Technology Transfer in South African Public Research Institutions

ROSEMARY WOLSON, *Intellectual Property Manager, R&D Outcomes, Council for Scientific and Industrial Research (CSIR), South Africa*

ABSTRACT

This chapter provides an analytical overview of technology transfer in South Africa. Technology transfer offices (TTOs) are relatively new in the country, and not all South African universities have explicit IP policies. The chapter discusses and analyzes the current performance of TTOs. Among other things, the results show that the income accruing to universities from technology transfer activities is not substantial, that there is a time lag before a TTO can generate sufficient income to become self-supporting, and that the performance of TTOs at different institutions varies widely. A history of public policy efforts to strengthen technology transfer in South Africa is provided, and the government's 2006 publication of the Framework for Intellectual Property Rights from Publicly Financed Research receives considerable analysis. Other measures being undertaken to support technology transfer are also discussed, as are the problems that such efforts still face.

1. CURRENT STATUS OF TECHNOLOGY TRANSFER ACTIVITY IN SOUTH AFRICAN RESEARCH INSTITUTIONS

1.1 *Background*

Institutional technology transfer offices (TTOs) are a relatively new development in South African universities and research organizations and are not yet found in all research institutions. While some efforts were made to promote technology transfer activities as early as the 1980s, it was not until the late 1990s that a handful of institutions set up TTOs. There are currently six universities and science councils with well-established technology transfer activities.[1] The main catalyst for setting up these TTOs appears to have been an awareness of international trends—the first offices were established before any meaningful attempts by government to better utilize research outputs. Some TTOs function as dedicated offices within their organizations. They are sometimes responsible for other functions, such as sponsored research, development, contract management, or industry liaison, and activities are sometimes dispersed among some of these offices. Other institutions have set up associated companies that are wholly or partly owned by the organization concerned to perform their technology transfer activities. In one case, a company was set up to manage jointly the IP from a science council and a university, but the partnership has since dissolved. The number of TTOs continues to grow. Several institutions have newly established offices, and those without TTOs are in the process of setting up offices. Institutions without TTOs either contract external service providers for assistance on a case-by-case basis or do not actively engage in technology transfer as an institution, although individual researchers or departments might do so.

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1.2 *Ownership of intellectual property*

1.2.1 *Within the institution*

Pending the introduction of legislation governing the ownership of IP developed by staff and students in the course of university activities, not all South African universities have explicit IP policies. Where policies are in place, these are not uniform across institutions. In some cases, IP is owned by individuals (unless specifically assigned, for example as a condition for the award of certain funding); in other cases, the university owns IP, depending on internal policies, conditions of employment, and student rules. Ownership rights of student IP vary widely, even for universities with clear policies that allow for institutional ownership of staff IP. When rights are assigned to the university, proceeds generated from the exploitation of IP are generally shared between the institution (possibly divided among multiple entities within the institution, such as research grouping, department, faculty, and to the central administration) and the individual inventor/s concerned, according to a formula set out in the IP policy.

1.2.2 *In respect of third parties*

While most institutions prefer to retain ownership of their IP and facilitate exploitation through licensing, and while most make every effort to negotiate this whenever possible, research sponsors frequently insist upon the assignment of IP as a key condition of a research funding agreement. This applies both to certain public sector and private sector funders, and may or may not include an obligation on the part of the assignee to share with the institution any future benefits derived from the exploitation of the IP. Ownership policies for IP that arises from government-funded research vary widely, ranging from unfettered ownership by the research institution, to shared ownership between the research institution and the funding agency, to full ownership by the funding agency, with benefit-sharing mechanisms applicable in some cases. The trend is for government entities to take a greater interest in IP matters than in the past, which often leads to more complicated funding contracts and longer negotiation periods to finalize them and release the research funding.

Industry research sponsors typically insist on owning technology that arises from research they fund, on the grounds that they have financed it. This does not, however, take into account the fact that universities also contribute to supporting these projects financially, because universities do not generally apply principles of full cost recovery when pricing these contracts. Research universities are therefore grappling with how to cost and price research contracts more effectively without alienating industry funders.

Companies wishing to access technology developed at a research institution that they have not funded are more likely to be open to a licensing arrangement, depending on the technology and the license terms.

