Chapter 13

Effects of the South African IP Regime on Generating Value from Publicly Funded Research: An Exploratory Study of Two Universities

Caroline Ncube, Lucienne Abrahams and Titilayo Akinsanmi

Abstract

This study analyses evidence from two South African universities of how innovation activity and research dissemination are being influenced by a new intellectual property (IP) commercialisation law for publicly funded research outputs. The study sought to understand the ways in which the Intellectual Property Rights from Publicly Financed Research and Development (IPR-PFRD) Act of 2008 and its Regulations influence the generation of value from research. The study was positioned within a theoretical frame which holds that maximalist approaches to IP protection tend to be sub-optimal for certain long-term socio-economic objectives inherent in research funding. The research found evidence of adaptation by both of the universities studied (UCT and Wits University) to the requirements of the Act, and evidence that the Act can have a positive influence on South Africa's innovation nexus provided that the Act's patenting orientation continues to be complemented by openness-oriented research dissemination and collaboration practices, including open access (OA) scholarly publishing.

1. Introduction and research design

The research outlined in this chapter investigated the potential impact of South Africa's Intellectual Property Rights from Publicly Financed Research and Development (IPR-PFRD) Act 51 of 2008 and its 2009 Regulations on the commercialisation of research and on research dissemination, including scholarly publishing. The study focused on practices at two leading public universities: the University of Cape Town (UCT) and Johannesburg's University of the Witwatersrand (Wits University).

The IPR-PFRD Act of 2008 and its Regulations of 2009 (which became effective in 2010) seek to promote the protection and commercialisation of intellectual property (IP) generated through South African public funding. The Act applies to IP emanating from publicly financed research and development (R&D), which is defined in Section 1 as "research and development undertaken using any funds allocated by a funding agency but excludes funds allocated for scholarships and bursaries". In particular, it applies to South Africa's higher education institutions, to its 10 listed research councils, and to any other institutions that shall be identified by the Minister of Science and Technology in the future (Sect. 1 and 3(2), and Sched. 1, of the Act). The Act and Regulations have been critiqued (Barratt, 2010; Chetty, 2009/2010; Gray, 2010) from a number of perspectives, including charges that they:

- may be counter-productive to achieving the objectives of promoting commercialisation;
- may have too broad an approach to conceptualisation of commercialisation, i.e. include knowledge that should be socialised rather than commercialised;
- approach IP protection in ways that may present potential obstacles to scholarly publication; and
- have provisions that may be unnecessarily onerous for universities and academics.

The critiques made to date have been primarily theoretical. The research presented in this chapter sought an evidence-based understanding of the effects of the Act and Regulations on research, innovation and scholarly publishing.

A mixture of research methods was employed: a legal doctrinal analysis and review of annual reports on UCT and Wits research were supplemented by interviews with leading academics who have created patentable inventions and also publish extensively, and senior administrators responsible for research productivity at the two universities. The study focused on research in health sciences and engineering sciences, two research fields which are among the "top 21" scholarly publishing fields in South Africa (Abrahams and Akinsanmi, 2011; Mouton *et al.,* 2008). The research did not aim to be a comparative case study between UCT and Wits, but rather to separately explore the experiences of UCT and Wits in order to find out what could be learned from each case.

Particular inter-relationships are believed to exist between innovation, closed or open IP systems, and socio-economic development, with these inter-relationships seen as sometimes being mutually supportive while at other times being in conflict (Bünemann, 2010; Gray, 2009/2010; Hargreaves, 2011). These inter-relationships, and the extent to which they exist, need to be better understood if research productivity and value are to be maximised.

Accordingly, this study included the following elements in its examination of the two selected fields of research (health sciences and engineering sciences) at UCT and Wits:

- identification of major research producers;
- investigation and cataloguing of research, innovation practices and scholarly publishing; and
- investigation of the potential effects of the Act and Regulations on the work of research administrators, IP creators and research collaborations.

The overarching research question was: *How does South Africa's 2008 IP commercialisation law potentially impact research, innovation and scholarly publishing in key fields at universities?* Three sub-questions were designed to answer the main question:

- Prior to the Act, how did universities approach IP generated by their scientific research output?
- What are the potential effects of the Act and Regulations on universities' IP protection and commercialisation of innovation?
- To what extent are universities' publicly funded research results being communicated through scholarly publishing channels, i.e. paid access and/or open access (OA) publication approaches, and to what extent are these approaches being impacted by the Act and Regulations?

UCT and Wits were selected for study based on their high levels of research performance and contribution to South Africa's national system of innovation. They are among South Africa's leading research-producing universities and have been identified as two of the major research universities in the southern African region (Mouton *et al.*, 2008). Thus, they were selected as *critical,* not *typical*, research settings in South Africa, as per Patton's (2002) research methodological distinction, i.e. the relatively narrow focus on UCT and Wits meant that there would be only limited general applicability of the research findings to other South African universities.

First, an analysis was conducted of relevant South African policy, and the IPR-PFRD Act and Regulations, in order to establish the legal requirements for publicly funded research institutions. Second, UCT's and Wits's annual research reports for 2010 and 2011 were analysed. Third, semi-structured interviews probed the experiences and perceptions of patent-holding academics and research managers who administer IP commercialisation at each university. Purposive sampling (Denscombe, 2010) was used to identify participants who could provide in-depth knowledge and experiential insights into the Act and Regulations and their practical implications. The criteria used to identify suitable researcher-inventor

interviewees included strong research and publishing records and evidence of patent holdings. Identification of interviewees was done in consultation with relevant academic management at UCT and Wits, and with reference to the universities' research and innovation reports. The data were collected through document analysis and through interviews with nine key informants at UCT and Wits University: five researcher-inventors and four research-IP managers. The four research-IP manager interviewees were drawn from the UCT Research Contracts and IP Services office (RCIPS) and from Wits Commercial Enterprise (Pty) Ltd. (Wits Enterprise). The data were analysed thematically in order to determine the common and distinctive perceptions, at each university, of the extent of the impact of the Act on generating benefit from publicly funded research.

2. Conceptual framework

The study was grounded in several conceptual assumptions, as outlined in the subsections which follow.

IP protection

IP is created when new knowledge or creative work enjoys protection under common law or acquires a proprietary right pursuant to legal frameworks governing patents, copyrights, trademarks and trade secrets. Commercialisation of IP occurs when the value of new knowledge or creative work is realised in the marketplace through an IP vehicle that results in financial return (Geuna and Nesta, 2006). In a recent review of the IP environment in the UK, Hargreaves (2011) states that the UK IP framework has a tendency to act as a significant drag against innovation and economic growth. The Hargreaves Report finds this to be true not just within the creative works domain but increasingly and extensively with respect to business and academic innovation. South Africa, as a former British colony and a member of the Commonwealth, has an IP framework that, in many respects, reflects that of the UK. It follows, then, that some of the problems identified by Hargreaves with the existing UK IP framework may also characterise the South African context.

Central to this study's focus on connections between IP protection, commercialisation and research publishing is the contention that IP protection has the potential to limit access to knowledge (A2K), via explicit and/or implicit barriers, and that such limits on A2K undermine the balancing mechanisms inherent in the notion of IP protection. IP protection is not supposed to stifle A2K. In extreme instances, the protection of research findings via IP can constitute knowledge

hoarding. Such hoarding has been found to lead to the "under-utilisation of research findings" (NACI, 2003). Access is necessary to allow others to build on prior knowledge, and IP should ideally improve conditions for sustained creativity and innovation. This research was premised on a view that knowledge will tend to have greater socio-economic impact where it is shared and utilised.

