Technology Transfer In South Africa

By Madelein Kleyn and SJ de Wet

Background

TRIPS sets down the minimum standards for the regulation by national governments of the many forms of intellectual property (IP). The concept of technology transfer (TT) is one of the objectives of TRIPS.[1] South Africa, as a member of TRIPS, have incorporated the objective of technology transfer into its national laws.

In the South African institutional context, TT from publicly funded research organisations, such as universities, is framed by the Intellectual Property Rights from Publicly Financed Research and Development Act 51 of 2008 (The IPR Act).

The stated objective of the IPR Act is that, "IP emanating from publicly financed research and development is identified, protected, utilised and commercialised for the benefit of the people of the Republic, whether it be for social, economic, military or other benefit."

The objective of the IPR Act resonates with South Africa's stated policy intent to improve the regulatory environment for the identification and utilisation of IP, to improve the translation of research results for economic gain, and to improve the living standards of citizens—in line with the 1996 White Paper on Science and Technology, 2002 National Research and Development Strategy and 2007-2010 Year Innovation Plan, and the long-awaited National IP Policy approved in August 2018.

Regulatory aspects of Technology Transfer in South Africa

The National Intellectual Property Management Office (NIPMO) was established in terms of Section 8 of the IPR Act as a Specialised Service Delivery Unit (SSDU)[2] of the Department of Science and Technology (the DST).

The IPR Act obligates recipients of public funds to assess, record and report on the benefits of their work to society and to ensure that IP emanating from publicly funded research becomes available to South African citizens, or improves their quality of life, directly or indirectly.

Schedule 1 requires Higher Education Institutions (HEIs) and Science Councils (SCs) to establish and maintain a Technology Transfer Function (TTF). This TTF can be in the form of a Technology Transfer Office (TTO), designated persons to undertake the TTF, or participating in a regional TTO with these functions including the receipt, analysis and subsequent statutory protection of any identified and commercialisation of these IP Rights.

There is no "special status" for IP coming from the universities *per se*. However, since the government provides funding and contributes to the enablement of the research, there are strict protocols in place in regard to reporting of disclosures and ownership to NIPMO. This also applies to cases when IP is abandoned. Requisite approvals from NIPMO are required before cases can be abandoned. The NIPMO regulations applied to IP generated from publicly funded research does pose a problem in regard to obtaining private sector funding and/or involvement. The private sector is wary of government involvement, particularly in regard to ownership, co-ownership and meddling with commercial matters when exploiting said IP.

Contribution of Universities and TT to Innovation Production

Publicly funded research in South Africa is performed at 23 HEIs as well as 10 SCs. Commercialising the output of this publicly funded research, in ways to benefit the country, is seen as a priority, not only by government, but various other stakeholders.

The TTF in South African HEIs and SCs is still relatively new. NIPMO statistics[3] show that, since August 2010 of the 1,057 invention disclosures made, 7 percent were commercialised, which resulted in revenue to universities of just over ZAR 4 million. See Table 1.

The DST, the Southern African Research and Innovation Management Association (SARIMA), NIPMO and the Centre for Science, Technology and Innovation Indicators (CeSTII) in 2017 published the results of a survey (the South African IP and TT Baseline Survey Report or SAIPTT Report for short)[5] conducted for the period 2008 to 2014 which was aimed at establishing a number of baseline indicators that are required to track overall activity in IP management TT.

Twenty-four institutions (comprising HEI and SCs) participated in the survey, 23 of which indicated they had a dedicated TTF. TTOs are generally staffed with highly skilled personnel that make an enormous effort to commercialise the institutions' IP.

According to the survey (as depicted in the table below), most institutions are actively performing portfolio creation and management functions, but enforcement functions are on the lower scale—possibly linked to maturity scale of the IP portfolio.

Findings from the survey concluded that the management of technologies, patent families, trade mark families, registered design families and new patent applications filed increased more

Table1. Publicly Funded Research In South Africa

Pipeline of Publicly Financed IP Disclosures:1057	Active Disclosures: 932 (88%)	Disclosures to Granted IP Right: 190 (18%)	Disclosures Commercialised: 74 (7%)
Exclusive Licenses: 45	Licenses Granted to SMMEs/BBBEE[4] 35	Revenue Received by Institutions from Commercialised IP: > R4.4 million	
OTT Support Fund Funding to Date: R106 Million	Institutions Receiving Support:28 Institutions and 2 Regional Offices	Highly Specialised TT Posts Created: 85 Posts (+19)	
IP Fund funding to date: R83 million		Institutions receiving support:24	

1. Article 7 of TRIPS stipulates: "The protection and enforcement of intellectual property rights should contribute to the promotion of technological innovation and to the transfer and dissemination of technology, to the mutual advantage of producers and users of technological knowledge and in a manner conducive to social and economic welfare, and to a balance of rights and obligations."

