in its quest, the benefits must be experienced by all stakeholders. Visible examples of successful

licensing endeavours are necessary to prove the value of and to sustain PRO technology transfer activities. As the Canadian Expert Panel notes (ACST, 1999:14):

Success breeds success. If firms licensing technologies from universities improve their competitiveness standing, they will continue to seek out innovations from ... universities and fund university research. If investors providing seed capital to emerging spin-off companies obtain a healthy return on their investments, they will continue to support the establishment and growth of new companies. If universities and their researchers obtain a fair share of the overall wealth they help create, they will have a vested interest in launching additional commercial undertakings. And, if the public witnesses the creation of well-paying jobs and improved social conditions as a result of university research, it will support ongoing public investments in this area.

Of course, the converse applies too, and roleplayers who fail to enjoy the conditions mentioned above will not continue to participate, dooming any associated policies to failure. The immediate South African challenge is therefore to generate 'success stories' to sow the seeds of support. The fact that these are so few and far between at present demonstrates the need for new policy interventions. By paying closer attention to the growing body of experience, both locally and overseas, by cultivating a better understanding of our own unique conditions, and by applying this learning appropriately, we should be well-placed to craft an adapted policy targeted at our specific needs and able to meet its goals.

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