THE ECONOMICS OF INTELLECTUAL PROPERTY IN SOUTH AFRICA

World Intellectual Property Organization

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The present publication is the result of a WIPO project on "The Economics of Intellectual Property in South Africa" coordinated by Prof. David Kaplan, under the auspices of the Policy Research in International Services and Manufacturing (PRISM) at the University of Cape Town. Professor Kaplan was responsible for securing authors for the chapters, providing guidance, writing the first chapter that provides an overall framework for this book and organizing the workshop on the Economics of Intellectual Property that gave rise to this book.

The project was coordinated within WIPO by Esteban Burrone and Pushpendra Rai, who supervised the publication, commented on individual papers and wrote the Introduction.

TABLE OF CONTENTS

INTRODUCTION

This publication is the first in a series that aims to promote the development of empirical research on the economics of intellectual property and strive toward more evidence-based policy-making in this field. Its origins can be traced back to the National Roundtable on the Economics of Intellectual Property that took place in Cape Town on May 3 and 4, 2007. The Roundtable was an opportunity for a group of South African economists to discuss areas of possible empirical research in the field of intellectual property with a view to identifying promising research avenues. In addition to the national economists, two renowned international economists and a number of representatives from South African governmental institutions were present at the Roundtable and participated in the discussions on different methodological approaches for undertaking such research in South Africa.

Following the Roundtable, participants and other interested researchers were invited to submit research proposals to the World Intellectual Property Organization (WIPO). All research proposals were peer-reviewed and a number were selected for WIPO funding and inclusion in this publication, which therefore brings together a series of empirical papers developed in the course of the project. It represents a first attempt at exploring a set of specific economic questions on intellectual property within the context of the South African innovation system.

The focus of the papers is quite varied. While some focus on a specific sector (e.g. natural products) or a single product (*Rooibos*), one paper devotes attention to public sector research institutions and another focuses on a single company, albeit South Africa's largest R&D spender (i.e. Sasol). While some rely on interviews, others use patent and trademark databases or published economic data as the points of departure for further analysis. In terms of intellectual property rights (IPRs), the papers devote their attention to patents, trademarks and geographical indications (GI). Issues relating to the protection of traditional knowledge are present in at least two papers and the importance of trade secrets and disclosure through publication is central to the case study on Sasol.

The papers are not meant to provide a comprehensive understanding of the economics of intellectual property in South Africa, but rather an initial exploration of a number of issues which could be the subject of further research. One of the objectives of this publication is to motivate researchers in South Africa and in other developing countries and countries with economies in transition to study the economics of intellectual property empirically. At various stages the researchers have identified areas that could be studied further so that a clearer picture can emerge. The conclusions from each paper are not and cannot be definitive, but provide, it is hoped, valid observations that emerge from the empirical research undertaken by the authors.

Due to the interdisciplinary nature of the subject matter, the publication, while remaining primarily focused on economics, has also ventured into a number of other fields,

including law, business and natural sciences, which explains the interdisciplinary background of the researchers involved in this endeavor. It is felt that in many areas of intellectual property it is crucial that economic research rely on expertise from other disciplines to ensure that the analysis takes into consideration the full range of issues that may be relevant to any specific research question.

Main Findings

In **Chapter 1**, David Kaplan provides an overview of the recent performance of South Africa's innovation system and the role of the IP system, in order to place the subsequent empirical papers in context. Dr. Kaplan indicates that South Africa's innovation system is at a critical juncture and it is important to understand what role IPRs have played and can play in the current context. The author points out that the performance of the national innovation system has generally not been as strong as might be desired, in terms of innovation outputs (such as publications, patents, high-technology exports and royalty income) when compared with the increases in resources committed. While it is possible that a time-lag may occur until policy changes begin to have an effect on outputs, the author expresses some concern. In particular, he highlights some of the constraints being faced by South Africa, such as limitations in the number of skilled R&D professionals.

With respect to the IP system, Dr. Kaplan's paper expresses concern for the limited economic research currently available on South Africa's IP system, a situation that is not different from that in most developing countries. This makes it difficult to draw strong conclusions on its role and impact in economic development. Nevertheless, some basic information does exist that makes it possible to draw some preliminary conclusions. With regard to the use of the patent system, the number of applications both in South Africa and abroad has been stagnant while the share of South African applicants in total patent applications has been declining. Compared with other countries, South Africa's innovation surveys indicate that the percentage of companies that have been granted a patent is fairly low, the use of patent databases as a source of technological information is very limited, and the use of the patent system by public research organizations (with some exceptions) has also been low. While hardly any studies have examined the possible impact of the IP system on, for example (a) innovation by domestic companies; (b) foreign direct investment (FDI) in South Africa; and (c) the country's participation in technology markets, the author indicates that these all represent fertile areas of research. For example, he highlights the recent establishment of a number of specialist technology suppliers, particularly in the field of engineering. The precise factors underpinning their growth (and the possible role played by the IP system) require investigation.

The author also points out some of the debates taking place in the policy arena with respect to intellectual property, including, for example, whether South Africa should transit from a patent registration system to one with substantive examination of patent applications; how to enhance the disclosure function of patents via the effective diffu-

sion of technological information contained in patent documents; how to properly balance the incentives for innovation with other public interest objectives such as public health; and issues relating to indigenous knowledge and genetic resources. In general, the author highlights the importance of economic research being enhanced so that future policy initiatives in South Africa rest on firm empirical foundations.

In **Chapter 2**, Rachel Wynberg, Judith Silveston and Cyril Lombard provide an interesting study on the role of patents in value addition in the South African natural products sector. The sector under consideration is one that has attracted much attention from policy-makers and academics in the context of discussions on the protection of genetic resources and associated traditional knowledge. It is a sector, however, on which there has been very limited systematic economic research, particularly with respect to its interface with the IP system. Anecdotal evidence of the existence of patents relating to the natural products themselves and to the processes required for their extraction and development have created much concern among various stakeholders in the field.

Focusing on three specific products, namely, devil's claw, *Hoodia* and *Rooibos*, the chapter seeks to understand whether patents have helped or hindered the development of the natural products industry and whether the low levels of value adding in Southern Africa can be attributed to patents and/or to other factors. The paper provides an analysis of the value chains for each of the products and examines the patent landscape in order to understand the extent to which the former has determined the latter and whether there are business opportunities that have remained unexploited.

While the paper identifies the existence of certain patents that could restrict the capacity of local producers to use certain technologies (e.g. extraction techniques for devil's claw and for *Hoodia*), substitute technologies that are not patented in South Africa are generally available but are not being used by the local industry. The difficulties that Southern African firms in the natural products' sector are facing in moving up the value chain and capturing greater value added seem to stem primarily from a number of other factors ranging from restricted market access, buyer dominance, a lack of strategic alignment amongst producers and insufficient technical and financial capacity to meet quality control standards, which would deserve further investigation.

The paper also points to the importance that patents have played in some instances (particularly in the case of *Hoodia*) in the development of the industry and in stimulating research and industrial activity. It identifies a number of business opportunities available to local firms due to the limited territorial coverage or scope of many of the existing patents. According to the authors, very low awareness and understanding of the IP system is often a problem, as the very existence of patent documents in a given area tends to put off investors and enterprises even if their territorial coverage, scope or status should not constrain their use by South African firms. Moreover, the authors conclude that little attention has been paid so far to the possibility of licensing-in technology as a strategy to start upgrading local technological capacity in this sector. Finally, the paper stresses the important role of prior traditional knowledge in the cases examined, with-

out which there probably would have been no industry at all. This aspect, which has often been overlooked in the past, has increasingly received recognition, including through the establishment of benefit-sharing agreements and attempts to enhance interaction between traditional knowledge holders and the local industry.

The case of the *Rooibos* sector is also the focus of **Chapter 3**, albeit from a different perspective. Cerkia Bramley, Estelle Biénabe and Johann Kirsten track the evolution of the IP strategies used by firms in that sector in response to changing consumer demands, threats of misappropriation and risk of loss of reputation. The focus is on the shift from individual to collective quality signaling strategies, which is at the core of recent moves by the *Rooibos* industry to apply for the protection of *Rooibos* as a geographical indication. The paper provides insights into the marketing strategies of the various actors in the industry at various levels of the value chain and explores the ways in which different companies have been seeking protection for the name "*Rooibos*".

According to the authors, the dispute that took place following the registration of *Rooibos* as a trademark in the US market in 1994, which ended in 2005, is what initially led to increasing awareness in the industry of the possible threats of misappropriation, particularly in key export markets. In addition, the risk of quality degradation as new actors enter an industry lacking quality control standards, and the possible loss of reputation for traditional *Rooibos* producers has set the scene for increasing collective action by *Rooibos* producers and exploration of ways to maintain the collective reputation. The authors indicate that the rationale for aspiring to GI protection in the case of *Rooibos* is anchored on the need for regulating product reputation rather than on a territorial quality strategy and focuses essentially on reserving the name "*Rooibos*" for the domestic industry, thus defining a minimum quality standard. While some territorial development strategies do exist associated with *Rooibos*, they have so far not been linked to the GI initiative. The emphasis is primarily on export markets, where the threat of misappropriation and the lowering of quality standards has been observed, which, in turn requires analysis of the different legal instruments available in the principal markets of concern to the producers. In addition, the key actors seem to be concerned exclusively with the mainstream herbal tea market and much less on the use of *Rooibos* in other sectors such as the cosmetic industry.

While the *Rooibos* producers consider the most suitable legal mechanisms for its protection in South Africa and various export markets, it is considered a pilot case for South Africa, which could set an important precedent for other South African products that may also consider using collective labeling strategies. Practical case studies from developing country industries such as this one provide interesting insights on the evolution and development of different IP strategies to address specific market developments. In the case of *Rooibos* the search for a collective labeling strategy and a suitable IP strategy has gone hand in hand with greater interaction and coordination among various actors in the supply chain in order to address the challenges they face.