2. With effect from 13 December 2013.

3. https://www.dst.gov.za/index.php/nipmo2/about-nipmo.

4. Broad-Based Black Economic Empowerment (BBBEE) is a form of economic empowerment initiated by the South African government in response to criticism against narrow-based empowerment instituted in the country during 2003/2004.

5. *http://www.sarima.co.za/wp-content/uploads/2017/05/SA-IPTT_BASELINE-SURVEY-REPORT-2017.pdf.*

rapidly than the increase in research expenditure, which indicates acceleration of these activities relative to research expenditure. On average, 100 new technologies were added annually between 2011 and 2014 to the portfolio managed by respondent institutions. See Figure 1.

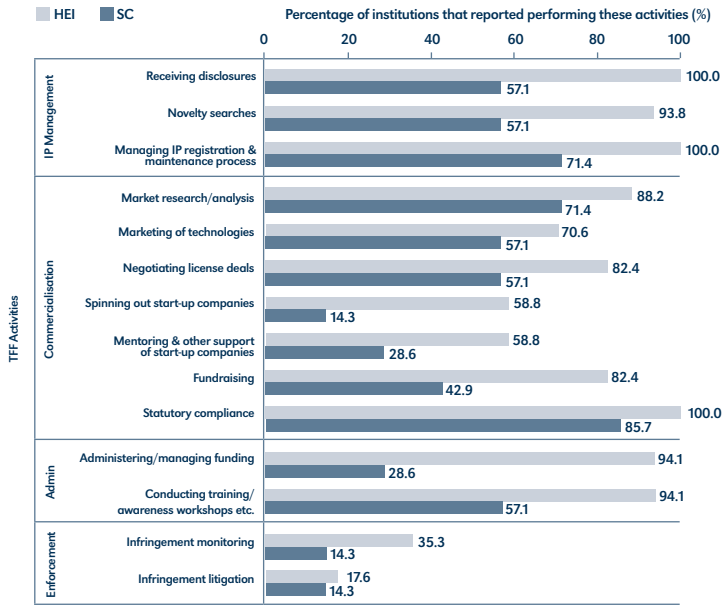
Over the last 10 years, most of the R&D[6] in South Africa has consistently been conducted in the engineering sciences, information, computer and communication technology sciences, medical and health and social sciences. The 2016-2017 results show that the majority of R&D activity is social sciences (21.0 percent), followed by medical and health science (19.2 percent), and then engineering sciences, at (12.9 percent). R&D expenditure on medical and health sciences is lower than those in the social science research field. The rapid growth in social sciences, starting in 2011/12, derived from activities taking place in the business sector, followed by the higher education sector. Since 2014-2015, R&D expenditure on engineering sciences, which for many years prior to 2011-2012 was the leading research field, has been declining.

South African research-intensive universities contribute to the innovation value chain, directly through the research endeavours from basic research, applied research and innovation, as well as indirectly through capacity building. Universities' role in creating a strong scientific workforce through capacity building, should not be under-estimated, as those graduates are the new generation of scientist, engineers, inventors, and entrepreneurs taken in by companies, or establishing start-up companies. Research from NWU[7] presented in a mini-thesis entitled "Identifying barriers to commercialisation of intellectual property at selected South African universities" expressed the view that the contribution of South African universities to innovation production is still limited. Bezuidenhout argues that while South Africa has made progress in efforts to transform into a knowledge economy, challenges remain in terms of its innovation capacity, with specific reference to commercialisation activity of IP at university level. Research have indicated that low commercialisation activity can be ascribed to commercialisation barriers experienced by universities. These barriers prevent university-based innovation from progressing into the marketplace for the benefit of the economy, universities, and society. A critical barrier to the commercialisation of IP emanating from universities, is finding business partners. In South Africa this is often very difficult largely due to a slow economy and businesses being very risk-averse. From the National key R&D statistics and Indicators report[8] it appears that fewer South African companies conduct their own R&D owing to uncertain political and business environment. Finding internationally based companies to take interest in the innovation output from South African universities is difficult largely due to the misconception that African universities are not on par with international counterparts.