The aforementioned Hargreaves Report (2011) argues for increased flexibility in the publishing of publicly funded research. Hargreaves addresses the potential conflict between, on the one hand, facilitation by digital communication technologies of "the routine copying of text, images and data" (2011, p. 3) and, on the other hand, closed-off online sources operating within a framework of laws that constitute a regulatory barrier to the creation of new knowledge and business development. Hargreaves proposes the development of a "digital copyright exchange" (2011, p. 3) designed to increase consumer confidence in the use of copyrighted material for both private and public benefit. The Report advises that "there should be a change in rules to enable scientific and other researchers to use modern text and data mining techniques, which copyright prohibits" (2011, p. 4).

Commercialisation

Commercialisation of research output is typically premised on the acquisition of IP protection. In order to realise the value contained in the IP, the entity seeking to commercialise it must have an established proprietary right over the knowledge via an IP right. Such a process of commercialisation requires a robust approach to IP protection. It is important to note, however, that securing patent protection is not a guarantee that commercialisation will succeed.

Knowledge socialisation

Knowledge socialisation, or "socialisation of knowledge" as it is referred to in the relevant literature, involves the adoption or uptake of norms, customs and ideologies through which social, cultural and economic continuity are sustained (Halloran, 2011; Nonaka, 1991; Plaskoff, 2011). The concept applies to non-commercial integration of knowledge in society. The socialisation of knowledge is underpinned by one major imperative – that knowledge is shared. Sharing allows the knowledge to develop, as it is adopted and adapted by various sections of society. In the context of academic research and publishing, the ability of researchers to disseminate knowledge into the public domain significantly determines the extent to which such knowledge becomes socialised. Advances in technology have opened up myriad ways for knowledge to be rapidly socialised. Some consequences may be negative, i.e. in the internet age, untried, untested and sometimes

unfounded knowledge can become social knowledge and prematurely become "truth". However, the positive consequences of rapid knowledge socialisation are substantial, with readily and rapidly accessible knowledge contributing to reductions in socio-economic inequality (De Assumpção, 2005).

Scholarly publishing

The trend towards the use of OA publishing, whereby works are made freely available online with minimal copyright restrictions, continues to grow in strength in relation to both learning materials and scholarly works. Proponents for and against OA publishing both agree that research findings should optimally benefit society. Some OA proponents argue that, where research publishing continues to be organised within the traditional closed access framework, only very slow increases will occur in the pool of quality researchers (Abrahams *et al.,* 2008).

At the same time, however, it must be borne in mind that the push towards OA can be daunting in developing countries, because the online platforms through which OA thrives are undermined in contexts where there are low levels of broadband internet access at higher education institutions. Online scholarly publishing is generally low in institutions located in developing countries and universities (Chan and Costa, 2005). Many scholars are restricted to publishing in Institute for Scientific Information (ISI) journals. Others publish in unrecognised platforms or fail to publish due to various restrictions, incapacities or resource limitations. Reductions in university library budgets, together with the increased cost of journals, foster demand for free access and alternative approaches to scholarly publishing and knowledge dissemination. OA publishing is a relatively inexpensive and inclusionary way of addressing this need but, at the same time, existing access barriers to publication are replicated in the digital world. Transitioning to OA publishing also generates issues of quality assurance, to ensure that research quality, credibility and ownership are not undermined.

Valuable, development-focused research is produced in Africa on an ongoing basis. While increasingly accessible online, dissemination of such research output is still considered low in the international context. In a report for Australia's Department of Education, Science and Training (DEST), Houghton *et al.*, (2006) recommend that greater levels of access to publicly funded research may be promoted by

> [...] [e]nsuring that the Research Quality Framework supports and encourages the development of new, more open scholarly communication mechanisms, rather than encouraging a retreat by researchers to conventional publication forms and media, and a reliance by evaluators upon traditional publication metrics (e.g., by ensuring dissemination and impact are an integral part of evaluation). (Houghton *et al.*, 2006, p. XIII)

Open science, open knowledge, open research

Interrogating the value of OA for research productivity, visibility, accessibility and knowledge in South Africa needs to be approached from a multi-disciplinary perspective. This entails moving beyond consideration of copyright and IP laws and traditional boundaries of scholarly publishing into consideration of the potential, offered by OA publishing, of what is sometimes referred to as "open science", "open knowledge" or "open research". The openness orientation implied by these terms entails the prioritisation of wide dissemination and sharing of the outputs of scientific research. This approach requires institution-wide commitment and change at universities. It requires the creation and/or strengthening of a research value chain that incorporates all levels of the academic hierarchy engaged in researching, writing and publishing. Abrahams *et al.* (2008) propose a framework "based on open knowledge approaches to knowledge production, publishing and dissemination in response to identified constraints and challenges to a productive academic research and publishing sector" (2008, p. 9).

This research endeavour thus combined consideration of ideas around IP commercialisation with consideration of the dynamics of knowledge socialisation and of the many transitions that are possible for managing IP and disseminating knowledge.

3. Findings Part 1: the Act and Regulations

Evolution of the South African approach, 1996 to 2012

The Act and Regulations have their roots (see Figure 13.1) in the government's 1996 White Paper on Science and Technology, which flagged the need for an IP regime that encourages innovation (DACST, 1996, Chap. 6). This orientation was reiterated in the Department of Science and Technology's (DST's) 2002 National Research and Development (R&D) Strategy, which lamented the absence of a formal policy framework for IP protection of publicly financed research and expressly mentioned the US Bayh–Dole Act as a model to emulate (DST, 2002, pp. 22, 67). The R&D Strategy was partially implemented by the creation of the Intellectual Property Rights from Publicly Financed Research Framework in 2006, which formed the blueprint for the eventual IPR-PFRD Act of 2008. The Framework preceded the publication by the Department of Science and Technology (DST) of a Ten-Year Innovation Plan in 2008 that identified financing and IP management as major challenges to successful IP commercialisation. Accordingly, the Ten-Year Plan provided for creation of the Technology Innovation Agency (TIA) to provide funding, and creation of the National IP Management Office (NIPMO)

"to enhance protection of IPRs" (DST, 2008, pp. 22–23). Ultimately, the essential elements of the IP Framework articulated via the foregoing developments were enacted as the Act in 2008, supplemented by the Regulations of 2009 (effective in 2010).

Meanwhile, since the mid-2000s, the Academy of Sciences of South Africa (ASSAf) has sought to promote OA publishing. By 2011, ASSAf had adapted the Brazilian Scielo OA publishing platform to create Scielo South Africa, encouraging South Africa's top scholarly journals to locate there. In 2012, Scielo South Africa was endorsed by international publishing firm Thomson Reuters's Web of Science scientific citation platform, meaning that authors publishing in a journal hosted by Scielo South Africa are recognised to have published in a Web of Science indexed journal. At the National Scholarly Editors' Forum convened by ASSAf in July 2012, the Department of Higher Education and Training (DHET) indicated that it was considering requiring all accredited South African journals to publish either on the Scielo South Africa platform or on another internationally recognised platform such as Web of Science. Also in 2012, DHET's Green Paper for Post-School Education and Training in South Africa, released in February of that year, prioritised open educational resources (OERs), i.e. learning objects made freely available online with minimal copyright or usage restrictions.