The evolution in IP strategy is also the focus of **Chapter 4** by Helena Barnard and Tracy Bromfield. The context, however, is quite different as the chapter provides an analysis of the way IP management functions have developed at Sasol, South Africa's largest firm and the highest R&D spender, from its establishment in 1950 to 2005, by which time it was firmly established as a multinational corporation (MNC) with research facilities in a number of locations worldwide. As the authors explain, having a coherent IP strategy is one of the characteristics of MNCs, especially in chemical and related industries. Apart from the direct financial benefits that firms can realize through, for example, the licensing of patents, patents and scientific publications also act as signals of technical competence and legitimacy in the field. For developing country MNCs – coming from economically less successful regions – such "currency" is especially important to gain access to the relevant international knowledge networks.

In the case of Sasol, the authors show how the development of an IP strategy has lagged behind the development of the firm's scientific and technological capacity. While in its early days Sasol relied on the use of foreign technology and later relied on secrecy as its main strategy for appropriating the results of its own research, the company gradually started experimenting with the patent system in a subsequent phase. The paper shows a clear evolution toward a more coherent patenting strategy combined with an active use of publications, to enhance the international technological credibility of the company. This appeared to be particularly important during the years in which the country was under economic sanctions. The study also highlights the way Sasol benefited from interactions with foreign partners in the development of its technological base, while the same did not seem to occur until much later with its IP strategy, which developed through internal trial and error. One reason for this may be that stronger IP management capacity at Sasol did not particularly serve the purposes of its foreign partners. Indeed, the alignment of motives that seemed to have spurred the mutually beneficial interactions between Sasol and its foreign partners around technological and scientific capability creation did not seem to spill over to developing competence in IP management until a proper joint venture was established in which both partners could clearly benefit from Sasol upgrading and fine-tuning its IP management capacity. The paper also points out the complementary roles of patenting and publishing in scientific journals and the dilemmas faced by companies when deciding whether to patent or keep a new technology secret.

The paper is perhaps one of the first thorough case studies of IP management within a developing country firm, and provides interesting lessons for other large companies with significant R&D capacity that are taking a similar road. It provides an interesting analysis of learning processes and makes a clear distinction between processes leading to the development of intellectual property and learning processes relating to the management of intellectual property, each requiring a different set of skills.

In **Chapter 5**, McLean Sibanda presents an analysis of patenting and technology transfer activity at South African publicly funded research institutions. The institutions form the largest concentration of skills and personnel in the area of science and technology

in South Africa and, therefore, a strong potential for the development of patentable inventions. In 2002, the South African Research and Development Strategy identified disparate practices in respect of ownership, management and commercialization of intellectual property emanating from publicly financed research at these institutions (DST, 2002) and highlighted the need for harmonization of IP practices and upgrading IP management practices in such institutions. The paper sets out to analyze the evolution in the way IP management evolved in the period from 2001 to 2007.

Although South African publicly financed institutions are generally characterized by low (and stagnant) patenting activity coupled with low conversion of these patents to licenses and/or products, the author notes that a majority of the main higher-education institutions and at least two of the science councils have made significant progress toward laying a sound foundation for IP management and technology transfer. The author indicates that patenting from South African institutions has concentrated primarily on areas of technology linked to biomedical/biotechnology and ICT. Moreover, patent citation analysis provides evidence of a number of patents having received several citations, some of which have been licensed to commercial partners, indicating their relevance and importance within the sectors concerned.

With respect to the commercialization of patents, the institutions have had variable success and only a few have been able to earn revenues from the licensing of patented inventions. While revenue generation may only be a secondary objective for patenting and licensing, the limited revenues received are an indication of the difficulties faced by the institutions in licensing patented technologies to industry. This may raise concerns, given the high costs often incurred in patenting, particularly in foreign markets. The authors also found evidence that spin-off formation was not a significant activity or preferred mode of commercialization of IP by most of the institutions, which generally preferred licensing to established firms.

Finally, the author concludes that institutional arrangements for managing and commercializing intellectual property seem to be at an early stage in South Africa, with a shortage of skilled professionals posing a challenge to the protection and commercialization of research results. According to the author, the lack of harmonized IP policies with clear benefit-sharing arrangements for inventors may have contributed to the low rate of patenting by the institutions. The author notes, however, that various initiatives by the South African government (including legislative proposals) have been developed to support IP management and commercialization and may be important in ensuring that South African publicly funded research institutions are able to upgrade their IP management capacity and better meet the challenges of the knowledge economy.

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We are also very grateful to all the other researchers who devoted time and effort to this pioneering endeavor, undertaking original research and analyzing the data collected in order to provide new insights on the economics of intellectual property in South Africa. Our gratitude also goes to Professor Ashish Arora, Professor at the Carnegie-Mellon University, Pittsburgh, US, and Professor Luigi Orsenigo, Professor at Bocconi University, Milan, Italy, for their participation in the Roundtable and for their useful insights and suggestions to the national researchers. We also thank the external referees who provided valuable comments to the researchers at various stages of the process in order to enhance the quality of the papers and ensure high standards. Last but not least, our gratitude is extended to the Government of South Africa for supporting this endeavour, participating actively in the workshop that launched this project and assisting the researchers at various stages of their work.

It is hoped that the publication will be useful to further inform debates on intellectual property and economic development both in South Africa as well as internationally. It is also hoped that it will contribute to generating interest among researchers in South Africa and beyond on the impact of intellectual property on economic development and will encourage them to undertake much-needed empirical work in this area.

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CHAPTER 1
INTELLECTUAL PROPERTY RIGHTS AND INNOVATION IN SOUTH AFRICA: A FRAMEWORK

DAVID KAPLAN*

1. INTRODUCTION

There is an elaborate and long-established system of IPRs in South Africa dating back to 1916, when comprehensive national legislation was passed, much earlier than most industrializing countries. However, despite this long history, while particular aspects of the IP regime in South Africa have received attention, there are virtually no studies or assessments that characterize and assess the overall IP regime.[1] An even wider gap is the absence of any study of the broader impact of the IP regime on innovation and economic performance. While innovation in South African firms and publicly funded research organizations (PROs) has received some, albeit limited attention, only a very few of these studies pay any attention to the impact of the IPR regime, and then only peripherally.[2]

This publication represents the first attempt to assess innovation in South Africa and in particular how it is impacted on and affected by the IP regime. Through a series of studies, this publication attempts to shed some light on these issues and to suggest further areas for research.

Studies of this kind should always be situated within a broader framework. Four issues are of particular relevance here. The first is the broad characterization of the overall IP regime and its likely impact on innovation and diffusion. The second is South Africa's innovation performance overall and its determinants and constraints. The third is the relationship of South Africa's innovation performance to the prevailing IP regime. The fourth is the policy context – government perspective on innovation and the proposed policy changes specifically in regard to intellectual property.

It is the broader context and these specific issues that are addressed in this chapter.

2. SOUTH AFRICA'S INTELLECTUAL PROPERTY REGIME

South Africa's IP system is, in many respects, very advanced. Legislative provision is particularly strong. There is an elaborate array of legislation, which has its origins in the Patents, Designs, Trade Marks and Copyright Act No. 9 of 1916. This was compendium legislation dealing with each of the major categories of intellectual property. Subsequently, separate statutes were enacted for each category. The South African Patents Act was initially closely based on British law and, much more recently, the European Patent

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The views expressed in this paper are those of the author and do not necessarily represent those of WIPO.

Convention. Accordingly, when South Africa joined the World Trade Organization (WTO) and thereby adhered to the Agreement on Trade-Related Aspects of Intellectual Property Rights (TRIPS Agreement), only minor changes were required in the legislation (Wolson, 2005:43). The scope of patent legislation is wide. Section 25 of the South African Patent Act 57 of 1978 specifies that: "A patent may…be granted for any new invention which involves an inventive step and which is capable of being used or applied in trade or industry or agriculture". (SA Chapter 5. Section 25 (1):18).[3] The courts function effectively and strongly to enforce the rights of patent holders. South Africa is a member of most of the international treaties on IP law. In terms of international patent protection, South Africa is a member of the Paris Convention for the Protection of Industrial Property, the Patent Cooperation Treaty (PCT), the Budapest Treaty on the International Recognition of the Deposit of Microorganisms for the Purposes of Patent Procedure and the TRIPS Agreement. In terms of copyright and related rights, South Africa was a signatory to the Berne Convention for the Protection of Literary and Artistic Works in 1928 and to the WIPO Copyright Treaty (WCT) and the WIPO Performances and Phonograms Treaty (WPPT) in December, 1997.

South Africa's patent regime is ranked highly among developing countries in terms of strength. Lesser (2001) constructed an IPR score for a number of countries based on three criteria: TRIPS and compliance with the International Union for the Protection of New Varieties of Plants (UPOV); PCT applications and prices and a corruption index, with the strongest weighting to the first criterion (Lesser, 2001:11). Out of a total of 44 developing and industrializing countries, for the year 1998, South Africa scored highest (Lesser, 2001:12). In 2005, South Africa scored 4.25 on the Ginarte Park index – higher than many countries at comparable stages of development (e.g. Brazil and Chile) and comparable with a number of industrialized countries (Park, 2008:762-763).[4] A recent report that utilized the Ginarte Park index on the strength of patent protection, but in addition also assessed the extent of copyright and trademark protection to construct an overall IP score, gave South Africa seven out of a possible 10 – 22nd highest out of 115 countries (Property Rights Alliance, 2008:26).[5]

The Companies and Intellectual Property Registration Office (CIPRO) administers South Africa's IPR regime. CIPRO was formed in 2002 by a merger of two former directorates of the Department of Trade and Industry (DTI), the South African Companies Registration Office and the South African Patents and Trade Marks Office. CIPRO is the registrar of patents, designs and trademarks and custodian of the registers of existing rights.

In respect of patents, individuals are able to file provisional patent applications, but full applications can only be undertaken by a patent attorney. The fees charged are – 60 rand (US$8) for a provisional patent application; 590 rand (US$79) for a full patent application and annual renewal fees of 130 rand (US$17). The registration of a trademark is 590 rand (US$79) and a new copyright application in respect of films and videos made for commercial use is 510 rand (US$68) (CIPRO, 2008).[6] This scale of fees is very low by international standards.