1.3 *Performance of South African TTOs*

No comprehensive benchmarking of the performance of South African TTOs has yet been performed.[2] Table 1 provides rough data and estimates for four universities offering technology transfer services. These data have been compiled from anecdotal evidence and collegial information sharing among technology transfer professionals. While the data is incomplete (lacking some of the most important benchmarks, such as invention disclosures and patenting activity) and is not necessarily fully comparable in all cases across the surveyed institutions, it provides initial evidence to demonstrate that South African activity corresponds with experience elsewhere. Among other things, the Table indicates that the income accruing to universities from technology transfer activities is not substantial, that there is a time lag before a TTO can generate sufficient income to become self-supporting, and that the performance of TTOs at different institutions can vary widely. This is in line with what might be expected for a technology transfer system in its early days.

1.4 *The Southern African Research and Innovation Management Association*

Established in 2002, the Southern African Research & Innovation Management Association (SARIMA) is a stakeholder organization that provides a platform for individuals from government, academia, and industry, with an interest in research and innovation management, to interact

on common issues. SARIMA's objectives include the professional development of those persons involved in managing research and in the creation of intellectual capital; promotion of best practices in the management and administration of research and in the use of intellectual capital to create value for education, public benefit, and economic development; advocacy of appropriate national and institutional policy to support research and generate intellectual capital; and advancement of science, technology, and innovation.[3] SARIMA has links with several local, African, and international organizations with related objectives.

2. KEY POLICY INSTRUMENTS

2.1 *Summary of main policies relevant to technology transfer*

With a new democratic regime in place since 1994, policy developments in South Africa have been numerous. Much attention has been given to supporting innovation, in acknowledgement of its critical role in promoting development, enhancing competitiveness, and improving quality of life. The 1996 White Paper on Science and Technology established the concept of a National System of Innovation (NSI).[4] The paper created the framework for a set of key enabling policies and strategies to inform the strategic development of science and technology in South Africa. In an effort to sustain the White Paper's vision for an effective, well-managed NSI and to improve the impact of the policy, the National R&D Strategy was released in 2002. This recommended specific strategic interventions to address identified weaknesses, including the commitment of substantial additional resources from government to support research and innovation.[5] Under the umbrella of the R&D strategy, various other initiatives have emerged, including the National Biotechnology Strategy[6] and the Nanotechnology

Table 1: Summary of TTO activity for Four South African Universities

	University A	University B	University C	University D	Note
Staff 2003	1,246	1,924	1,014	530	
Students 2003	19,978	24,769	16,660	27,729	
Licenses					4.0 licenses per US$100 million adjusted research expenditure
2001	2	0	3	3	
2002	4	0	3	1	
2003	3	0	3	1	
Spinouts					3.1 spinouts per US$100 million adjusted research expenditure
2001	1	0	4	3	
2002	0	2	2	4	
2003	1	0	1	0	
License income 2001–2003	R209,000	?	R1,656,948	R32,173	0.1% of research income
Patent budget 2002–2004	R450,000	R355,000	R500,000	R800,000	0.3% of research income
TTO staff FTEs					
Professional	1	4	3	4	
Support	1	1.5	2	1	

Strategy.[7] These aim to build on and enhance existing strengths in these key sectors, while developing human resources and generating research outputs to help South Africa to become more globally competitive and address some of its socio-economic problems. Of particular relevance to technology transfer practitioners was a proposal contained in the National R&D Strategy to introduce measures to encourage better protection and exploitation of IP arising from publicly funded research projects. This has recently been expanded upon with the release in 2006 of the Framework for Intellectual Property Rights from Publicly Financed Research.[8]

This framework is intended to bridge the "innovation chasm," which describes the gap in South Africa between knowledge generators (in particular, universities and research institutions) and the market. Although research organizations are performing some high-quality basic and strategic research, and while industry has some relatively sophisticated manufacturing operations, South African technology-led companies typically access their technology from abroad—local innovation has had relatively little impact on economic growth. The framework calls for a consistent approach to protecting IP developed with public financing, based on good practice globally while remaining responsive to the local context. Institutions will be required to put in place IP policies consistent with this legislation within a limited timeframe after the legislation takes effect. This will ensure a level of harmonization across institutions. One of the more significant provisions is that these policies would obligate employees and students to disclose all IP that they develop.

The framework draws heavily on the U.S. Bayh-Dole Act and proposes the adoption of several similar provisions. These include:

- conferring on institutions the responsibility to seek protection for their IP in exchange for the right to own and exploit it
- a reporting duty to a designated government agency about IP management activity
- an obligation to share revenues earned from the exploitation of IP with the individual inventors or creators of the IP concerned
- a right for government to a "free license" to IP should this be in the national interest
- a preference for licensing to local companies and small business

Additional provisions are proposed to address unique local conditions. In this vein, a further preference for licensing to Broad-Based Black Economic Empowerment (BEE) companies is recommended.[9]

A short public consultation process was carried out to give stakeholders the opportunity to comment on the framework. Legislation based on the framework, and taking into account responses received as part of the public consultation process, was being drafted at the time of writing.