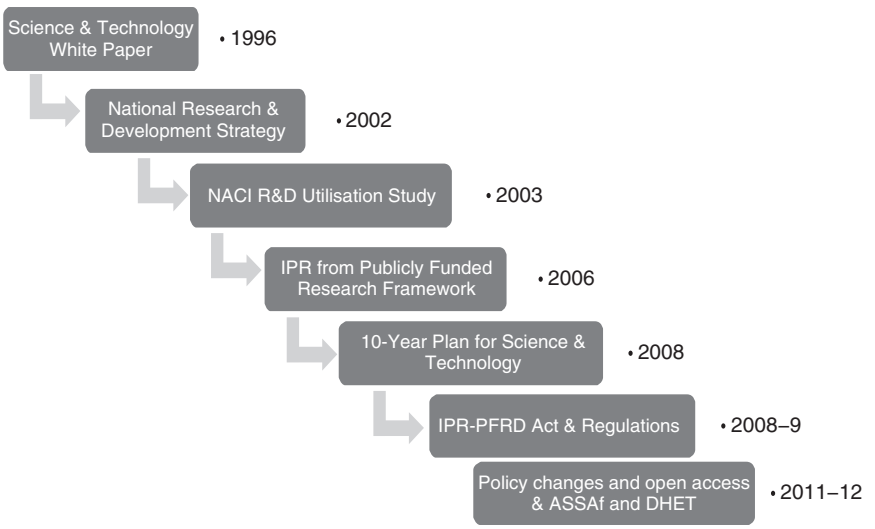

Figure 13.1: Evolution of the South African approach: timeline

Source: Authors' data collection.

Rationale

At the time of the IPR-PFRD Act's formulation, it was argued that the Act was essential to encourage publicly funded research institutions to be innovative and productive in the knowledge economy (DST, 2006, pp. 5–7). The lack of a national IP protection and commercialisation framework, it was argued, prejudiced South Africa because publicly funded research was being underutilised (NACI, 2003) and IP was being "lost to foreign jurisdictions" or "sitting on shelves" and failing to contribute to national socio-economic development (Sibanda, 2011). South Africa's poor patent profile was cited as an indicator of "a major weakness in South Africa's ability to become a full player in the global knowledge economy" and "[i]ncreasing patenting activity" and "building capacity in entrepreneurship and technology transfer within publicly funded institutions" were identified as remedial solutions (DST, 2006, p. 15). The legislation therefore provides for protection and commercialisation of IP from publicly funded research and places restrictions on offshore IP transactions to limit the loss of IP to foreign jurisdictions. There were also perceptions that a lack of clear incentive and benefit-sharing formulae were resulting in an environment with little or no motivation for researchers to innovate and commercialise inventions. The legislation, therefore, provides for benefit-sharing to incentivise researchers, an approach seemingly inspired by the approach adopted in the US via the provisions of the 1980 Bayh-Dole Act (see Chapters 14 and 15 of this volume for examples of attempted Bayh-Dole-type orientations in Ethiopia and Botswana, respectively).

Primary intent of the IPR-PFRD Act

The Act of 2008 defines "commercialisation" as

> [...] the process by which any intellectual property emanating from publicly financed research and development is or may be adapted or used for any purpose that may provide any benefit to society or commercial use on reasonable terms, and "commercialise" shall have a corresponding meaning. (Sect. 1 of the Act)

This definition is expounded by Section 1 of the Regulations, which defines "benefits" as:

> [...] contribution to the socio-economic needs of the Republic and includes capacity development, technology transfer, job creation, enterprise development, social upliftment and products, or processes or services that embody or use the intellectual property. (Sect. 1 of the Regulations)

These definitions result in a problematic conflation of IP commercialisation with socialisation of knowledge. The underlying theoretical perspective that

informs the Act does not recognise the differing trajectories between research which is commercialised via IP protection and research which is socialised via sharing.

While the legislation requires attempted acquisition and commercialisation of IP generated from publicly funded research, the Act excludes from its provisions "copyrighted works such as a thes[e]s, dissertation[s], article[s], handbook[s] or any other publication which, in the ordinary course of business, is associated with conventional academic work" (Sect. 1 of the Act). Trademarks and designs are included in the provisions of the Act, and institutions may choose to use trade secrets as a form of protection. The legislation's emphasis on patenting as a means of economic development fails to recognise that patents do not always lead to commercialisation and economic growth (Webster and Jensen, 2011, p. 447). The legislation could, for instance, prod institutions to build large patent portfolios with little prospect for commercialisation, i.e. portfolios of weak patents barely meeting the statutory patentability requirements. Such a phenomenon is possible in South Africa because South Africa does not examine patent applications (see Chapter 10, this volume, for discussion on lack of patent application examination processes in Africa). The DST acknowledges that "patenting for the sake of patenting is not adequate", but argues that a focus on patenting is a prerequisite for successful commercialisation in alignment with South Africa's technological growth strategy (Sibanda, 2007, p. 31).

Meanwhile, despite the exclusion of copyrighted scholarly publications from its provisions, the Act's focus on patenting could still have a negative effect on written academic output. Rapid publication of research findings relating to potentially patentable inventions could potentially have to be curtailed in order to prevent the compromise of novelty requirements for patentability. If publications were to be routinely delayed (for the lengthy periods of time required to formalise a patent application), this would have a chilling effect on written scholarly outputs, making South African scholars less competitive on the global stage of academic exchange and less able to participate in the aforementioned open science and open knowledge paradigms.

Key provisions

Several provisions in the Act and Regulations have the potential to be counterproductive. Section 1 of the Act defines IP as:

> [A]ny creation of the mind that is capable of being protected by law from use by any other person, whether *in terms of South African law or foreign intellectual property law,* and includes any rights in such creation, but excludes copyrighted works […] (Sect. 1 of the Act, emphasis added)

The inclusion of foreign IP law means that South African institutions are required to obtain statutory protection in foreign jurisdictions, even if the R&D in question is ineligible for IP protection in South Africa (Tong, 2010, pp. 409–10). This extension is understandable given that the underlying objective of the legislation is to increase South African local and international patenting. However, the extension raises two concerns. First, South African institutions will now have to ensure they possess adequate knowledge of foreign IP law, so that the required international protection is obtained. Second, acquisition of international IP protection is lengthy and costly, placing a heavy burden on institutions. The legislation seeks to answer these concerns by providing for partial or full funding for the "development of appropriately skilled personnel" in institutions through NIPMO (Sect. 6(4)*(b)*(iii)), and by establishing a national IP fund to finance institutions' acquisition and maintenance of local and foreign statutory IP protection (Sect. 13(2)*(a)*).

Institutional infrastructure

NIPMO, which oversees the Act (Sect. 8–9) and the IP fund, is mandated to financially support, manage and protect onshore and offshore IP efforts of publicly funded research institutions (Sect. 13). The Act provides for institutions to separately or collaboratively create technology transfer offices (TTOs) with the support of NIPMO. TTOs are to be "responsible for undertaking the obligations of the institution" (Sect. 6(1) and 6(3)) in respect of management of the identification, protection, development and commercialisation of IP, and to provide mandatory biannual disclosures to NIPMO (Sect. 5 and 7).

IP ownership and statutory protection

The Act provides for institutions, rather than researchers, to own IP derived from publicly financed research (Sect. 4(1)). However, where the full (as opposed to partial) cost of the research is privately funded, the IP does not fall within the ambit of the Act, i.e. the IP does not rest with the institution, but rather with the private funder (Sect. 15(4) of the Act).

The Act defines private entities or organisations as "a private sector company, a public entity, an international research organisation, an educational institution or an international funding or donor organisation" (sect. 15(5)). (This inclusion of "public entity" in the definition of a "private entity" is odd and, in the absence of a detailed explanatory memorandum accompanying the Act, is difficult to explain.)

The precise meaning of "full cost" has to be made clear within the policy prescripts of the institution, with full cost funding generally meaning that the funder

pays the full cost of the research (including overheads) and, subject to agreement with the institution, owns any resulting patents. For partially privately funded research, the private funder takes precedence and must be offered the option to acquire ownership and statutory protection for the IP. The Act does not provide for, or stipulate, any level or threshold that must be passed by a partial funder in order to earn entitlement to be offered ownership of the IP. The Act merely provides that "where a private entity or organisation had provided some funding" it should be offered ownership of the IP ahead of the IP creator (Sect. 4(4)*(b)* of the Act). Therefore, such an offer must be made to any partial funder regardless of the extent of the funding granted by that funder.