■ Dr. Madelein Kleyn,
Innovus, Stellenbosch University,
Director, Technology Transfer, CEO, of Mad K IP Consulting (Pty) Ltd,
Stellenbosch, South Africa
E-mail: madelein.kleyn@outlook.com

■ SJ de Wet,
Innovus, Stellenbosch University,
Technology Transfer Manager,
Stellenbosch, South Africa
E-mail: sjdewet@sun.ac.za

Figure 1: Percentage Of Institutions That Reported Performing These Activities (%)



Seed/gap funding is a critical intervention to transition very early stage technologies to where the techno-economic prospects are better understood and the technical feasibilities proven. It is extremely difficult to build a business case for subsequent investment, either by an existing industry partner or an investor in a start-up company, without reaching this point of development of the technology.

The SAIPTT Report results show that, although data obtained during the survey was inadequate to allow for reporting on the absolute numbers, between 2012 and 2014 seed funding available to Higher Education Institutions (HEIs) has increased.

Various government initiatives aim to provide funding to enable this transition and fund innovation. For example, the Technology Innovation Agency (TIA)[9] provides seed funding to HEIs and SMEs. The grants are up to R650 000 per application for a technology development rating of Technology Readiness Level[10] (TRL) 3 to TRL 7. The TTOs manage the funds made available through a seed fund committee established at relevant TTO's. Seed funds are available for certain activities which are defined on the TIA website.

The DTI's Technology and Human Resource for Industry Programme (THRIP),[11] aims to increase

6. The National R&D Survey is published annually to update South Africa's R&D statistics. It measures the size, growth and composition of R&D expenditure and the HRs devoted to R&D *https://www.dst.gov.za/images/2018/SA-RD-SURVEY-STATISTICAL-REPORT-201617_WEB.pdf.*

7. *https://repository.nwu.ac.za/bitstream/handle/10394/30624/Bezuidenhout_FR_2018.pdf?sequence=1&isAllowed=y.*

8. SA R&D Survey Statistical Report 2016/17 *https://www.dst.gov.za/images/2018/SA-RD-SURVEY-STATISTICAL-REPORT-201617_WEB.pdf.*

9. *www.tia.org.za.*

10. *http://www.innovus.co.za/archived-news/where-does-your-invention-idea-fit-in-the-technology-readiness-levels-continuum-1.html.*

11. *https://www.nrf.ac.za/division/aric/instruments/technology-and-human-resources-industry-programme-thrip.*

collaborative efforts between industry and HEIs and SCs through university applied research, design, engineering and technology development projects by providing co-funding. THRIP aims to boost South African industry by supporting research and technology development which improves the competitiveness of industry and enhances the number of appropriately-skilled people.

Although there are barriers, the national key R&D statistics and Indicators (shown in Table A below[12]) illustrate the importance of university IP commercialised from R&D.

The HEI sector was the largest contributor to the overall increase in GERD of R827 million. The HEI sector contributed an amount of R790 million to the increase in R&D expenditure. See Table 2.

R&D expenditure in the business sector increased by only 0.2 percent, with the State Owned Enterprises (SOEs) contributing R365 million to this. The private sector showed a decreased R&D expenditure. The government sector decreased expenditure by 2.4 percent, whereas the science council sector showed only marginal growth. See Table 3.

There has been a quadrupling in the actual number of licences executed per year in the period. Of significance is that more than 88 percent of this revenue accrued consistently each year to the same four institutions that have well-established TTFs. The majority of IP transactions yielded less than R100 000 per year.

For the survey period of the SAIPTT Report, in total, 45 start-up companies were formed to commercialise the institutions' technology, 73 percent of which were based on publicly funded IP.

Relationship Between Industrial Companies and the Public Research Centers

The IPR Act does not apply to research conducted at a public research institution if fully funded (referred to as full cost) by an industry partner. In a full-cost scenario, IP ownership is negotiated between the company and institution. This is of significant importance as it has the direct effect that not ALL innovation and development emanating from a research institution would follow the normal technology transfer route via the TTO, and as such the success of innovation production by research institutions in South Africa is not a true reflection when assessing merely TTO's output *per se*.

Strong links and relationships between universities and industry are important to ensure the sustainability of research performed by South African universities. As conventional funding sources such as subsidies decrease, the importance of obtaining external funds for funding research (basic as well as applied) is ever increasing.

The industrial companies that are active in the SA research scene do have strong and enduring ties with selected faculties at selected SA universities. Most of these contacts have been built on historic ties with faculty, proven research expertise and/or competencies and flexibility with regards to IP management. Ultimately the longevity of the cooperation is of course a function of the value that it unlocks for both partners.