2.2 *Innovation Fund*

The Innovation Fund is one of the main agencies responsible for implementing the R&D Strategy. It aims to promote competitiveness by investing in "technologically innovative R&D projects, the effect of which will be new knowledge and widespread national benefits in the form of novel products, processes or services."[10]

In its early days, the Innovation Fund was essentially a funding agency that supported research projects carried out by consortia (typically a combination of universities, science councils, and/or firms).[11] More recently, though, it has assumed a more proactive role in promoting technology transfer and assisting eligible South African institutions and researchers in their technology transfer activities.

The Intellectual Property Management Office (IPMO) and the Innovation Fund Commercialization Office (IFCO) are units within the Innovation Fund that support IP management and technology commercialization, respectively. They also assist in building capacity for the exploitation of IP, having co-hosted a series of training courses for technology managers with MIHR (the Centre for the Management of IP in Health Research and Development) and other organizations. An internship program in partnership with a multinational business consulting and advisory service firm has also been put in place. The Innovation Fund holds subscriptions to patent

and marketing databases that can be accessed by universities and public research organizations at no cost or at subsidized rates. The Patent Support Fund allows universities and science councils to reclaim up to 50% of their patent expenditures annually. As an incentive to increase patenting activity, the Patent Incentive Scheme makes cash awards to inventors who have assigned their rights in an issued patent to a South African university or public research organization. The Innovation Fund has also provided financial support for various ad hoc initiatives, such as the establishment of university technology transfer offices and a university chair in intellectual property. It is proposed that the Innovation Fund be the designated reporting agency responsible for overseeing the implementation of the IP framework.

Other support measures for commercializing R&D include several directed-funding programs for research, development, and innovation, accessed on a competitive basis, funds from these programs are accessed on a competitive basis. Business incubators and government venture-capital funds are examples of other forms of support available.

3. TAKING STOCK

3.1 *A summary of progress to date*

Technology transfer in South Africa shows encouraging signs of progress:

- A handful of TTOs have been operating for several years and are now regarded as established entities within their organizations.
- Several new TTOs have recently been set up or are in the process of being launched.
- A track record of licensing deals and spin-out companies is gradually being built up.
- A core exists of professional, experienced technology transfer practitioners who are enthusiastic about sharing their skills with newcomers to the profession.
- A vibrant stakeholder organization provides a platform for networking and professional development in the field.
- Links have been forged that strengthen research collaborations and technology transfer partnerships with organizations elsewhere on the African continent and internationally.
- All of this is underpinned by support from government.

3.2 *Constraints*

Despite these advances, however, it must be acknowledged that technology transfer performance can, and indeed must, be improved. It is therefore instructive to identify the constraints and discuss how to overcome them.

3.2.1 *Few invention disclosures*

South African TTOs generally receive a weak flow of invention disclosures. There are several reasons for this. Some overburdened academics juggling heavy teaching loads, research responsibilities, and administrative duties are reluctant to take on the additional obligations that follow an invention disclosure. Other researchers are unaware or skeptical of the role of the TTO. Research funding levels are also fairly low, which limits overall research output (and thus the subset with commercialization potential). Furthermore, the typical funding mix of South African universities leaves them with a relatively small proportion of unencumbered IP. Few South African universities substantially contribute to research from their own internal budgets. Government funding makes up a relatively small proportion of total research expenditure, and so the greatest share of research funding comes from external sources, including local and international companies, philanthropic organizations, development agencies, and nongovernmental organizations. The research projects carried out with such funding are governed by research agreements that, among other things, lay out terms for the use and ownership of project IP. Commercial entities frequently insist on the assignment of any project IP, and even not-for-profit funding entities are increasingly demanding more stringent IP provisions (although generally for different reasons, such as ensuring their own freedom-to-operate for utilizing or disseminating the results of the research they fund).

The rate of invention disclosure could likely be improved to some extent by proactive actions on the part of the TTO (for example, more effective marketing of its services to potential clients within the institution, more frequent IP audits of research groups, or the introduction of internal procedures for compulsory disclosure prior to publication). But ultimately, more examples of successfully commercialized technologies are needed to persuade skeptical researchers that disclosing inventions is worthwhile.