When institutions choose to forfeit ownership and statutory protection of IP from a research undertaking, they must notify NIPMO and provide reasons (Sect. 4(2)). Section 2 of the Regulations provides factors that must be considered by institutions in making such a choice. These include South Africa's socio-economic needs, the costs and advantages of possible IP protection, the potential for commercialisation, and whether the IP should be placed in the public domain. Should the balance of factors lie with retaining ownership and obtaining IP protection but the institution chooses to do neither, NIPMO may, upon referral from the institution (Sect. 2(4) of the Regulations), acquire ownership of the IP and seek statutory protection. NIPMO can do so if it is of the view that the state would be prejudiced if statutory protection were not obtained (Sect. 4(3) of the Act).

When the balance of factors does not lie with securing IP ownership and protection – i.e. neither the institution nor NIPMO wishes to acquire IP ownership and protection – the institution must give the researcher(s) who created the IP the option to assert ownership and obtain IP protection (Sect. 4(4)*(b)* of the Act and Sect. 4(10)–(11) of the Regulations).

IP transactions

The Act also regulates IP transactions, which are defined as:

> [A]ny agreement in respect of intellectual property emanating from publicly financed research and development, and includes licensing, assignment and any arrangement in which the intellectual property rights governed by this Act are transferred to a third party. (Sect. 1 of the Act)

The Act preserves the right of institutions to determine the type and terms of IP transactions they enter into, provided preference is afforded to non-exclusive licensing, to broad-based black economic empowerment entities (as per South Africa's B-BBEE Act 53 of 2003), to small businesses and to parties who intend to use the IP for the benefit of South Africa's economy (Sect. 11(1)*(a)–(c)*). Section

11(1) of the Regulations provides for the terms of non-exclusive licences to be determined "on an arms-length basis". NIPMO's approval must be obtained in cases where the "consideration payable by a licensee to a recipient is not determined on an arms-length basis", or where royalty-free licences are granted, or where offshore exclusive licences are granted and/or where assignments of IP are made locally and offshore (Sect. 11(2) of the Regulations).

Conditions that apply to all licences

Section 11(1)*(e)* of the Act states that each IP transaction must provide the state with an irrevocable and royalty-free licence authorising the state to use or have the IP used throughout the world for South Africa's health, security and emergency needs. Section 11(2) of the Act provides that each IP transaction must contain a condition that "should a party fail to commercialise the intellectual property to the benefit of [South Africa], the State is entitled to exercise" walk-in rights provided for in Section 14 (see "state 'walk-in' rights" sub-section below). Section 11(3)*(a)* of the Act provides that where the relevant IP is assigned to a small business, the assignment agreement must contain a condition that if the business is liquidated, the IP will revert to the institution.

Conditions that apply only to exclusive licences

Section 11(1)*(d)* of the Act requires that "exclusive licence holders must undertake, where feasible, to manufacture, process and otherwise commercialise" the invention in South Africa, failing which NIPMO has the power to request that the exclusive licence be converted into a non-exclusive licence.

Conditions that apply to offshore transactions

Section 12 of the Act requires institutions to notify NIPMO and to obtain its approval before concluding offshore exclusive IP transactions (exclusive licences and assignment), i.e. licences and assignments granted outside South Africa. Such approval will only be given pursuant to a number of considerations, including the requirement that NIPMO is satisfied that there is insufficient capacity within South Africa to commercialise the IP.

State "walk-in" rights

Sections 14(2) and 14(3) of the Act and Section 14(1) of the Regulations require NIPMO to conduct annual reviews of non-commercialised IP in consultation

with publicly funded research institutions. Should an institution fail to commercialise the IP after review and consultation, NIPMO may require the institution to grant a licence to a third party (Sect. 14(4) of the Act). The institution will be afforded an opportunity to challenge the exercise of the state's walk-in rights prior to NIPMO's final determination (Sect. 14(2) of the Regulations). Overall, the exercise of walk-in rights by the state must be reasonable and balanced in relation to other competing rights and must terminate once the specific health, security or emergency need has been met (Sect. 14(7) of the Regulations).

Benefit-sharing

Creators of IP from publicly funded research (or the creators' heirs) are entitled, under Section 10, to at least 20% of the first ZAR 1 million in revenues generated by the IP. They are also entitled to at least 30% of the net revenues in excess of the first ZAR 1 million earned. Revenues are to be shared equally among creators unless another benefit-sharing formula has been agreed to previously (Sect. 10(3)). Creators are entitled to timely access to monetary and non-monetary incentives (Sect. 19(1)). Section 9(3) of the Regulations also requires institutions to develop policies for sharing non-monetary benefits with IP creators for approval by NIPMO.

4. Findings Part 2: UCT and Wits University

The two studies, of research and IP management realities at UCT and Wits University, respectively, took different directions. These differences resulted to some extent from differences in data availability and to some extent from differences between the matters identified in each setting, during the course of the research, as being worthy of investigation and analysis.

UCT

Research and innovation indicators

UCT's IP Policy was amended in 2011 to implement the provisions of the Act (UCT, 2011b). The Policy addresses the role and duties of UCT's TTO, the roles and duties of UCT's Intellectual Property Advisory Committee, the ownership of IP, IP commercialisation and dispute resolution. UCT's *Innovation at UCT 2011* report outlines the institution's IP and commercialisation efforts, which are summarised in Table 13.1.

Table 13.1: Research indicators for UCT (ZAR = South African Rand, m = million)

Research contracts signed 1,056 (2010) 882 (2009)	Research contract value ZAR 550 m (2010) ZAR 543.9 m (2009)	Total research income ZAR 760.5 m (2010) ZAR 768 m (2009)
Foreign research funding ZAR 382.5 m (2010) ZAR 334.7 m (2009)	Local (South African) research funding ZAR 167.7 m (2010) ZAR 209.2 m (2009)	Publications* 1,188.22 (2010) 1,086.15 (2009)
Invention disclosures 31 (2010) 25 (2009)	Patent applications filed 57 (2010) 46 (2009)	Patents granted 36 (2010) 47 (2009)
Licence agreements 8 (2010) 6 (2009)	Materials transfer agreements (outbound) 29 (2010) 21 (2009)	Spin-out companies 0 (2010) 1 (2009)
Licence income ZAR 3.5 m (2010) ZAR 136,494 (2009)	Profit from UCT-incubated companies ZAR 400,000 (2010) ZAR 693,630 (2009)	Total income from IP ZAR 3.9 m (2010) ZAR 830,699 (2009)

Source: UCT (2011), p. 3.

* These publication counts have decimal points as a result of DHET's method of calculation, which translates publications into units and half units and shares them between institutions where a publication is co-authored.

Researchers in the Department of Chemical Engineering, the Department of Molecular and Cell Biology and the Institute of Infectious Disease and Molecular Medicine (IIDMM) are among UCT's top inventors, as evidenced by their very high publishing outputs (UCT, 2010, pp. 7–8). Recent research in these departments has been focused on minerals, the creation of human and animal vaccine candidates, preventive HIV vaccines, anti-malarial drug discovery and the development of a device that enables *in situ* evaluation of ferro-metallic catalysts (UCT, 2010, pp. 17–27, 65).