However, CIPRO is a non-examining registration office. The substantive novelty and the inventive merit of the application are not subjected to verification. Apart from registration, CIPRO offers simple searches. WIPO's International Patent Classification System (IPC) is followed only to a limited extent – to the level of subclasses, but not to the level of groups and sub-groups (Teljeur, 2003:52). Hardcopy registers are available for scrutiny but there is, as yet, no complete electronic system available at CIPRO. There are proprietary systems such as the Electronics Patent Journal (EPJ). Searches can therefore be performed on a contract basis, but only at considerable cost. It is not possible to get an accurate picture of the current backlog, but it is substantial. As an indication, local patent attorneys report that while registering a provisional patent is quick and effective, there are substantial delays in other areas. For example, obtaining a file to undertake a patent search may take up to a year and trademark registrations currently take two to three years (telephonic interviews. February 15, 2008). Since CIPRO does not currently have a fully electronic database, hardcopy searches add substantially to the time required.

Thus, while South African innovators have cheap and easy access to local registration, there are also some considerable drawbacks. What are the implications for local innovators? The absence of search and examination before a patent is granted results in the absence of any guarantee that the patent is valid. Possession of a patent granted in South Africa, will be of no substantive value to any South African innovator wishing to commercialize a product abroad. Similarly, local innovators who wish to commercialize a product or a process in South Africa, and who are at risk of infringing another innovator's patent, do not have a secure patent right. Patents are only confirmed, in effect, after being granted, generally by the courts and by patent holders who, on challenge, have to prove the validity of the patent. The South African legal system is expensive and this imposes a considerable obstacle, particularly for smaller and less capitalized firms.

The absence of a local patent examination system, and the subsequent ease of securing a patent, is also said to result in companies filing a large number of patents locally. This could serve to discourage innovators.[7] In addition, the absence of an examination system may well result in the granting of patents with a very broad scope. Again, this is likely to discourage new innovators. High costs of search, consequent on the non-existence of a freely available searchable electronic database, combined with long delays, create further disincentives to innovation. Finally, the absence of an examination procedure, combined with the difficulty of searching patent databases, results in local innovators having little incentive to search the patent register. The public good character of local patenting, via the diffusion of technological information contained in patent documents and its potential impact on access to new knowledge, is accordingly limited. Thus the diffusion of new knowledge to local innovators is significantly impeded.

However, despite these considerable disadvantages to local innovators, it is not at all clear that CIPRO should function as an examination office. Legal certainty requires that the search and examination undertaken is of a high quality. This is an expensive process entailing large numbers of qualified examiners as well as access to sophisticated technological information in specialized fields. South Africa is a severely skill-constrained so-

ciety.[8] In addition, it has many competing and urgent demands combined with very limited government resources.

There are a number of alternative potential solutions to this problem (for a listing of the potential possibilities, see WIPO, 2008:54-55). For example, it may be possible to contract some other country's IP office to conduct the examination. It may also be possible to engage the services of the local universities and science councils in conducting search processes – but they too are severely skill-constrained. These and other potential solutions need further examination. The issue concerning search and examination is how to maximize the quality of the patents granted with the limited resources allocated to the patent office. One possible answer is to engage in more international cooperation – intergovernmental regional cooperation has reduced administrative burdens and improved cost-effective operations as well as fostering trade and investment within the region (WIPO, 2008:55).

There is considerable debate as to the impact of IPRs on foreign investment (Maskus, 2000). While stronger IPRs are likely to have a positive impact on foreign investment, it is evident that they are not the sole or possibly even a major determinant of FDI. Certainly, South Africa has attracted far less FDI than other countries whose IPR system appears to offer potential foreign investors weaker protection.

There are no studies, as yet, of the impact of the current IPR system on FDI inflows or on technology transfer to South Africa – a fertile area for further research. South African lawyers report that the larger and more innovative transnational corporations for whom they act are filing ever more patents locally and that they regard South Africa as a country with fair levels of protection (telephonic interviews, February 18, 2007). It appears though that many of the global corporations engage routinely in patenting locally as a matter of course, and it is not clear if this has any impact upon their investment decisions. Some sectors and activities will be more sensitive to IP protection than others.[9] Accordingly, such studies would need to distinguish between different types of foreign investment.

With respect to trademarks, South Africa has offered strong protection, including for well-known global brands. Thus, to cite one example that has received considerable publicity, the courts upheld the McDonald's trademark against a local trading firm, even though McDonald's had not been trading in South Africa for several years. The Appellate Division overruled the decision of a lower court that had accepted the argument that the company had not proved that it was a well-known trademark in South Africa.[10] The Appellate Division ruling assuaged concerns that South Africa could not be relied upon to fulfill its obligations under Article 6bis of the Paris Convention by not protecting well-known international trademarks.

With respect to plant breeder's rights, South Africa joined UPOV in 1977. Local courts have functioned effectively to uphold plant breeder's rights.[11] While there is no direct evidence, this is likely to be a positive factor in encouraging foreign owners of plant varieties to supply propagating material to South Africa.

In respect of enforcement, South Africa has adhered to the practices required under international obligations. There is a Counterfeit Goods Act which lays down strong penalties for illegal activities. There also is a specialist police unit engaged in enforcing the Act. This unit works closely with business. However, in general, policing is not always effective in South Africa and, while there is no data, it would seem likely that policing in this area may be similarly limited in efficacy.

South Africa has made very little use of mechanisms to limit the rights of patent holders in the interests of broader public interest – compulsory licensing or parallel importation, for example. In 2001, 39 large pharmaceutical companies withdrew from a legal attempt to stop the government promulgating legislation that it had passed in 1997. The legislation aimed at lowering the cost of drugs including Section 15C on the importation of drugs. Following the withdrawal, the South African government gave assurances to the industry that it would only utilize Section 15C to import brand-name drugs, which are on the market in other countries at a lower price than in South Africa. The government also reiterated its commitment to honor international obligations, in particular the TRIPS Agreement.

Overall, therefore, the IP system in South Africa can be considered generally as favorable to foreign investors who are concerned with the protection of their intellectual property. But, to reiterate, FDI into South Africa has not been strong generally. Furthermore, there is no evidence of significant investment from foreign firms in areas where IP protection will be of particular concern – IT and pharmaceuticals, for example. This is certainly an area that merits much further research.

Likely future changes in South Africa's IP system are considered later (Section 4).

3. SOUTH AFRICA'S INNOVATION PERFORMANCE

3.1. Inputs

In 2004, South Africa's Gross Expenditure on R&D (GERD) was 0.87 per cent of GDP. This is comparable with many industrialized countries and significantly higher than many of the middle-income countries with the same level of GDP *per capita*.[12] While there are problems interpreting the data, GERD has been growing steadily. Between 1993 and 2004, it almost doubled, and the GERD/GDP ratio increased from 0.60 per cent to 0.87 per cent (DST, 2007b:9-11).

A significant feature is the share of GERD performed by business enterprises in South Africa – at 56.3 per cent in 2004, this is comparable with a number of industrialized countries and significantly higher than most comparable middle-income countries (OECD, 2007:5; 45). Business expenditures on R&D are heavily focused in four areas – engineering sciences (32 per cent), information, computer and communication (20 per cent), medical and health sciences (15 per cent) and applied sciences and technologies (13 per cent) (OECD, 2007:49).

In 2004/5, there were almost 30,000 full-time equivalent personnel engaged in R&D. At 2.7 researchers per 1,000 employees, this is low relative to industrialized countries, but also relative to a number of countries with a comparable GDP *per capita*. Although South Africa devotes comparatively large resources to R&D, this is not reflected in a greater number of researchers employed. The reason is that South African research workers command significantly higher salaries than in comparable countries. Moreover, while the number of full-time equivalent (FTE) researchers has increased, this has been slow – rising by only seven per cent in the period 1992-2004.

Growing commitment of resources has been accompanied by extensive policy experimentation. Grounded in the overall concept of the National System of Innovation (NSI), policy design has drawn extensively from international experience and thinking. It has included policies to improve governance of the innovation system; the more effective functioning of key performers of S&T, especially the science councils; new mechanisms for funding R&D and innovation; and the development of new organizational arrangements and programs to support R&D and to undertake R&D directly.

While there is clearly considerable room for improvement, extensive institutional reform and ongoing evaluation have enhanced efficiency of organizations as well as increased inter-organizational cooperation. In the main, the institutions undertaking financing and supporting innovation function effectively (Kaplan, 2008).

3.2. Outputs

More resources combined with an effective and improving institutional structure and innovative and directed policy changes might have been expected to yield significant results. However, the high-level output performance indicators for the S&T system are disappointing.

3.2.1 Publications

In terms of publications, there has been a slight increase in the number of South Africa's scientific publications (listed by the Institute for Scientific Information) since 1994. In relative terms, South Africa's global share has declined significantly from a peak of 0.7 per cent in 1987 to 0.48 per cent in 2003. In contrast, other comparable countries, such as Brazil, India, and the Republic of Korea, starting from a lower base, have overtaken South Africa as their share of world publications has climbed steadily (NACI, 2003:60; Pouris, 2003:425-6).

3.2.2 Patents

The situation with regard to South African patents registered abroad is broadly similar to publications. Since the end of apartheid and the election of a democratic government in 1994, there has been a slight increase in patents. However, no clear trend is evident. Indeed, the number of South African patents registered in the US has remained stagnant throughout the period 1994-2007.

Table 1. Patents of South African Origin Granted by the USPTO, 1994-2007

	'94	'95	'96	'97	'98	'99	'00	'01	'02	'03	'04	'05	'06	'07
Utility Patents	101	123	111	101	115	110	111	120	113	112	100	87	109	82
All Patents	109	127	116	114	132	127	125	137	123	131	115	108	127	116

Source: USPTO, 2006(a); USPTO, 2006(b).
Data for 2007 supplied by the USPTO, January 18, 2008.

South Africa's relative position in terms of patents has declined. Its share in all foreign patents registered in the USPTO has consistently declined from 0.28 per cent in 1992 to 0.13 per cent in 2007. For utility patents, South Africa's share declined from 0.3 per cent in 1992 to 0.11 per cent in 2007. A recent study of the patenting activity at the USPTO by the five most innovative South African universities concludes that their performance is well below that of other countries (Lubango and Pouris, 2007:7).

In terms of South African patent applications filed through the PCT, the trend is less well-defined. The PCT only became operative in South Africa in March 1999. Since that date, there has been no clear trend and considerable fluctuation. However, the figure was lower in 2007 than in 2001. Moreover, as with the USPTO, South Africa's share in PCT patent filings has declined consistently – from 0.42 per cent in 1999 and 2000 to 0.26 per cent in 2007.