There are some more formalised university- industrial partnerships, some of which are incentivised through government funding. For example, the DTI's THRIP programme, discussed earlier in the article.

Another is the Research Chairs and Centres of Excellence (RCCE) programme managed by South Africa's National Research Foundation (NRF).[13] The NRF established RCCE to bring together two strategic investments of the South African government, namely, the South African Research Chairs Initiative (SARChI) and the Centres of Excellence (CoEs).

The CoEs are physical or virtual centres of research that concentrate existing research excellence and capacity and resources to enable researchers to collaborate across disciplines and institutions on long-term projects that are locally relevant and internationally competitive in order to enhance the pursuit of research excellence and capacity development. In some instances, the expertise of international stakeholders also form part of these CoEs. The programme was launched in 2004 with the establishment of seven CoEs which now stands at ten. The five key performance areas of the CoEs are: Research/knowledge production; Education and training; Information brokerage; Networking and Service rendering. Over the past decade the Advisory Boards for each of the CoEs have played an important steering and oversight role in ensuring the success of the CoEs. Industry partners find these CoEs' operations highly successful constructs that strengthens the various technical communities and offers a unique entry point for industry to the holistic consolidated expertise of SA universities.

Another example of a university and industry partnership is the Eskom Power Plant Engineering Institute (EPPEI),[14] which provides world-class training and research to drive efficiency in power plant engineering at eight University Specialisation Centres in six leading South African universities. Academics team up with industry specialists to teach, mentor and guide power industry students. Special focus is on the research and training in new technologies that will reduce polluting industry emissions and so lessen the carbon footprint in the production of South Africa's energy.

South African Success Stories

Innovus,[15] Stellenbosch University's (SU) IP TTO, established the LaunchLab business incubator to ensure not only that its group of spin-out companies enjoys the best

Table 2. R&D Expenditure By Sector (2007-2008 to 2016-2017)

YEAR	GERD	GOVERNMENT	SCIENCE COUNCILS	HIGHER EDUCATION	BUSINESS	NOT-FOR-PROFIT
	R'000	R'000	R'000	R'000	R'000	R'000
2001/08	18 624 013	1 154 399	2 886 094	3 621 862	10 738 456	223 202
2098/09	21 041 046	1 139 676	3 137 343	4 191 366	12 332 012	240 649
2009/10	20 954 677	1 067 302	3 458 074	5 101 224	11 139 237	188 840
2010/1 I	20 253 805	1 011 340	3 596 023	5 424 602	10 059 010	162 830
2011/12	22 209 192	1 235 669	3 729 680	6 609 216	10 464 022	170 605
2012/13	23 871 219	1 437 509	4 025 998	7 333 153	10 570 726	503 833
2013/14	25 660 573	1 697 151	4 304 556	7 292 853	11 782 848	583 165
2014/15	29 344 977	1 893 010	5 004 669	8 377 575	13 290 951	778 712
2015/16	32 336 679	2 013 021	5 740 897	9 876 623	13 814 995	891 142
2016/17	35 692 973	2 098 646	6 136 183	11 659 258	14 781 270	1 017 616

Note: Improved coverage of the NPO sector in 2012-13 resulted in a R281 509 000 increase in expenditure, contributing 1.2% of GERD. In 2015-16, coverage was again improved, which resulted in a Rl85 302 000 increase in expenditure, contributing 0.6% of GERD.

12. SA R&D Survey Statistical Report 2016/17 can be viewed here *https://www.dst.gov.za/images/2018/SA-RD-SURVEY-STATISTICAL-REPORT-201617_WEB.pdf.*

13. *https://www.nrf.ac.za/.*

14. *http://www.eppei.co.za/.*

15. *http://www.innovus.co.za/spin-out-companies.html.*

early-stage development, but also to support its students' ventures and to bring entrepreneurs from outside the university to the SU campus. On 1 August 2013, when the LaunchLab was opened, the Innovus group of spin-out companies consisted of 10 companies. Only three of these companies were purely technology based, all in start-up stage, and three more companies offered technology-related services. In 2018, the group of companies has grown to 25. In 2014 the institution made history by becoming the first African university to file a patent for blockchain technology, which is now successfully commercialised through the spin-out company Custos. Custos, working closely with Innovus and NIPMO, also recently became perhaps the first company, to spin IP out of a publicly funded university in South Africa, when it announced earlier this year that it had spun-out its IP from Stellenbosch University into the company, demonstrating that it is possible under the IPR Act.[16]