3.2.2 *High costs associated with patenting*

Patenting costs are a problem. A new TTO typically struggles to secure a reasonable budget allocation for patent filing and prosecution. The TTO is sometimes viewed as competing with researchers, many of whom would prefer this funding to go directly to research. Patent protection is rarely worthwhile if pursued only in South Africa because the local market is not very large. The volatility of the currency makes it difficult to budget properly for international patent filing. Moreover, because of the pressure academics face to publish their research, patenting often takes place earlier than would be optimal, with the result that the technology is insufficiently developed to interest a licensee by the time it must be filed internationally. Universities cannot rely on licensees to assume foreign patent costs; at best, they can hope to be reimbursed at a later date, if and when the technology is finally licensed. TTOs are therefore severely constrained in terms of the number of patenting opportunities they can pursue.

This has been partially addressed by the Innovation Fund's Patent Support Fund, which allows universities and public research organizations to reclaim up to 50% of their expenditure on patent-related costs retrospectively.

3.2.3 *Limited capacity*

Local training opportunities are limited. There are only a few experienced technology transfer practitioners to act as mentors and share good practice. At the same time, the number of new entrants and available positions in the profession are too few to sustain specialized extended training programs. As a result, capacity-building initiatives consist of short courses that try to draw a wide audience by covering a broad range of general subject matter. Opportunities for continuing education on more advanced topics are rare and are often included as part of courses with a large proportion of beginners' content.

Longer-term capacity-building programs are being investigated, and some organizations have set up internship programs, but the system is probably still too immature to assess future needs accurately. The costs of an ambitious dedicated program will only be justified if there is a large enough pool of candidates. It is difficult to determine how quickly the system will be able to absorb new entrants as well as to estimate the number of technology transfer professionals needed to establish and sustain an effective system. Much of this will depend on when institutions without TTOs begin requiring technology transfer services (whether through an institutional TTO or via external service providers). Ongoing monitoring and refinements are likely to be required. Meanwhile, training opportunities overseas are also being explored.

3.2.4 *Unclear expectations and objectives for TTOs*

The rationale for university technology transfer is frequently misunderstood, which makes it difficult to obtain support from the broader university community. Income-generating objectives often assume greater importance than they should, and revenues accruing to an institution from technology transfer activities remain one of the main measures of success, despite the fact that most institutions explicitly acknowledge that income generation is not a major driver of their technology transfer activities. Among other things, this leads some academics to criticize the TTO on the ideological grounds that universities should not be undertaking commercial activity. Others resist the idea that the university has any right to IP that they feel entitled to own personally. Executive management often has unrealistic expectations about the financial returns that are likely to be generated by the TTO. When these fail to materialize quickly, they withdraw support or redirect the focus of the TTO. Clear objectives must therefore be set

(preferably in conjunction with stakeholders) and communicated to all frequently and effectively.

3.2.5 *Difficulties with IP management in the life sciences*

The IP landscape has become increasingly complex, particularly with respect to biotechnological inventions. Available expertise, however, is limited. Only a handful of local patent attorneys have life sciences training, and those with advanced degrees are even rarer. Freedom-to-operate constraints are often encountered. Access to proprietary biological material, reagents, or tools for research purposes (for example, under an MTA) could facilitate the development of a new invention, but negotiating the rights for commercial use may prove too time-consuming or complicated to pursue, or the terms offered might be prohibitive.

3.2.6 *Limited licensing opportunities*

Licensing opportunities for existing companies are lacking. Domestic firms often lack the markets or distribution channels for viable exploitation. Without a track record or personal contacts to facilitate meaningful links, marketing to overseas companies can be difficult. At the same time, spinout opportunities for new businesses are few and far between. Financing is not easily raised from risk-averse financial institutions and venture capitalists, who are particularly wary of biotechnology because they do not understand it. Angel investors are few and far between.

4. CONCLUSION

Clearly, the impact of the IP Framework will be one of the most critical factors shaping the future prospects of South African technology transfer. Still, the ultimate success of this initiative is likely to depend on the implementation of details that are not provided in the Framework. These will have to be sufficiently flexible to accommodate the varying levels of resources, expertise, and capacity in research, research management, and technology transfer in different organizations.

Expectations will have to be managed carefully. A growing body of evidence shows that 1) substantial investments in technology transfer are needed to generate downstream benefits, 2) there is typically a significant time lag before net benefits are realized, and 3) the distribution of returns is very skewed (for example, analysis of AUTM surveys).[12] But in South Africa it remains a fairly common perception that the main motivation for undertaking technology transfer activities at a university is to generate income. This is fortunately not a universal perception, but technology transfer practitioners, government, and agencies such as the Innovation Fund will have to dispel such misperceptions via effective communication strategies.