Table 2. Patents Applications of South African Origin Filed through the PCT, 1994-2007

	'94	'95	'96	'97	'98	'99	'00	'01	'02	'03	'04	'05	'06	'07
SA Patents	30	42	72	84	114	317	387	419	384	357	411	358	422	360

Source: WIPO Statistics Database.

Table 3 shows the number of patent applications made at the local Companies and Intellectual Property Office (CIPRO). The number of patents remained constant throughout the period 1994 -1998 and then declined by a third. Numbers picked up again in 2001, but have been slowly declining since. The drop in 1999 may largely be attributed to South Africa becoming a part of the PCT system in March 1999 as many international companies would have channeled their applications to South Africa via the PCT system, with a time-lag until such applications entered the national phase in South Africa. Overall, local patenting at about 270 patents per million population is low and, at least since 2001, showing a slowly declining trend.

Table 3. Patent Applications at CIPRO, South Africa, 1994-2005

	'94	'95	'96	'97	'98	'99	'00	'01	'02	'03	'04	'05
Total Patent	10,414	11,050	10,956	11,734	11,953	7,838	7,793	10,553	10,408	9,955	10,396	10,044

Note: Data are for provisional and complete patent applications. For 1994-1997 from Teljeur; data for 1998-2005 from Innovation Fund, 2007.

Source: Teljeur, 2003:55; Innovation Fund, 2007:36.

A recent study concluded that "…at least 50% of the patent applications filed at CIPRO in this period (2000 – 2002) were filed by foreign nationals, with the biggest contributors being USA and German nationals". (Innovation Fund, 2007:28). From the table below, a clear and consistent trend is evident for the period 2001-2006: (1) the overall number of patents has been stagnant; (2) the number and the share of resident patent applications has been declining; (3) *pari passu* the number and particularly the share of non-resident patent applications has risen significantly.

Table 4. Number and Share of South African Resident and Non-Resident Patent Applications (Filed and Granted) at CIPRO, 2000-2002 and 2004-2006

	2000	2001	2002	2004	2005	2006
Total	7,793	10,553	10,408	10,420	10,456	10,787
Resident	5,204	4,985	4,721	4,587	4,328	4,058
Non-resident	2,589[13]	5,568	5,687	5,843	6,128	6,729
Non-resident percentage of total	33	53	55	56	59	62

Source: Data for 2000-2002 from Innovation Fund, 2007:28. Data for 2004–2006 supplied by CIPRO.

A detailed breakdown of patents filed in South Africa by country reveals that every country increased the number of its patents, between 2004 and 2006. However, patenting by South Africans declined in the same period by almost 12 per cent.

Table 5. Patents Filed in South Africa, by Country of Origin, 2004-2006

Date	ZA	US	GB	FR	DE	NL	CH	JP	Others
2004	4,587	1,953	506	275	716	223	387	268	1,517
2005	4,328	2,112	529	284	782	193	373	313	1,443
2006	4,048	2,269	555	429	858	270	434	277	1,666

Source: Data supplied by CIPRO.

3.2.3 Royalty Receipts and Payments[14]

The technology balance of payments (TBP) registers a country's commercial transactions related to international technology and transfer of know-how. It consists of payments made or received for the use of patents, licenses, know-how, trademarks, designs and technical services. These receipts and payments are generally registered as royalties paid abroad and royalties received from abroad.

In South Africa, consistent data for royalties received is only available from 2000. Analysis of the data regarding royalties from 2000 shows that in the period 2000-2007, royalties received from abroad increased by 58 per cent – a compound annual rate of 6.8 per cent per annum. In the same period, royalties paid abroad increased by 360 per cent – a compound annual growth rate of 20.1 per cent per annum.

Moreover, royalty payments greatly exceeded royalty income. In 2000, royalty payments were some 10 times royalty income. In 2007, royalty payments were 30 times royalty income.

The widening adverse technological balance of payments and, even more significantly, the relatively slow growth of royalty receipts from a very low base, are a further index of South Africa's weak overall innovation performance.[15]

3.2.4 Share of Global Trade

A country's performance in global trade in industries where innovation is central to economic success is an important output indicator, particularly in respect of business sector R&D. In the period 1992-2005, South Africa's exports of high technology products grew at 9.5 per cent per annum. While at first sight, this appears impressive, it is lower than the global average (11 per cent), and well below that for developing countries (21 per cent). As a result, as with scientific publications and patents, South Africa's share of global high technology exports has declined. This cannot be attributed to the country's dependence on commodity exports. Brazil's share of global high technology exports increased and the share of high technology exports in total country exports has risen significantly. South Africa's export performance was similar to that of Argentina. The share of high technology products in South Africa's total exports is much lower than that of Brazil and marginally lower than Argentina.

Table 6. Share of Global High-Technology Exports, 1992-2005 and Share of High Technology Exports in Country Exports, 1992-2002: South Africa, Brazil and Argentina

Share of Global High-Technology Exports	1992	2005
South Africa	0.07	0.07
Brazil	0.29	0.49
Argentina	0.05	0.03

Share of High-Technology Exports in Country Exports	1992	2002
South Africa	1.63	2.51
Brazil	3.9	10.5
Argentina	2.1	2.6

Source: COMTRADE, TIPS and own calculations

3.2.5 Composite Indicators

There are a number of composite indicators that measure the ability to generate, adopt and utilize new knowledge. The Knowledge Economy Index (KEI) compiled by the World Bank, probably the most widely used, is based on the average of the normalized performance of a country or region in four areas – economic incentives, institutional regime, education and human resources, the innovation system and ICT. In terms of the KEI, South Africa has declined since 1995. In contrast other commodity-based exporters,

such as Brazil, have seen a rise in the index as has the upper middle-income country group. Overall, South Africa is currently ranked 50 out of 140 countries – a decline of nine places since 1995. South Africa's performance on the KEI is again similar to that of Argentina.

Table 7. Knowledge Economy Index (KEI): South Africa in Comparative Perspective, 1995-Latest Year

	1995	Latest Year
South Africa	6.08	5.64
Brazil	5.14	5.50
Argentina	6.41	5.49
Upper middle income	6.38	6.50
World	6.41	5.93

Source: World Bank, 2007:7, available at *http://info.wordbank.org/etools/kam2/KAM_page7.asp* (accessed September 7, 2007).

3.3. Constraints on Performance

In summary, the resources committed to R&D in South Africa are commensurate with other countries at similar stages of development and have been increasing significantly. Moreover, business accounts for a very significant and rising share of expenditure on R&D. However, the number of personnel engaged in research is lower than for many comparable countries and has risen only slowly. This reflects the high cost of skills engaged in research, which in turn is a consequence of the limited supply of the skills needed.

While each of the system level output indicators has its limitations, all of them – publication counts; patents (local, US and PCT); royalty receipts and payments; shares of global trade and composite KEIs – tell essentially the same story; despite the injection of more resources and the introduction of a raft of new policies derived from international experience that have significantly improved the policy environment at the aggregate level, South Africa's innovation performance is largely stagnant if not declining slightly, particularly seen in a comparative perspective.

At the same time, South Africa has a number of highly innovative firms situated in different sectors and embracing a wide range of activities. In addition, there are also organizations in the public sector that are strong innovators. Many firms and public sector organizations have been able to profitably exploit this expertise in innovation in global markets.

South Africa is host to many innovative firms. A range of government policies and programs provides support for innovation; public funding is significant and growing and there is a local supply of engineering and scientific skills. There is an emerging consen-

sus that the key factor that acts as a constraint on innovation and the emergence of more innovative firms is a severe shortage of skills (Blankley and Kahn, 2005; Kahn, 2006; Breitenbach, 2007; NACI, 2006). The recent Review of South Africa's Innovation Policy by the OECD confirmed this consensus. The OECD identified a looming crisis in two areas. The first is a large and growing "engineering gap". "A very large gap appears to be opening up between the supply of design, engineering and related managerial and technical capabilities and demand for such resources being generated by the increased rate of investment across the economy." (OECD, 2007:7). The second is the very limited supply of university graduates capable of undertaking research. Unless this is addressed, the entire innovation system will be constrained (OECD, 2007:7). The OECD assessed human resource development as "…perhaps the issue that will be central to all other aspects of the development of the STI system over the next decade". (OECD, 2007:87)

4. THE SIGNIFICANCE OF IP TO INNOVATION

As noted earlier, there is a dearth of studies attempting to assess the specific impact of the IP regime on innovation in South Africa. There are two major criteria by which we might measure the impact of the IP regime on domestic innovation. The first would be to assess the extent to which local innovators, particularly innovating firms, make use of patents, both to protect their own intellectual property and as a source of information. The second would be to assess the impact of intellectual property in encouraging the emergence of specialist suppliers of technology – firms that are able to earn returns from their intellectual property, notably patents (Arora *et al*., 2007:27).[16]

With regard to the first, the Innovation Survey of 2005 provides an overall picture of the usage of IPRs on the part of innovative firms. Between 2002 and 2004, 11 per cent of innovative firms registered a trademark while 5 per cent claimed a copyright and 4 per cent registered an industrial design; 3.1 per cent of innovative firms secured a patent in South Africa while 2.5 per cent applied for a patent outside South Africa. About 1.7 per cent of innovating firms granted IPRs originating from their own innovation activities to third parties (DST, 2007:28-29). As outlined above, the indications are that patenting activity – particularly international patenting – has been in decline among South African firms. Other research performers, publicly funded science councils and universities, also make little use of patents: "analysis of the patent patterns for South African institutions shows very low levels of patenting by publicly funded institutions." (NACI, 2006:36)

The percentage of South African innovative firms applying for a patent abroad (2.5 per cent) is lower than for any of the EU 27 Member States plus Norway, except for Cyprus (data supplied by William Blankley, February 8, 2008).

The system level data suggest that only 21 per cent of innovating firms in South Africa make use of patents as sources of information – and only 8 per cent of innovating firms

regard patents as important (5 per cent) or very important (3 per cent). Apart from the innovation centers (which have a very limited presence in South Africa), patents rank lowest as sources of information for innovating firms in South Africa.