Table 3: Key Indicators

Key Indicator	2014/15	2015/16	2016/17
Expenditure on R&D			
Gross domestic expenditure on R&D (GERD) (Rm)	25 661	29 345	32 337
Business enterprise expenditure on R&D (BERD) (Rm)	*11 783*	*13 291*	*13 815*
Not-for-profit (NPO) expenditure on R&D (Rm)	*583*	*779*	*891*
Government expenditure on R&D (GOVERD) (Rm)	*1 697*	*1 893*	*2 013*
Science council (SCI) expenditure on R&D (Rm)	*4 305*	*5 005*	*5 741*
Higher Education (HE) expenditure on R&D (HERD) (Rm)	*7 293*	*8 378*	*9 877*
Gross domestic expenditure on R&D in constant prices (Rm)	21 554	23 304	24 458
Funding Sources			
Government-funded* R&D (Rm)	11 007	12 873	14 426
Business-funded R&D (Rm)	10 616	11 982	12 578
Foreign funding of R&D (Rm)	3 315	3 566	4 210
Foreign funding of BERD (Rm)	*1 227*	*1 419*	*1 533*
Foreign funding of NPO R&D (Rm)	*333*	*457*	*501*
Foreign funding of GOVERD (Rm)	*259*	*179*	*500*
Foreign funding of SCI R&D (Rm)	*455*	*431*	*470*
Foreign funding of HERD (Rm)	*1 043*	*1 080*	*1 206*
R&D Personnel			
Total R&D personnel (FTE**)	37 956.5	38 465.0	41 054.5
Total researchers# (FTE**)	23 346.0	23 571.9	26 159.4
Total researchers# (headcount)	45 935	48 479	51 877
Female researchers# (headcounts)	20 231	21 471	23 334
Indicators computed from R&D survey			
GERD as a percentage of GDP (%)	0.72	0.77	0.80
Civil GERD as a percentage of GDP (%)	0.69	0.72	0.75
Basic research (R millions)	6 102	7 133	8 210
Total R&D personnel (FTE**) per 1 000 in total employment	2.5	2.5	2.6
Total researchers# (FTE**) per 1 000 in total employment	1.6	1.5	1.7
Female researchers# headcounts as a percentage of total researchers headcounts (%)	44.0	44.3	44.4
Indicators obtained from external data sources			
Gross domestic product (GDP)†† level at current prices (Rm)	3 539 792	3 807 677	4 049 760
GDP†† (%)	2.5	1.7	1.3
SA employment ('000)	15 055	15 459	15 663

***Government-funded R&D includes science council funding and university own funds.**
****FTE: Full-time equivalent.**
#Includes doctored students and post-doctoral fellows. Also includes emeritus professors, research fellows and honorary research fellows (2016/17 only). These categories do not incur salary, but these are time and costs (included in "Other current costs") associated with them.
Note: Headcounts include non-SA R&D personnel in 2016/17. Non-South African personnel are classified as those that are not from South Africa but undertaking research for a period exceeding six months.

A number of products based on University of Cape Town (UCT) IP have been successfully commercialised and in certain instances spin-off companies created to commercialise the IP.[17]

Wits Commercial Enterprise (Pty) Ltd.[18] is 100 percent owned by the University of the Witwatersrand, Johannesburg and is mandated to market and commercialise the University's intellectual capital through short-course management, contract research and consulting, intellectual property management and technology transfer.

To consolidate technology opportunities generated by a selection of research-intensive South African universities, a common dedicated venture capital (VC) fund is proposed between some of the leading universities in South Africa. The University Technology Fund (UTF) presents a compelling investment case as it has the preferential rights to evaluate commercial investment opportunities emanating from these universities.

The UTF will enable universities to have funding to commercialise its research and development outputs, be able to develop and commercialise their patented research on an ongoing basis, assist graduate entrepreneurs to successfully develop their innovations to the commercial phase, encourage cross-collaboration between universities, attract students and academics, support job creation for the universities' graduates and contribute to the knowledge economy. Ultimately, the UTF will anchor universities as drivers of the knowledge industry and create national wealth and jobs in accordance with international developments in the higher education sector.

Participating universities for this proposed fund, presently, are U.S., UCT, Wits, University of the Western Cape, University of Johannesburg, Nelson Mandela Metropolitan University and Cape Peninsula University of Technology. ■

Available at Social Science Research Network (SSRN): *https://ssrn.com/abstract=3380598*

16. *http://ventureburn.com/2018/11/custos-spin-out-ip-university/.*

17. *http://www.rci.uct.ac.za/rcips/innovation_achievements/spinout_companies.*

18. *https://wits-enterprise.co.za/.*