Administration perspectives

UCT's TTO function is performed by its RCIPS office, which in the last few years has focused its efforts on implementing the IPR-PFRD Act and Regulations. RCIPS

has conducted a campus-wide education and awareness campaign, and runs seminars aimed at creating awareness about the Act and demonstrating UCT's compliance arrangements. According to an RCIPS staff member interviewed, there are minimal negative impacts on IP commercialisation under the Act, but implementation has presented practical challenges. For instance, researchers interested in socialising their ideas at conferences or through publication may face constraints or delays because of the prioritisation of patent filing. The interviewee said that, with proper planning, however, a patent application could be filed prior to conference presentations or publication. RCIPS strives to assist UCT's academics and researchers to "fit IP protection seamlessly into the publication or thesis submission process" (RCIPS interviewee, 2012).

However, in the RCIPS interviewee's opinion, it was not necessarily ideal for commercialisation of research to be mandated by legislation. While it was appreciated that the intent of the legislation was to more concretely motivate a reflective approach to commercialisation by publicly funded institutions, some research lends itself more readily to commercialisation, and thus implementation of the Act has to be reasonable and bear such distinctions in mind. The RCIPS interviewee also said that other elements of South African IP protection could be amended to become more conducive to commercialisation. For example, the fact that South African patents are not substantively examined leads to "commercial uncertainty, as the claims have not been tested by examination and can only be contested in court – which is an expensive process" (RCIPS interviewee, 2012). Funders are understandably hesitant to invest when faced with this state of unpredictability over the future of a patented invention.

Another concern voiced by the RCIPS interviewee related to the lack of funding for development of early-stage IP:

> This [early-stage funding] is scarce and significantly impedes actual transfer of technology. There is a need for development to mature the IP within a university to fashion it into a commercialisable form [...] I think that there is a need for a parallel stream of people working on development, rather than research, to focus on translating research findings into tangible outputs that can be of relevance in the marketplace. (RCIPS interviewee, 2012)

A UCT researcher-inventor interviewee stated that full funding by industry of South African university research (necessary for the funder to acquire full rights to the IP in terms of the Act of 2008) is "uncompetitive and expensive" (UCT researcher-inventor interviewee, 2012). As a reflection of this sentiment, the interviewee pointed to a small but significant loss of industry-contracted research at UCT. The interviewee stated that barriers also arise from the need to seek NIPMO permissions for certain IP transactions, as per the Act. This requirement

lengthens research contract negotiations and their implementation, making the process more expensive and less attractive to industry.

Also having a potentially chilling effect on research funding, said a UCT interviewee, is uncertainty about the exercise of state walk-in rights in terms of the Act. Funders are unsure of how the government will exercise these rights and may be unwilling to invest in a project that may be subject to the exercise of such rights. An additional burden cited by a UCT interviewee is the fact that the university has had to increase its screening work, because more researchers are informing RCIPS of their inventions so that they can be scrutinised for patentability. Researchers now disclose everything, including borderline inventions. Before the Act, only clearly patentable inventions were disclosed (UCT researcher-inventor interviewee, 2012).

At the same time, it was argued by one UCT interviewee that the Act does not constrain socialisation of research, if one defines socialisation as compatible with both *financial* and *non-financial* returns from publicly funded research. This interviewee argued that the requirement that researchers screen their work for protectable IP prior to public disclosure may result in more reflective practices among scholars, due to the awareness raised and the duties imposed by the legislation. This interviewee went on to say that UCT research had habitually been socialised and identified with significant "societal benefit" prior to the introduction of the legislation, and the Act will not have an impact on this emphasis on socialisation. At UCT, the interviewee argued, societal benefit is a core objective and not "something that one will measure by monitoring protectable IP rights" (UCT researcher-inventor interviewee, 2012).

Indeed, evidence was found of significant knowledge socialisation by UCT researchers, through both traditional and emerging scholarly publishing and distribution channels. UCT has an online research portal through which its staff and postgraduate students can manage their research. UCT also disseminates publications and other research outputs through an open-licensed website called UCT OpenContent (http://opencontent.uct.ac.za), where Creative Commons (CC)-licensed learning materials are published. UCT motivates scholarly publishing by providing career progression and research funding incentives to academics who publish regularly. UCT uses open source software and CC licences to ensure wide promotion and dissemination of the knowledge it generates (UCT, 2011b). Many UCT researchers enter competitions and receive awards for their work, affording them opportunities for wider engagement beyond publishing. UCT also supports events and competitions that disseminate knowledge, and it seeks to report specifically on the societal contributions of its research and innovation. In 2011, UCT signed the 2002 Berlin Declaration on Open Access, affirming its commitment to distribution of UCT research output on an OA basis.

Another UCT researcher-inventor interviewee argued that the Act may hinder the socialisation of knowledge – because of the need, mentioned above, to consider obtaining IP protection before engaging in research dissemination. However, even this interviewee stated that in many instances, the cost of the publication delay would likely be outweighed by the benefits of commercialisation.

The RCIPS interviewee stated that there might be difficulties in situations where IP is jointly created or shared, resulting in a situation where one of the parties (i.e. UCT) is required to comply with the Act while others may not be required to do so. This would be the case where the other parties are not publicly funded and thus not obliged to comply with the Act. The interviewee expressed hope that NIPMO would issue guidelines addressing this concern. Thus far, UCT has negotiated such situations by obtaining the necessary approvals from collaborating partners. However, obtaining these approvals invariably delays the conclusion of an agreement. Meanwhile, some philanthropic donors do not use a full-cost pricing model (which would entitle them to the IP rights) and instead seek alternative approaches to IP protection, such as direct IP transfers to them, which are subject to NIPMO approval.

RCIPS often works with researchers and inventors to prepare patent applications. It was stated that NIPMO compliance is onerous for RCIPS, but that UCT's administrative practices (e.g. the use of databases) and the provision of funding by NIPMO to finance capacity enhancement are mitigating the burden. The RCIPS interviewee said that capacity development funding is critical because universities have to be

> [...] suitably capacitated to cope with the implementation of the IPR Act – both in terms of human resources [and] skills transfer to the research community, and [in terms of] funding both to support early commercialisation as well as to pay for patent application and maintenance. (RCIPS interviewee, 2012)

Researcher-inventor perspectives

The UCT researcher-inventor interviewees generally reported that they favour the notion of open research, i.e. they favour extensive dissemination and publication of their research findings, and participation in international research consortia. They also stated that it is critical that resources are not wasted, that research is properly directed, and that appropriate benefits accrue from their research. The interviewees reported that they employ both full-cost and partial-cost funding models. Sometimes the full-cost model of funding entails limitations on related publications and strict regulation of confidentiality through the use of non-disclosure agreements (NDAs). In contrast, the partial-cost model is one in which the funder does not cover all costs and therefore does not own the IP (but must,

in terms of the Act, be offered the opportunity to acquire the IP). As noted above, this is in all cases where partial funding, regardless of extent, has been provided. Frequently, such funders only seek royalty-free use of the final product or process for five years, with the result that UCT researchers working on such projects have no restrictions related to publishing, conference presentations or other modes of socialisation of the knowledge they produce.

One researcher-inventor interviewee expressed concern that the full-cost model may starve some companies, who are unable or unwilling to provide full-cost funding of research inputs. The Act may also block UCT relationships with other universities because of the restrictions imposed by NDAs (interviewee, 2012). It was also stated by a researcher-inventor interviewee that, when a project has multiple funders, there may be difficulties in gaining consensus on matters of IP ownership.

The UCT researcher-inventor interviewees stated that academic publishing is their main mode of knowledge dissemination, and that the Act does not necessarily inhibit this kind of knowledge socialisation because delays occasioned by the need to maintain secrecy prior to the filing of a patent application can be minimised by proper planning. For instance, a provisional patent specification can be filed on short notice in a case where a researcher needs to make a presentation at an international conference that could potentially undermine the novelty of an invention if presented in advance of a patent application. There was consensus among UCT researcher-inventor interviewees that implementation of the Act must seek to minimise any negative impact on scholarly publishing. One researcher-inventor interviewee stated that "publishing, collaboration and the free exchange of info between the people in the world engaged in our area of research is the only way forward" (UCT researcher-inventor interviewee, 2012).