Table 8. Innovative Firms' Usage of External Information Sources

External Sources	Source not used	Used but little	Used and important importance	Used and very important
Competitors	32	18	41	9
Exhibitions	35	18	40	7
Suppliers	36	21	29	14
Professional literature	38	17	38	7
Buyers	43	20	27	10
New personnel	57	14	23	5
Consultants	58	17	16	8
Electronic info.	61	18	16	5
Group	65	10	10	14
Sector institutes	74	14	9	4
Universities	75	12	11	2
Research labs	78	13	6	3
Patents	79	13	5	3
Innovation Centers	86	9	4	1

Source: Innovation Survey, 2001 quoted in OECD, 2007:53

In a recent study of 20 innovative high technology firms in South Africa, the absence of an examining patent office was listed as a constraint on innovation (Breitenbach *et al.*, 2006:11). Lodging a patent with CIPRO and obtaining a South African patent is straightforward and inexpensive. However, most innovators are looking to global markets and CIPRO does not undertake any search for prior art. As a result, obtaining a local patent provides no indication of whether this patent could succeed in any other dispensation. As a consequence, innovative firms which are considering attempting to exploit global markets will have little incentive to secure a local patent. They accordingly undertake a time-consuming and difficult process of engaging local patent lawyers who then instruct patent lawyers abroad to file.

With regard to a second major criterion by which we might measure the impact of the IP regime, there is no systematic data on the extent and growth of specialist technology suppliers in South Africa. However, there are a number of examples of such firms, notably in the mineral and other resource-based industries. A number of these specialist firms have spun off from the large mining houses themselves, exploiting and further developing technology that was first established within the firm. One example is Lodox Systems. The company was spun off from De Beers, the diamond mining company. It is engaged in advanced full-body radiography equipment, initially for the mines, but now principally for healthcare applications. It has had considerable success in developed coun-

try markets and its Scannex product is now installed on five continents. Another example is Merisol, a joint venture between the large South African chemical firm, Sasol, and the US firm Merichem. Established in 1997, this firm supplies high quality phenolic products to the chemical industry. The company holds numerous patents. Gradchem Solutions was established in 1999 by engineers previously employed by Sasol. It provides innovative solutions to the fine chemical industry through innovation – including plant design and novel equipment. There are many other examples (Breitenbach *et al.*, 2007).

The development of specialist technology suppliers seems to have accelerated as South Africa has liberalized in terms both of trade and investment. Faced with global competition, South African firms have faced increasing pressures to specialize in their areas of core competence and to out-source other activities to specialized technology suppliers. In particular, there has been a significant growth of local engineering service firms, especially geared to supporting resource-intensive activities, but also more widely (OECD, 2007:96; Segal and Malherbe, 2000). A comprehensive mapping of such specialty suppliers and the precise factors underpinning their growth require investigation. Moreover, the role that intellectual property has played in the emergence and development of these firms is unknown. They are all fertile areas for future research.

5. GOVERNMENT POLICY ON INNOVATION AND INTELLECTUAL PROPERTY – CURRENT DEVELOPMENTS

South Africa's National Research and Development Strategy (NRDS), published in 2002, provides the framework for South Africa's policy. The NRDS highlights South Africa's low levels of patenting and the importance of intellectual property to wealth creation and foreign investment. Noting South Africa's weak performance in patenting, the NRDS identifies the lack of a policy framework for intellectual property as one of six key weaknesses that need to be addressed in order to improve system performance (DST, 2002:21). The NRDS is especially concerned about the lack of a policy framework in regard to intellectual property that arises from public funds allocated to research (Kaplan, 2004:283).

Indeed, while expressing concerns about the IP framework in general, the NRDS confined its analysis and concrete recommendations to considerations of publicly funded research. There was no examination of the totality of the wider IP system, or of its economic and social impacts. Nor has such an investigation been undertaken following the NRDS. The impact of the IP system as a whole has never been examined nationally. Curiously, this neglect is matched by the lack of any consideration of this issue by any international agency reporting on South Africa's innovation system. The OECD has recently completed a full-scale review of South Africa's innovation policy (OECD, 2007). In contrast with the NRDS, intellectual property is not identified by the OECD as one of the weaknesses in the innovation system. Accordingly, the OECD makes no proposals with respect to it – indeed the report is completely silent on the whole issue.

As a consequence, there has never been a discussion or consideration of the economic role of the IP system *in toto* in South Africa or of the objectives sought. While there is a general perception that an overhaul of this system may be required and that this will need to be based on clear principles and objectives (NACI, 2006:80), it does not appear that such an exercise is on the agenda in the short term. While there have been recent changes to the IP regime, these have been largely to accommodate international requirements and have been amendments to the legislative framework and the Patents Act.

South Africa is a signatory to the 1992 Convention on Biological Diversity (CBD) and in 2004 introduced the South African Biodiversity Act (BA) to comply with its international obligations under the Convention. In terms of the BA, any patent sought in South Africa will be required to state whether the invention is derived from any indigenous biological or genetic resource. In this event, provision must be made to ensure compensation for the person or community providing access to the indigenous biological resource. Where the invention is based on or derived from traditional knowledge and where the indigenous community is the owner of this knowledge, such indigenous communities must be adequately compensated. The Patents Act has similarly been amended to ensure disclosure of any biological resources utilized with all patent applications.

Another recent amendment to the Patents Act allows third parties, during the term of the patent, to make use of patented inventions for non-commercial R&D purposes. This allows users to enter the market immediately upon expiry of the patent (Wolson, 2005:21).

Two further changes to the IP regime are to be effected in the short term.

The first relates to intellectual property arising from public funds allocated to research. The approach that was taken by the NRDS to this issue was to list the general attributes that such a policy framework should possess. Thus, it should be based on best global practice and create a context for benefit sharing. It should also be legislated (DST, 2002:68-69). This approach led to the formulation of a new Bill entitled Intellectual Property Rights (IPR) From Publicly Financed Research. This has been widely discussed and is due to be debated shortly in Parliament . The other concrete measure proposed by the NRDS was: "A dedicated fund to finance the securing of intellectual property rights resulting from publicly financed research and development." (DST, 2002:69) An Innovation Fund Commercialization Office has subsequently been established to provide financial support for intellectual property resulting from publicly funded research.

In addition to legislation relating to intellectual property arising from publicly funded R&D, Parliament is expected in 2008 to debate a Bill in respect of traditional knowledge, which will be protected *sui generis* within the framework of existing legislation. Accordingly, there will be amendments to existing acts – the Copyright Act, the Trade Mark Act and the Patents Act. These amendments will require inter alia that recognition of TK will have to be accompanied by a clear benefit-sharing arrangement with an indigenous community.

6. CONCLUSION

South Africa's innovation system is at a critical stage. System performance has not been strong, particularly relative to the increases in resources committed. There has been considerable policy experimentation and innovation in many areas, but with regard to intellectual property, policy changes have been piecemeal and largely reactive to changing circumstances, particularly international obligations. There is a need for a comprehensive review of the IP regime. Such a review should rest on a consideration of the role that it has played and could play in enhancing innovation, investment (particularly FDI) and growth.

This, in turn, requires considerable research on the economic impact of intellectual property – an area that has attracted very little attention in the past. The purpose of this publication is to provide some initial research, but also to initiate and stimulate further research. Such research has the potential to enhance understanding, and also make an invaluable contribution to ensuring that future policy changes in South Africa rest on firm empirical foundations.

Notes

1 Teljeur, 2003 is a valuable exception, but it is of limited scope. The Department of Trade and Industry has indicated its plans to address this issue by embarking on a project that would analyze the impact of intellectual property on education, health, research, innovation and development, franchising, information sharing, telecommunications and ICTs, technology transfer, consumer protection and access to knowledge in South Africa.

2 The following are excluded as not being considered as an invention – "(a) a discovery; (b) a scientific theory; (c) a mathematical method; (d) a literary, dramatic, musical or artistic work or any other aesthetic creation; (e) a scheme, rule or method for performing a mental act, playing a game or doing business; (f) a program for a computer or (g) the presentation of information." (SA Chapter 5. Section 25 (2):18.)

3 The mean for all countries was 3.34 with a standard deviation of 0.89 (Park, 2008:763).

4 It is understood that such indexes can only be indicative and must be taken with caution, as they only reflect certain aspects of the IP system and may not be a good reflection of actual IP protection (and enforcement) in any given country.

5 Conversions at 7.50 rand to US$1.

6 Teljeur cites "anecdotal evidence" of companies registering large numbers of patents which would not pass the international criteria and as result, "…some companies have diverted R&D funds away from an area in which superfluous patents exist, even though the company can contest the validity of the patent". (Teljeur, 2003:54).

7 Enterprise managers identified the skills constraint as the most serious obstacle to their operations and growth. Clarke *et al*. (2007: xvii).

8 Javorcik, 2002.

9 On May 1, 1995 a new Trade Marks Act, No 194 of 1993, was promulgated in South Africa and Section 35 thereof made provision for the protection of well-known foreign trademarks.

11 A recent well-publicized case concerned the local propagation of a variety of sweet pepper – peppadew. The Appeal Court upheld the plant breeder's rights of the developer. The Sunday Times, 'Peppadew court victory protects breeder rights'. Business Times, February 16, 2007:6.

12 "…the proportion of GERD performed by business enterprises in South Africa is broadly similar to, or a little higher than, in (sic) several other countries, with much higher GERD/GDP ratios like Spain, New Zealand, Norway, Netherlands and Canada. It is also 1.6 to 2.0 times higher than the levels in countries with lower GERD/GDP ratios, including some with higher levels of GDP *per capita* like Portugal or Greece." (OECD, 2007:92)

13 As explained above, the low number of non-resident patent applications for the year 2000 is likely due to South Africa becoming a member of the PCT in March 1999.

14 This section is based on data supplied by the South African Reserve Bank. Royalty payments and income are not currently published by the Bank. It therefore gave permission to the author to outline the data trends, but not to publish the actual data.

15 The rapid increase in the import of foreign technology may partly be the result of strong IP protection. In addition, increased inflows of technology will impact on productivity. These are issues that merit further research.

16 A third might be the impact of intellectual property on the access of South African companies to international markets for technology and the extent to which this enhances productivity and local innovation.

17 The Department of Science and Technology announced on January 14, 2009, that the Intellectual Property Rights Bill had been signed into law.