One of the greatest benefits that the envisaged legislation might provide would be to align the IP policies of public funding agencies, which would reduce the transactions costs of navigating the complex and varied structures that are currently in place and that often require protracted negotiations. It is not apparent, however, that the legislation will achieve this.

Similarly, by providing clear guidelines for the use and ownership of IP developed at public research institutions with industry funding, negotiations around sponsored research agreements could be simplified and expedited. The Framework proposes a default position of ownership by the public organization, which can be altered if certain criteria are met. This establishes a useful starting point, as long as the process for exceptions to the default position is not made too cumbersome. Private-sector funding represents a higher proportion of overall research funding in South Africa than in many other countries (estimated at 28% overall according to CENIS[13]), and universities will want to avoid creating disincentives for their industry research collaborators and sponsors. At the same, such research support comes at a price because it seldom fully recovers costs and overhead charges. The IP Framework will strengthen the bargaining position of institutions in this respect by making it easier to price research contracts appropriately.

The Framework for Intellectual Property Rights has successfully drawn attention to the

need for more effective exploitation of publicly funded research, stimulating a robust debate among stakeholders around the country. The real test of its impact, of course, will come with implementation. A positive outcome may be expected if a cooperative, enabling approach is taken that draws on the experience of organizations active in the field for some time. An approach that is too prescriptive and lacks sufficient flexibility to take into account unique circumstances will likely yield much less valuable results. ■

ROSEMARY WOLSON, *Intellectual Property Manager, R&D Outcomes, Council for Scientific and Industrial Research (CSIR), PO Box 395, Pretoria 0001, South Africa. rwolson@csir.co.za*

1 These have been in operation for at least five years and were included in an Innovation Fund assessment exercise conducted in 2003.

2 A handful of information-gathering exercises attempting an assessment have yielded data of limited value, because clear definitions of requested values were not always given and were thus not interpreted in the same way by all respondents, which made the information supplied incomparable.

3 SARIMA Charter.

4 Department of Arts, Culture, Science and Technology. 1996. White Paper on Science and Technology. www.dst.gov.za/legislation_policies/white_papers/Science_Technology_White_Paper.pdf.

5 Department of Science and Technology. 2002. South Africa's National Research and Development Strategy. www.dst.gov.za/legislation_policies/strategic_reps/sa_nat_rd_strat.pdf.

6 Department of Science and Technology. 2001. A National Biotechnology Strategy for South Africa. www.dst.gov.za/programmes/biodiversity/biotechstrategy.pdf.

7 Department of Science and Technology. 2006. The National Nanotechnology Strategy. www.dst.gov.za/publications/reports/Nanotech.pdf.

8 Department of Science and Technology. 2006. Framework for Intellectual Property Rights from Publicly Financed Research Department of Science and Technology: Brummeria, South Africa.

9 Broad-Based Black Economic Empowerment (BEE), a key component of the government's growth strategy, is considered a tool to broaden the country's economic base and accelerate growth, job creation, and poverty eradication, by addressing inequalities resulting from the past systematic exclusion of the majority of South Africans from meaningful participation in the economy. BEE is implemented and measured by means of a 'balanced scorecard' approach, which takes into account the elements of equity ownership, management, employment equity, skills development, preferential procurement, enterprise development and other residual elements.

10 www.innovationfund.ac.za/callforproposals.asp.

11 The Innovation Fund has been operating since 1997.

12 AUTM 2005. AUTM Licensing Survey™: FY 2004. Association of University Technology Managers: Northbrook, Illinois. www.autm.net. See also Scherer FM and D Harhoff. 2000. Technology Policy for a World of Skew-Distributed Outcomes, *Research Policy* 29; Heher AD. 2003. Return on Investment in Innovation: Implications for Institutions and National Agencies. Paper prepared for the First Globelics Conference on Innovation Systems and Development Strategies for the Third Millennium, Rio de Janiero; Advisory Council on Science and Technology. 1999. Public Investments in University Research: Reaping the Benefits. Report of the Expert Panel on the Commercialization of University Research Presented to the Prime Minister's Advisory Council on Science and Technology. acst-ccst.gc.ca/comm/rpaper_html/report_title_e.html Crown Copyright. 2003. Lambert Review of Business-University Collaboration.