At the same time, UCT researcher-inventor respondents expressed the belief that if, for instance, students had to delay publishing their theses because of the requirements of the Act, it would in most cases be an acceptable trade-off relative to the potential benefit that could accrue from a related patent and from the student's participation in patentable innovation. One researcher-inventor interviewee recounted how a student had become co-author of a patent derived from joint research conducted jointly by the interviewee and the student. The licensing of the patent had resulted in significant benefits for the student.

Wits University

Research and innovation indicators

Wits engages in multiple international research collaborations and has plans to establish six global research institutes (Wits University, 2010). In 2010, Wits had

research funding in excess of ZAR 426,691 million, of which ZAR 102,591 million constituted public funding from the National Research Foundation (NRF), the Medical Research Council (MRC) and other government departments and science councils, while ZAR 75,751 million came from external sources, including the private sector and philanthropic donations. The rest came from miscellaneous sources. The largest volume of research output in 2010, including graduate work, was in the Faculty of Humanities (433 research units), followed by the Faculty of Science (418 units) and the Faculty of Health Sciences (366 units). Most patentable inventions stemmed from faculty members in Science, in Health Sciences, and in the Faculty of Engineering and the Built Environment.

Patent filing

Working from its 2003 IP Policy, Wits has effectively complied with the Act, transferring IP from inventors to the university, in the process securing "a cupboard full of patents [while] the challenge is to take the stuff out of the cupboard, get it out to the market and have an impact on society" (Wits Enterprise, 2012). Historically, according to Wits Enterprise, the university has handled patenting more as an academic exercise, spending on patenting but not on transferring patents into outcomes. In the future, patenting decisions would need to be based on all available information, in order to patent only where it will create value. The Act also requires universities to drive IP for societal benefit, which, arguably, includes economic benefit. Of these two approaches, patenting comes with the biggest formal overhead and expense (Wits Enterprise, 2012). One of the key challenges for the TTO remarked on by Wits Enterprise is to find ways to assist researchers in becoming proficient in IP management. The institutional perspective is that there is an onus on academic researchers to work for the public good, and the Act guarantees that the inventor will share in the financial and non-financial benefits, even though the university owns the IP (Wits Enterprise, 2012). Wits's IP Policy has historically permitted funding for Wits Enterprise to facilitate technology transfer and patenting; however the university needs to research the market and network with industry to operate in the broader ecosystem. University management does not yet have all necessary systems in place (Wits Enterprise, 2012).

The Wits portfolio of patenting doubled every year between 2003 and 2011 (Wits Enterprise, 2012), following the introduction of the Wits IP Policy in 2003 (Wits University, 2003). Prior to this Policy, which requires academics to disclose research that can be patent-protected, only a few small pockets of patent activity existed at Wits, in industrial diamond technology, gene-silencing technology for hepatitis B, and in bone generation. Today, the university's patent portfolio covers a relatively wide range of activity, including inventions in Health Sciences,

Engineering and the Built Environment, and Science. In the Faculty of Health Sciences, the Department of Pharmacy and Pharmacology in the School of Therapeutic Sciences had, by 2010, filed 25 patents in a single patent class in South Africa. The research involved drug delivery technologies to enhance the efficacy of drugs, with the focus on improved drug delivery of existing molecules (at low cost) as compared to the development of new molecules (with extended time to develop/market and high cost) (Wits University, 2010, pp. 103–5). The inventors were the most highly published in the field of pharmacy in South Africa, and were publishing approximately 15 journal articles annually.

Between 2010 and 2012, Wits established a dedicated Technology Transfer Unit to perform TTO functions within its IP management unit, Wits Enterprise. Wits Enterprise is a stand-alone company, established by the university in 2002, and offers a wide range of IP management research contracts and short courses.

The cost of patent filing at Wits is covered by a mix of public funding and funding from the university (for the legal fees, via Wits Enterprise). Prior to the Act, Wits made only limited financial commitments to technology transfer from the university, because it apparently did not see value in protecting inventions if there was no intention to exploit them commercially. In 2011, Wits introduced funding of IP protection for the first time, and increased its budget for this activity in 2012 (Wits Enterprise, 2012). Wits records patents through the RIMS (InfoEd) patent database, which includes a technology transfer module and a database for patent filings. The InfoEd system prompts the inventor or system administrator to either file a patent or take another specific action. NIPMO has access to the system data (Wits Enterprise, 2012).

Research-IP manager perspective

Wits research-IP managers explained that many industry funders have had to re-evaluate their approach since the introduction of the IPR-PFRD Act, because most industrial support had not, before the Act, been on a full-cost basis. Before the Act, industry-funded research projects generally had additional university or government funding, and IP from this research belonged to Wits, according to its IP Policy. The university would then negotiate the industry funder's rights to the IP, e.g. rights to post-commercialisation reward. South African petrochemical parastatal Sasol is an example of a company that has restructured its approach since the promulgation of the Act. The company has, since the Act, developed a policy for university research funding that allows it to retain ownership of IP from research of high commercial value in return for paying full cost to the university (Wits Enterprise, 2012).

The view was expressed that most South African businesses do not fully understand IP. Since much IP comes from offshore, businesses know how to commercialise it but not how to manage it. Full-costing for industry research funding is seen as an essential way forward wherever possible, otherwise Wits owns the IP even where it may lack the capacity or the finance to develop such. Initially, there was a fear that the full-cost model would be a problem; as it turned out, key industry players were not fazed, but wanted to understand the risks and liabilities more explicitly (Wits Enterprise, 2012).

Wits Enterprise expresses the view that there have been limited developments at Wits regarding collaboration between the university, industry and government, i.e. "triple helix" collaborations. Examples cited of early-stage triple helix formation were the Technology and Human Resources Programme (THRIP) programme of the NRF and the Department of Trade and Industry (DTI), and the De Beers Element Six programme of funding for industrial diamond research. These, however, were funding approaches rather than cases of commercialisation of research output. It was apparently too early to gauge the degree to which the triple helix approach on the input side was resulting in triple helix in operation on the output side (Wits Enterprise, 2012).

Though Wits research-IP managers interviewed stated that converting IP to commercial products and services is becoming more active at Wits, traditional forms of academic achievement are still pre-eminent among the majority of Wits academics and, in the short period since the Act has taken effect, there has been very little impact on broader research practice at Wits. The majority of academics were in fact unlikely to be aware of the Act, though there were plans to raise awareness. Scientists in Engineering Science were said to be knowledgeable, while greater awareness of the Act was needed in Health Sciences (Wits Enterprise, 2012).

Meanwhile, in the realm of dissemination and publication, Wits in November 2012 signed the aforementioned Berlin Declaration on Open Access (which UCT signed a year earlier, in 2011). However, the interviews with Wits research-IP managers and a Wits researcher-inventor revealed that there is a degree of uncertainty at Wits regarding what should or should not be disclosed through OA publishing, and thus there is a need for greater clarity on the Wits approach to OA. The technology transfer process regulated by the Act does not prevent OA publishing. Because a regulator's permission is required in the case of publication of potentially patentable information, this hurdle to publishing ensures that motivation to publish includes inventors' consideration of their actions in terms of the best way to make the knowledge useful. This involves thinking through the issues, rather than simple regulatory compliance.

Since inventions can only be protected prior to publication, the university advises academics to attach draft conference papers or scholarly articles to their patent applications. Academics can then publish the paper or article once the provisional patent is filed and a priority date is given (Wits Enterprise, 2012).