References

Arora, A., A. Fosfuri and A. Gambardella, 'Patents and the Markets for Technology' in *The Handbook of Intellectual Property Rights and Technical Change*, K. Maskus, 2007.

Breitenbach, P., D. Kaplan and E. Wood, 'The Influence of Publicly Funded R&D on National Development', *Report for the National Advisory Council on Innovation*, mimeo, Center for Innovation and Entrepreneurship, Graduate School of Business, University of Cape Town, 2006.

Buys, A.J., L.A.G. Oerlemans, M.W. Pretorius and G. Rooks, *Report on the South African Innovation Survey 2001,* University of Pretoria, Pretoria, 2003.

Clarke, George R.G., J. Habyarimana, M. Ingram, D. Kaplan and V. Ramachandran, *An Assessment of the Investment Climate in South Africa*, World Bank, Washington, D.C., 2007.

Companies and Intellectual Property Registration Office (CIPRO) Products and Services, and Fees and Costs, available at *http://www.cipro.co.za/fees.costs-asp* (accessed on February 15, 2008).

Javorcik, B.S., 'The Composition of Foreign Direct Investment and Protection of Intellectual Property Rights: E vidence from Transition Economies', *European Economic Review*, 48:39-62, 2002.

Kaplan, D., 'South Africa's National Research and Development Strategy: A Review', *Science, Technology and Society*, vol. 9, No.2, 2004.

Lesser, W., 'The Effects of TRIPS Mandated Intellectual Property Rights on Economic Activities in Developing Countries', paper prepared under WIPO Special Service Agreement, available at *http://www.wipo.int/about-ip/en/studies* (accessed on February 14, 2007), 2001.

Lubango, L.M. and A. Pouris, 'Industry Work Experience and Innovation Capacity of South African Academic Researchers', *Technovation*, vol. 27, No. 12, pp. 788-796, December 2007.

Maskus, K.E., 'Intellectual Property Rights and Foreign Direct Investment', *Working Paper No. 22,* Center for International Economic Studies, Center for Economic Studies and Ifo Institute for Economic Research, World Bank, May 2000.

National Advisory Council on Innovation (NACI), 'The South African National System of Innovation: Structures, Policies and Performance', Background Report to the OECD Country Review of South Africa's National System of Innovation, mimeo, NACI, Pretoria, July 2006.

Organisation for Cooperation and Development (OECD), 'Review of South Africa's Innovation Policy', Directorate for Science, Technology and Industry, Committee for Scientific and Technology Policy, mimeo, March 15, 2007.

Park, W.G., 'International Patent Protection:1960-2005', *Research Policy* 37, 761-766, 2008.

Property Rights Alliance, 'International Property Rights Index, 2008 Report', Property Rights Alliance, available at *http://www.IntellectualProperty RightsIndex2998.htm*, Washington, D.C., 2008.

Segal N. and S. Malherbe, 'A Perspective on the South African Mining Industry in the 21st Century', Report by the Graduate School of Business, University of Cape Town, Chamber of Mines of South Africa, Johannesburg, mimeo, 2000.

Sibanda, M., 'The State of Patenting in South Africa. Special Report. Analysis of the South African Patent Landscape', Innovation Fund Intellectual Property Management Office, Pretoria, 2007.

Teljeur, E., 'Intellectual Property Rights in South Africa: An Economic Review of Policy and Impact', The Edge Institute, South Africa, mimeo, 2003.

Wolson, R.A., 'The Role of Technology Transfer Offices in Building the South African Biotechnology Sector: An Assessment of Policies, Practices and Impact Paper prepared for the Bringing Sciences to Life Conference', University of Toronto, April 29 to May 1, 2005.

World Intellectual Property Organization (WIPO), *Report on the International Patent System*, Standing Committee on the Law of Patents, Twelfth Session, WIPO, Geneva, June 23-27, 2008.

CHAPTER 2
VALUE ADDING IN THE SOUTHERN AFRICAN NATURAL PRODUCTS SECTOR: HOW MUCH DO PATENTS MATTER?

RACHEL WYNBERG*, JUDITH SILVESTON** and CYRIL LOMBARD***

Abstract

Southern African countries are actively engaged in natural product development but, in common with other developing countries, typically export their biodiversity as raw materials with little or no processing, technological input or other value adding. IPR protection for innovations relating to biodiversity has been accelerated by the TRIPS Agreement and there is concern that this will strengthen the market power of Northern innovating firms and raise prices in developing countries. At the same time there is recognition that IPRs can assist developing countries in obtaining access to technological capacity and provide commercial opportunities for encouraging inward investment.

Virtually all species under commercial development in Southern Africa have patents associated with their processing and/or use, mostly under foreign ownership. Two questions comprise the focus of this paper: (1) What is the role of IPRs in stimulating industrial activity in the Southern African natural products sector? (2) Does the existence of IPRs stimulate or restrict value adding in countries of origin of biological material and traditional knowledge?

Three Southern African plants currently traded in global markets are analyzed: *Harpagophytum* (devil's claw), *Aspalathus linearis (Rooibos)* and *Hoodia*. It is concluded that IPRs seldom restrict value adding, but may instead stimulate trade and may provide further commercial opportunities. Low awareness among local firms, however, prevents such opportunities from being exploited. Low levels of value adding stem from a complex mix of factors including market access, buyer dominance, a lack of strategic alignment among producers and insufficient technical and financial capacity. Traditional knowledge has played a central role in catalyzing industrial activity in all of the cases examined but this is poorly reflected and acknowledged in value chains.

1. INTRODUCTION

South Africa is actively engaged in natural product development and bioprospecting[1], with the past decade witnessing a flurry of activity in the exploration of local biodiversity for commercially valuable genetic resources and biochemicals (e.g. CSIR, 2001; PhytoTrade Africa, 2006; Wynberg, 2004; Diederichs, 2005). This is due largely to the

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country's extraordinarily rich and unique biodiversity (Endangered Wildlife Trust, 2002), well-documented and vast traditional knowledge base, and strong research, institutional and technological capacity which, combined with considerable business capacity, place South Africa and the Southern African region at the forefront of new strategies to glean economic benefit from biological resources (Geldenhuys and van Wyk, 2002; Wynberg, 2004).

In common with other developing countries, South Africa and her neighbors have historically exported their biodiversity in the form of raw plant material, traded as bulk commodities with little or no processing, technological input or other value adding before export. The situation has been exacerbated by trends within industries in importing countries toward greater consolidation and vertical integration – along with increased control over price and demand (Laird and Wynberg, 2008). Intellectual property protection for innovations related to biological organisms has been accelerated by the inclusion of IPRs over biological resources within the TRIPS Agreement (Gebhardt, 1998; Dutfield, 2000). A concern is that IPR protection will strengthen the market power of Northern innovating firms and raise prices in developing countries (Chen and Puttitanun, 2005). At the same time, there is recognition that IPRs can assist developing countries obtain access to technological capacity, and this in turn can help to achieve economic and social development and reduce poverty (Commission on Intellectual Property Rights, 2002). The exclusivity provided by patent protection may also provide commercial opportunities for encouraging inward investment and revenue flow in developing countries (Maskus, 2000). Additionally, patents owned by developing country organizations may provide the opportunity for licensing, a source of revenue that can be used to finance other projects.

Technology transfer is a central component of both TRIPS and the 1992 Convention on Biological Diversity (CBD), the latter recognizing the sovereign right of countries over their biological resources and their right to determine access to these resources. The CBD notes that access to genetic resources should be on the basis of prior informed consent from providers of resources and knowledge, and on mutually agreed terms that provide fair and equitable sharing of the results of research, development and commercialization. It also calls for the fair and equitable sharing of benefits derived from the use of traditional knowledge. Article 16 of the CBD aims to ensure that access to and transfer of technology to developing countries is facilitated both by government institutions and the private sector. To date, however, there has been little evidence of this having been achieved (CBD, 2007) and, where it has, its extent and interpretation have often been contested (e.g. Lettington, 2003; Laird and Wynberg, 2008).

Virtually all species under commercial development in Southern Africa have patents and/or patent applications associated with their processing and/or use, mostly under foreign ownership. This represents a 10- to 20-fold increase over the past decade (Wynberg, 2006). Despite the burgeoning natural products industry in the region, there has been little research conducted on the effects of associated patents and applications, and the extent to which they constrain or facilitate value addition and technology transfer

in the sector. As a general rule, subject matter of a patent must be new and inventive over traditional knowledge but this has not always prevented patents from being granted (Dutfield, 2004). Recent changes to the South African Patent Amendment Act (20 of 2005) require applicants to furnish information relating to the use of indigenous biological resources or traditional knowledge in an invention. However, many countries do not have such information disclosure requirements and the topic remains complex, poorly understood and highly controversial.

This chapter aims to enhance understanding of the economic impacts of IPRs on local value addition in the natural products sector in South Africa and neighboring countries. Two research questions frame this analysis: (1) What is the role of IPRs in stimulating industrial activity in the southern African natural products sector? (2) Does the existence of IPRs stimulate or restrict value adding in countries of origin of biological material and traditional knowledge? Patents comprise the primary focus of the analysis, although the paper also includes some discussion of the role of geographical indications and other IP tools. Through improved knowledge it is intended that policy-makers can make informed and evidence-based decisions about the development and adoption of appropriate policies and strategies to promote local value addition whilst facilitating technology transfer and protecting traditional knowledge. The chapter begins by describing the methods used for the study, and then examines three case studies of Southern African species currently traded in global markets – devil's claw, *Hoodia*, and *Rooibos* tea. The final section integrates findings from each case study and draws conclusions from this research.

2. METHODS

Case studies were selected as the unit of analysis for the study, with three Southern African species identified for detailed investigation:

- Devil's claw (*Harpagophytum* species), a plant used widely for the treatment of rheumatism and arthritis;
- *Hoodia* species, succulent plants indigenous to Southern Africa and long used by the indigenous San to stave off hunger and thirst on long hunting trips; and
- *Rooibos* tea (Aspalathus linearis), one of South Africa's oldest and most successful indigenous products.