The view was expressed that the requirements of the legislation have fostered a conversation about commercialisation and innovation at Wits – a conversation that would not have been possible prior to the Act of 2008 (Wits Enterprise, 2012). Wits is now beginning to build the commercialisation component of its innovation system, with Wits Enterprise emphasising that the IP protection strategy of the university must be linked to an ability to deploy IP in the market. Spending money on patenting commercially unviable inventions is pointless, because the roughly ZAR1 million required to file a single full international patent family application is a large financial commitment for an organisation with a research budget of under ZAR500 million. It is possible that the rate of patenting will decline as understanding of the commercial prospects of academic research grows (Wits Enterprise, 2012).

In working to build the resource base for commercialisation, both the research-IP managers and the researcher-inventor interviewed said they felt that there is a need for appropriately skilled technology transfer professionals. Such professionals are scarce, however, with some estimates suggesting there may be as few as 20 such experts in the country (Wits researcher-inventor interviewee, 2012). Because NIPMO, the TIA, the universities and the legal profession all need such expertise, this personnel shortage presents a major system constraint. It is therefore necessary to identify and train professionals to fill the gap in this field. Furthermore, effective access to information tools and databases that allow analysis of the industry and market (to support potential partnerships) is also needed (Wits researcher-inventor interviewee, 2012).

To commercialise technology, a university can either license its IP to existing parties or create a company to use the IP. Wits currently licenses IP generated at the university to firms that have the capacity for, and interest in, commercialising it. This is because much of the patentable IP produced by researchers at the university is very early-stage and requires a fair amount of development before it is market-ready. It would be very risky for the university to establish start-up companies, as this would require venture capital, entrepreneurial management and possible incubation centres or specialised laboratories. These necessary elements are not within the natural scope of university competency. Wits attempted the alternative avenue for commercialising IP by establishing two start-up firms. Both, however, were in the process of being closed in 2012 because they had proved to be too risky (Wits Enterprise, 2012).

Where highly specialised clinical trials are required, neither Wits nor local companies have access to the large financial investments necessary. In fact, access to venture capital in South Africa, on the whole, is limited by the country's relatively undeveloped venture capital sector. Local venture capital has historically failed to engage with very-early-stage high-tech start-ups. While institutions such as South Africa's Industrial Development Corporation (IDC) could potentially have some interest, the applicable university-based research is typically too early-stage to meet the criteria for IDC development financing (Wits researcher-inventor interviewee, 2012).

An important challenge and priority is funding of TTO functions at Wits Enterprise. More funding is needed from the university and NIPMO. For example, in one of the most advanced cases (as mentioned above) of invention and patenting at Wits, academics and research students in the School of Therapeutic Sciences are working on enhanced drug delivery technologies, potentially making an important contribution to knowledge. Now, argues Wits Enterprise, "[t]he university needs to assist in getting the most impact out of that science" (Wits Enterprise, 2012). This case suggests strong opportunity in the future for entrepreneurial science at Wits, facilitated by Wits Enterprise.

Researcher-inventor perspective

The researcher-inventor interviewed, working in the commercially oriented space, explained that the research team prioritises publishing academically. However, since inventions can only be protected prior to publication, the researcher-inventor pointed to a potential conflict between academic publishing and the exploitation of their knowledge through commercial channels. Some research team members would prefer to delegate the commercialisation aspect of their patents to Wits Enterprise, but are limited by the difficulties involved in commercialising early-stage research (Wits researcher-inventor interviewee, 2012). It was stated that global patenting is an important issue for certain research fields. By way of example, South Africa has no local pharmaceutical development industry so inventors can effectively only transmit their research for commercialisation in global R&D markets. Thus, with respect to the invention and patenting phase, local inventors in the pharmacy sector may benefit from global linkages and global clout. The Wits pharmaceutical research team had filed a provisional patent application locally first and then filed an international Patent Cooperation Treaty (PCT) application. However, the degree of protection that a local patent gives, in a context where no local R&D industry exists, is an important question that needs to be addressed (Wits researcher-inventor interviewee, 2012), as this could amount to an inefficient utilisation of scarce funds.

The investment of public funds in research is understood to place an obligation on researcher-inventors to ensure returns are realised in the local economy, while at the same time facilitating a competitive innovation sector. One of the most effective means of moving the research and commercialisation agenda forward in South Africa is seen to be through the global patenting market. At Wits, an advanced drug delivery platform is being developed for a disease that affects everyone globally, making the securing of patents in the US, EU and Japan (the major pharmaceutical markets) essential. In this context, Wits inventors are engaged in a global value creation process, while aiming to generate a revenue stream back to South Africa. South African scientists can have a global agenda, participating in global R&D markets in order to enhance competitiveness. It can be argued that a local patent has limited value if it pertains to a global disease where R&D occurs abroad (e.g. ulcerative colitis, cancer), while a local patent for HIV drug delivery has significant value. Both approaches can deliver positive macro-economic effects. Publication occurs after receiving the priority date in the case of a provisional patent application in South Africa (Wits researcher-inventor interviewee, 2012).

It was noted that knowledge gained through pharmaceutical R&D contributes to knowledge socialisation through the scholarly publishing and citation process. Inventors within the field of pharmaceutical research at Wits publish between 15 and 20 papers a year in high-impact international journals. The researcher-inventors publish in both paid-access (per article or via subscription) journals and via OA modes. OA scholarly publishing has been observed to increase citations, as more academics have access to the articles. Global researchers have approached the pharmaceutical research team for access to their findings, and OA simplifies the process for academics who cannot afford access to paid-access publications, while data related to patent filings that have commercial potential is not shared (Wits researcher-inventor interviewee, 2012).

It was argued that researchers who want visibility "to make ourselves known" value OA, as it has many benefits. OA publishing is observed to help validate the research, as international researchers find it valuable and cite it. For example, Wits research papers on advanced drug delivery platforms are extensively cited and high visibility has led to many expressions of interest in collaboration from researchers in, for example, Egypt, Argentina and Mauritius. Additionally, citations are among the criteria used for promotion, e.g. through reporting H-Index values. High citation rates suggest the article has created attention, something that is wanted in the innovation space. The objective is to create attention for the inventors, the institution and the country. Given the importance of OA in facilitating basic research, the view was expressed that the focus of the Act should not be solely on commercialisation (Wits researcher-inventor interviewee, 2012).

The Wits researcher-inventor interviewee's perspective includes the view that, in particular research fields, the officials scrutinising the patents should be experts. It was noted that the patent examination process in South Africa is not as stringent as it could be and that greater capacity is required at the patent office. However, researchers filing for patent protection are usually the local experts, and thus cannot also be active in a patent examination office. This raises questions regarding the exact nature of expertise needed at the point of patent scrutiny and where such expertise might come from. NIPMO and the Companies and Intellectual Property Commission (CIPC, formerly CIPRO) may need to engage in global and local collaborations for effective patent scrutiny. In this regard too, however, there is a risk of bias that would need to be managed (Wits researcher-inventor interviewee, 2012).

Ambiguities in the Act and Regulations

Since 2008, when the Act became law, the process of setting up the complementary Regulations, as well as the Act's implementing infrastructure, has remained gradual, and at the time of this study had yet to be completed. There is a sense of ambiguity and uncertainty regarding the Act's practical application, warranting the feeling that the Act needs redrafting (Wits Enterprise, 2012). While amendments to many of the ambiguous aspects of the Act were proposed by universities and other advocates prior to enactment, the amendments were not adopted. Furthermore, certain sections in the Regulations are inconsistent with the provisions of the Act. However, thus far, despite being "left with the chaos", as one respondent put it, Wits appears to have taken a goodwill approach to meeting the objectives of the Act through pragmatic adaptations and general commitment to make the Act work. In order to clarify areas of uncertainty in the Act and Regulations, the regulator has published guidelines. Practice notes, similar to those deployed on tax matters by the South African Revenue Service, have been proposed as another tool for NIPMO to use, but it is not yet known whether this approach will be introduced (Wits Enterprise, 2012).