Preliminary data were collected through reviewing the published and unpublished literature and identifying and analyzing existing patents and patent applications associated with each species. The patent search was carried out using the esp@cenet database, searching under the species name and common name and, where appropriate, under any characteristic chemical component (harpagoside and harpagide in the case of devil's claw).[2] Information about the status of patents and applications up until June 1, 2008 was obtained from INPADOC and the European, German, Japanese and US patent office databases. This analysis was accompanied by a review of the theoretical and applied literature on IPRs, technology transfer and value addition. Semi-structured

questionnaires were used as the primary method of data collection, and they formed the basis for focused one-on-one interviews with value chain participants and key informants.

To corroborate information and reflect different interpretations and perspectives, the technique of triangulation was used, which entails collecting material in as many different ways and from as many diverse sources as possible, to enable the understanding of phenomena from several different angles (Terre Blanche and Kelly, 1999). For each species, the same set of information was collected from different social players, compared and contrasted across respondents, and, where possible, corroborated or refuted with information gleaned from the literature review. Respondents included local traders involved in trading case study species, importers and foreign processors and producers, representatives of producer communities/traditional knowledge holders, relevant departments of trade and environment, and NGOs, researchers and other key informants working with case study species. Part of this data was drawn from earlier research conducted by one of the authors (Wynberg, 2006).

Data was analyzed in a number of ways. Each interview was read through thoroughly and accompanying notes and diagrams were made to highlight key themes. Information gathered was categorized and coded based on similarity of theme. Information from each interview was clustered into a number of key themes. This was expanded and verified through use of secondary data sources and other literature.

Although one-on-one semi-structured interviews comprised the main strategy for empirical data collection, quantitative data was also gathered on trade statistics and pricing at different levels of the value chain. This data was however limited by the reticence of commercial players to share sensitive information and the short time-frame of the study. Value chain analysis, a conventional form of commodity chain analysis, was used as one approach to understanding the position and behavior of actors in natural product value chains, and the opportunities for upgrading, meaning the possibility for developing country producers to move up the value chain and secure better returns (Kaplinsky and Morris, 2001; Gibbon and Ponte, 2005).

3. DEVIL'S CLAW

3.1. Overview

Devil's claw is a plant indigenous to the Kalahari region of Southern Africa. Roots of the plant are widely used as a medicine, both traditionally and in Western preparations. Indeed, traditional knowledge was the basis for initiating Western interest in the plant at the turn of the 20th century, catalyzed by a German soldier secretly tracking a local healer's use of the plant, thus marking one of the first and certainly one of the most significant "biopiracy"[3] incidents in Namibia (Volk, 1964; Wynberg, 2006). Traditional use of the tuber for fever relief, to treat blood diseases and muscular aches and pains, and

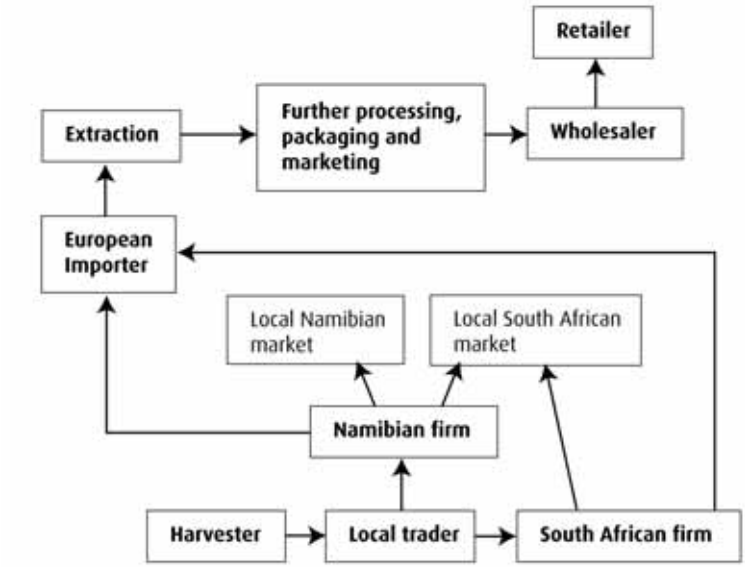
as an analgesic during pregnancy, is widely recorded, as is the use of pulverized root material as an ointment for sores, ulcers and boils and for difficult births (Watt and Breyer-Brandwijk, 1962; Giess and Snyman, 1995). Infusions of the dried root are also locally used as a cure for digestive disorders, as an appetite stimulant and for *post partum* complaints.

Today the plant is widely traded on international markets, where it is used to treat arthritis and rheumatism. Extracts of the tubers are found in pharmaceutical preparations, herbal remedies and cosmetics, either in preparations in the form of raw or powdered material or as standardized extracts in the form of capsules, tablets, tinctures and ointments. A small market also exists for veterinary herbal remedies and herbal teas. A number of studies have demonstrated the efficacy of devil's claw as an anti-inflammatory (e.g. Lanhers *et al*., 1992; Chrubasik *et al*., 1996), and its properties are considered comparable to cortisone and phenylbutazone but without the accompanying side effects (Moussard *et al*., 1992). These factors, combined with the proven safety of the plant and its recognition by the international pharmacopoeia, has led to a rapid escalation in demand for devil's claw, evidenced for example by the fact that it accounts for 74 per cent of treatments for rheumatism in Germany (Grünwald, 2003).

Devil's claw has been traded internationally for some 50 years, with most material exported from Namibia to Germany. Although the trade has been erratic there has, over the years, been a steady increase in export volume, which has led to an expansion of the area from which material is sourced to include Botswana and South Africa as well as the more remote parts of Namibia. The net value of the trade is significant. Grünwald (2003) notes that in 2001/2002 devil's claw sales in Germany alone topped 30 million euros (US$34 million), representing the third highest sales of medicinal plants in the country. Based on the average size of the annual world devil's claw market of 400,000 kg., and an approximate retail value of US$200 per kg., the industry is worth an estimated US$80 million per annum.

A large number of steps characterize the devil's claw value chain, illustrated in Figure 1. Once material is exported, it is either milled or packaged for sale as a tea or herbal supplement, or subject to a greater degree of processing, including the extraction of active constituents through water or alcohol-based extraction methods. Extracts are then manufactured into diverse products, often with proprietary formulations, before being sold in pharmacies, supermarkets, or health food shops. A diverse group of players is engaged in these different steps and the material may pass through a number of agents, wholesalers, manufacturers, packagers and extractors, before reaching its final shelf destination, with the largest and most established markets by far being those in Germany.

Figure 1. A Typical Devil's Claw Value Chain



After Wynberg (2006).

3.2. Devil's Claw Patents and Patent Applications

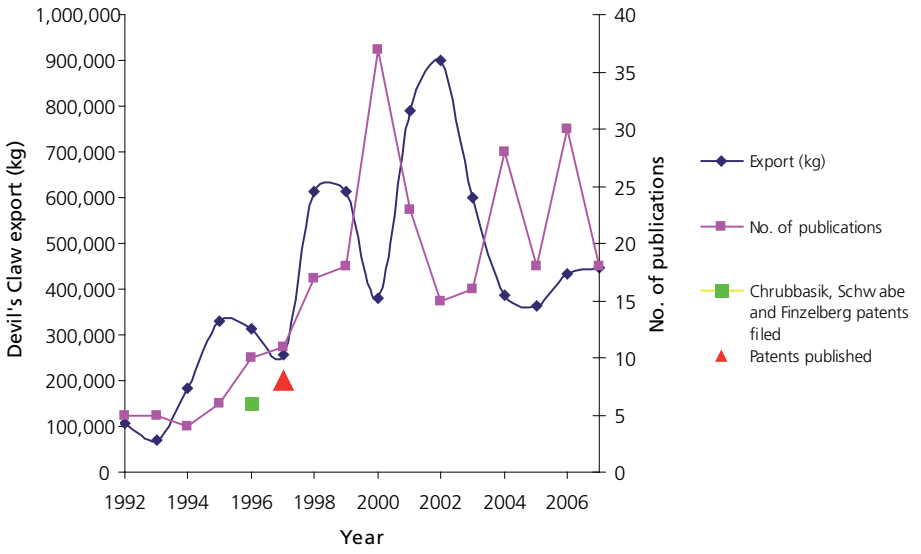
Devil's claw has been characterized by high levels of patent activity since the early 1980s. In large part this has closely followed research conducted on the active constituents of the plant, with publications seemingly driving innovation and catalyzing industry to think of potential uses. Licensing and publication activities in turn seem to be linked to spikes in trade, with key patent "publication dates" predating a significant upturn in the devil's claw trade in the late 1990s (Figure 2). Figure 2 highlights the increase in the number of devil's claw publications after the first patent was filed in 1989. A considerable increase in publications is also observed after a key patent filed by Chrubasik in 1996; 33 of these publications involve the patent holder (Chrubasik) as first or co-author.

Some 35 patents and applications had been lodged as of June 1, 2008. These fall into three categories:

(i) processes (7) for producing extracts or isolating chemical compounds;
(ii) compositions (18), including pharmaceutical, herbal and nutritional compositions and chewing gum for treatments based on known anti-inflammatory and analgesic activity; arthritic conditions, rheumatoid disorders, osteoarthritis, bone and joint inflammation, pain relief from neuralgia, arthritis and rheumatoid conditions; and
(iii) compositions for allegedly new uses (10): delaying weakening of cartilage, regeneration of deformed and damaged cartilage; osteoporosis; skin itching; rough-

ening, firmness and wrinkling of skin and adhesion of makeup; renal disease, dysfunction or damage; endometriosis and/or endometriosis-related proliferative and/or inflammatory process and/or analgesic therapy; skin inflammation and reduction of skin barrier function; anti-aging skin treatment; use as Maillard reaction inhibitor in foods and beverages; and hair treatment.

Figure 2. Relationship Between Exports, Publications and Key Patents for Devil's Claw



Three of the process applications were filed in Germany by different companies in early 1996, while four later process applications were filed in the Republic of Korea, the UK and the US. This is to be expected, given that Germany is the main processor of devil's claw and a major user of devil's claw products. However, no clear pattern of ownership is evident. As befits the largest processor and user of devil's claw products, Germany has the greatest number of applications for devil's claw compositions and uses, with other applicants from all over the world: Germany (8), France (5), the Republic of Korea (3), Japan (4), the UK (2), Canada (2), the US (1), Spain (1), Italy (1), Mexico (1).