A primary issue appears to be the matter of what falls within the scope of the Act, because the Act does not define R&D, referring only to IP emanating from publicly financed research. Regulatory guidelines are in the process of development, and South African universities have had some input into the guidelines, on a confidential basis. It is unclear whether the draft guidelines will be published for comment. (The regulator NIPMO is also focusing on getting its systems operational to guide the TTOs, but is under-resourced (Wits Enterprise, 2012).)

5. Conclusions

The evidence outlined in the previous two sections of this chapter – the legislative and regulatory analysis in Section 3 and the UCT and Wits case study findings in Section 4 – suggest that the research landscape for the two universities studied (and potentially for other South African research universities and public research entities) is experiencing a period of transition. The transition would seem to be from a more purely research orientation to more mixed research and innovation orientation.

The IPR-PFRD Act of 2008 is a primarily a patent act, not an omnibus piece of legislation for publicly funded innovation. The Act is therefore part of an innovation puzzle, in which the roles and contributions of various actors (DHET, the DST, ASSAf, universities and industry) are shifting from the historically more linear contributions to research towards a form of research-innovation interconnectedness or entanglement, to use the terminology of Hanauske *et al.*, (2007). The DST's initiative, via the Act, to promote and regulate the patenting of publicly funded research seems clearly to be prompting behaviour. At the same time, global trends in publishing are raising philosophical and ecosystem questions in South Africa about how to maximise the value of academic publication output – as evidenced by the aforementioned change of approach at ASSAf (with the support of the DST and DHET), and the adoption by Wits of the Berlin Declaration. Both the patenting and scholarly publishing environments in South Africa are thus in a state of flux.

While the evidence gathered by this research project suggests that there may have been an initial chilling effect on scholarly publishing following introduction of the Act in 2008, as well as a rearranging of industry finance for university research and increased emphasis on university-level IP policy and practice, it would appear that significant amounts of successful adaptation have occurred. The provisions of the Act and Regulations require, and appear to have prompted, investments in increased IP management capacity at state level and at the two universities studied. Further system-building and legal-regulatory mechanisms are likely still required, in order for the DST, TIA, NIPMO, universities and industry to create, and adapt to, the new rules of the game. There is also evidence that the scholarly publishing landscape is beginning to shift, based on new thinking about academic journal accreditation, OA publishing and financial incentives for scholarly publishing. The whole system of knowledge production is in motion. At the same time, the human and financial infrastructure to support patenting of university-based R&D is slowly unfurling. This system change has the potential to reset the "publish or perish" approach to a mixed "patent, publish, commercialise" and "publish and socialise" approach.

In conclusion, we now consider two particularly important themes that have emerged from this research:

Building the new ecosystem

The following are levers for building the new ecosystem for publicly funded research:

- from government: policy, legislation, regulations, supporting institutions (NIPMO, TIA) and funding frameworks;
- from universities and other publicly funded research entities: IP policy, externally funded work policy, TTOs and legal offices; and
- from industry: research funding approaches.

These levers are all necessary, and must be interlinked, in order for the knowledge capacity and base of publicly funded research entities to be aggregated and extended. For instance, legislation and regulations alone can only have limited impact on the challenge posed by the fact that South African university research tends to be underutilised at this stage in the country's knowledge production evolution, because most potentially commercialisable research is early-stage. In addition to the fact that the Act and Regulations only deal with a tiny slice of the research and innovation pipeline, we saw above that even on the matters specifically addressed by these legal instruments, the instruments are vague on important points, including the distinction between economic and social value and modes of support for key activities in the value chain of transformation of IP into both economic and social value.

Only an interlinked ecosystem, with the levers of government, public research entities and industry combining effectively, can improve utilisation of early-stage research and help bring it to later stages in a manner that can deliver on both commercial and social objectives. The components of South Africa's new ecosystem for publicly funded research are still at an early stage of development, with supporting institutions at state level and at public research entities (NIPMO, TIA, TTOs) still in their formative stages. The role of NIPMO is protection- and support-related; the role of the TIA is support-related; and the synergistic linkages between these two bodies, TTOs and public research entities are still in an early stage of evolution.

There is also the matter of how to give both patenting and scholarly publishing the attention they require for their combined future development. Attention to one without attention to the other limits the potential of the IP landscape as a whole. The Act's focus on patenting, and lack of emphasis on scholarly publishing, may be perceived as a weakness. This is because the production, commercialisation, dissemination and socialisation of knowledge are all related endeavours.

As such, some argue that legislation must treat them as related processes, on the grounds that if the legal-regulatory system does not address all elements of knowledge production in the IP ecosystem, systemic weaknesses will result, with every element of the ecosystem undermined. It can thus be argued that the IPR-PFRD Act should also have included proactive provisions on scholarly publishing. Such an argument is not persuasive, however, because scholarly publishing cannot and should not be driven by legislative requirements, so as to maintain the sanctity of university autonomy and the academic freedom of researchers and scholars. This research study has shown that there are non-legislative mechanisms which can, and are being, harnessed to build a scholarly publishing environment conducive to the new ecosystem.

Knowledge socialisation

The Act conceptualises commercialisation broadly, and potentially applies a commercialisation imperative to knowledge that should, in our view, be prioritised for socialisation. This over-broad conception of commercialisation requires forethought by universities and inventors at universities, so that knowledge production is not collapsed into a requirement that all knowledge be subject to patent applications by default.

Socialising knowledge is important because it forms the foundation of knowledge-building for future generations of researchers, inventors and universities. Whether published using paid-access journals or OA platforms, scholarly research is a specific form of knowledge socialisation. In the interests of socialising knowledge, UCT and Wits have both confirmed their institutions' commitment to OA by becoming signatories to the Berlin Declaration.

The Act, and the actors interviewed at UCT and Wits for this research, envision achievement of broad societal and economic impact through publicly funded research. Differences emerge, however, with respect to the means through which to foster such impact, with arguments ranging from calls to protect IP to calls for it to be made openly available. It is important to distinguish between two main kinds of potential impact: commercial and social. A university is, above all, a social institution of knowledge generation, with a broad societal role, not merely a narrow economic, commercial, instrumentalist one. We have seen that the emerging South African innovation landscape addresses patenting, licensing, commercialisation and scholarly publishing (in either paid-access or OA format), but narratives aligned with notions of open science, open research, open knowledge and "open development" (see Chapter 1 of this volume) are not prominent in the South African innovation and IP discourse, and they ought to be.

Finally, it is necessary to return to the research question for this study, as provided in the opening section of this chapter: *How does South Africa's 2008 IP commercialisation law potentially impact research, innovation and scholarly publishing in key fields at universities?* The research has found that the Act appears to have the potential to steer university research, innovation and scholarly publishing in new directions. However, it seems clear that if South African universities approach the Act simply from a compliance perspective, the R&D objectives of the Act could be lost. A compliance-based approach could lead to indiscriminate patenting, without consideration to real potential commercial and social benefits and costs. Such an approach would not achieve the developmental intentions of the Act, as it would not sufficiently engage universities and their inventors in the task of considering how best to transfer knowledge generated by public funds to industry and to society. A compliance-based approach would represent a lack of the philosophical questioning and iteration necessary for constructing a 21st-century knowledge and innovation ecosystem in South Africa.

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