3.2.1 Process Patents and Applications

For reasons unknown, only one of the patents and applications relating to processes for producing devil's claw extracts has been filed in South Africa.[4] This patent was filed by Finzelberg GmbH & Co. KG, one of the subsidiaries of the German company Martin Bauer GmbH & Co., which is the predominant European company involved with devil's claw. The Finzelberg patent has been granted in South Africa, and also in Europe (effective in Austria, Belgium, Denmark Germany, Italy, Luxembourg, Monaco, Spain,

Sweden, Switzerland, and the UK), Australia, Canada, China, and the US, with applications pending in Japan and the Republic of Korea. The Finzelberg extraction process involves a three-stage aqueous/alcoholic extraction process, which is said to give an extract having a high content of harpagoside, the major active compound in devil's claw. This technology is not available for use in South Africa by third parties without authorization, though it could be used in other Southern African countries where the patent is not filed or in South Africa itself under a license. However, the extent of the patent coverage for the major markets for devil's claw would make such production commercially unattractive.

There are, however, two other German-originating patent families with somewhat similar claims to processes for extracting devil's claw, neither of which has been filed in South Africa. The first was filed and granted in Germany only, by Dr. Chrubasik, who was actively publishing in the scientific literature on devil's claw at that time. The Chrubasik process is also an aqueous/alcoholic extraction, but is preceded by an initial purification step using an adsorbent resin. The other application was filed by Willmar Schwabe GmbH & Co., another German devil's claw processor, about six weeks after Chrubasik and two months before Finzelberg. The Schwabe process, too, involves aqueous/alcoholic extractions. Patents have been granted in Europe, Japan and the US.

Information provided by an adverse third party on the file of the Finzelberg European application indicates that the Chrubasik patent gives a product very similar in quality to the Finzelberg product, and that the Schwabe product is less effective. This and the fact that the Chrubasik patent was filed in Germany only whereas the Schwabe patent has been granted in Europe, Japan and the US, makes the Chrubasik process a commercial possibility for South African processors. While it is a disadvantage that the product cannot be exported to Germany, the major market for devil's claw, other valuable markets are open.

Three of the remaining four process applications were filed only in the country indicated (Dongkuk Pharm Co. Ltd. KR, Essential Nutrition US, Korea Institute for Science and Technology KR), so the process can be used in South Africa. In many countries, however, it is an infringing act to import the product of a patented process. As a general rule it is therefore prudent to avoid exporting such a product to any country where there is a patent for the process. The Essential Nutrition application was not granted in the UK, so the process can be practiced in Southern Africa and the product exported to the UK.

3.2.2 Composition and Use of Patents and Applications

Of the patents and applications that relate to compositions and/or uses in categories (ii) and (iii) above, seven have been dropped;[5] hence these products can be produced freely in Southern Africa and sold anywhere.

Of the remaining patents and applications, 13 have been filed in the named country only: Grosmond (France), Veradi (Italy), Rivadis (France), Farm KKI (Japan), Stanley (US), TS Aasu (Japan), Shin Jun Sik (Republic of Korea), MFE Marienfelde (Germany), Bioplanta (Germany), Chung Choung Buk Do (Republic of Korea), Ichimaru Pharcos (Japan), Naris Cosmetics (Japan), and Touch of Love Inc. (Canada). The products can therefore be produced anywhere in Southern Africa and exported to any country other than that in which the intellectual property exists, without requiring a license.

The final eight applications in this category have been filed in more than one country: Shin Jun Sik in the Republic of Korea, Japan and the US (granted); Salus Haus in Europe (only maintained in certain countries including Austria, France, Germany, Greece, Italy, Luxembourg, Spain, Switzerland and the UK); Cognis Iberia (European Patent); Cognis Deutschland (European Patent, but only France, Germany, Italy, Spain and the UK), Japan and the US; Velez-Rivera (Brazil, Mexico and the US); Flavin-Koenig (European Patent); Reimser Arzneimittel (European Patent); Henkel (International phase). The same principle applies, that the product can be produced in Southern Africa for export anywhere other than where a patent or application exists. However, if a patent has lapsed due to non-payment of renewal fees, or an application has been dropped, the claimed product can then be exported to that country.

3.3. Intellectual Property and Value Addition

Seemingly, existing patents do impose restrictions on both the production and export of devil's claw in Southern Africa, and South Africa in particular, with respect to the significant Finzelberg patent. However, the extent to which these patents legally restrict economic activity is arguably and surprisingly negligible. Moreover, the intellectual property relating to devil's claw products, uses of devil's claw material, and processes for extracting devil's claw also potentially offer the opportunity to add value in Southern Africa and possibilities for licensing-in technology.

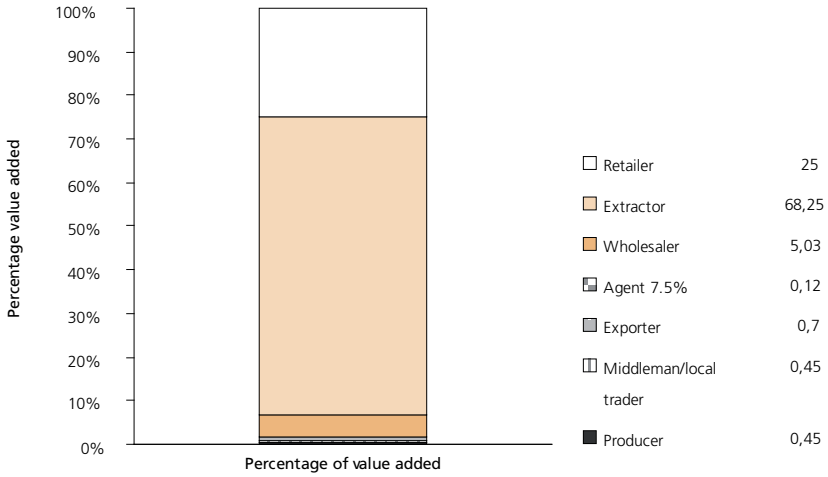
What then are the experiences of those engaged in the devil's claw value chain? Are existing patents and applications perceived to restrict local value addition or do they create opportunities to add value? Despite the fact that this research demonstrates negligible legal restrictions, the perception of commercial firms is somewhat different. A common view, for example, is that patents have played a restrictive rather than a facilitative role. Commented one South African firm: "Germany has spent years trying to develop all aspects of the IP of devil's claw; every time we try to come up with something new it is always covered by patents from elsewhere". This view suggests low levels of awareness of the complexities of patents and may well be based on one or more common misconceptions about patents and the patent system (see Box 1). The "patents" may well be patent applications, not granted patents, and they may be filed in only one country that is not particularly relevant. Nevertheless, whether right or wrong, such opinions affect commercial decisions.

While the link between value addition and patents may be debatable, the low levels of value addition for the devil's claw industry in Southern Africa are not. Indeed, negligible benefits are procured by harvesters and range states through the trade. In Namibia, foreign income earned from devil's claw in 2002 was an estimated US$3.3 million, based on an average export price of US$3.20 per kg. of raw material, while Botswana and South Africa in the same year earned US$94,720 and US$416,000 respectively. While these amounts are significant, they represent only 2.1–4.3 per cent of the value of the final product that is captured by producer countries.[6]

A more detailed breakdown is provided in Figure 3, which shows that based on a final retail price of US$200 per kg, most harvesters receive 0.45 per cent of the value of the final product, or about 0.2 per cent if the higher retail price of US$350 per kg. is used. Exporters and local middlemen, although popularly cited as the villains in the natural product trade, do not fare much better, capturing between 0.12–0.90 per cent of the US$200 per kg. retail price, although clearly their advantage lies in the larger volumes they trade. Agents obtain about 7.5 per cent commission on export sales, some 0.1 per cent of the retail price, while wholesalers secure approximately 4.6–5 per cent of the retail price. Processors, extractors and manufacturers capture a massive 68 per cent of value, while retailers obtain about 25 per cent of the value of the final price.[7]

Devil's claw is certainly not unique in this regard and a compelling case can be made to demonstrate that the nature of extractive markets tends to keep wages and prices for producers low, and that profit shares increase with increased processing as the product moves closer to the consumer (Southgate *et al*., 1996; Neumann and Hirsch, 2000). For example, Hersch-Martinez (1995) tracked the commercial path of six medicinal plants from the field to national markets in Mexico, and reported that only 6 per cent of the consumer price returned to custodians of the resource. King *et al*. (1999) noted that harvesters received between US$0.30 and US$0.65 per kg. for unprocessed cat's claw (*Uncaria tomentosa*) in Peru, yet the price of bulk, unprocessed cat's claw in the US fetched US$11 per kg. – a 37-fold appreciation with little value added. In an analysis of the volatile coffee trade, Biswas and Potts (2003) remark that of the US$26.40 required to buy a 1 kg. bag of soluble Ugandan robusta in a UK supermarket, 14 cents goes to the farmer for each kilogram of dry beans. Even accounting for the loss of weight during the refining process, this represents a price inflation of more than 7,000 per cent. However, it is important to note that, while levels of inequality in wealth accumulation and distribution have intensified in recent years with globalization and the attendant rise to power of supermarkets and transnational corporations, such trends probably have little to do with IPRs. Indeed, their role is poorly understood and documented along such chains.

Figure 3. Devil's Claw Value Chain, Indicating Proportional Value Captured by Each Role Player Along the Chain



All figures pertain to 2002. After Wynberg (2006).

These figures illustrate that the devil's claw trade is characterized by an extremely low level of value adding that takes place locally and within the country of origin, and a lack of investment in supply areas. Apart from initial slicing and drying, and the sorting and bagging of raw material before export, between 60–80 per cent of all devil's claw supplied by Namibian exporters goes to international buyers that simply clean, grade, grind and repack it, while only 12 per cent of exports goes directly to extractors and manufacturers (Lombard, 2003). Agents, who redirect supplies to other buyers, also play a major role, accounting for 19 per cent of exports in Namibia (Lombard, 2003). The situation is very similar in South Africa and Botswana. Although there are obvious costs and investments involved in the development of a market for a plant such as devil's claw, in reality the trade is monopolized by a small cohort of international companies and increased profits (or favorable changes in exchange rates) are seldom passed down the chain to producers. In a similar vein, processing activities take place almost exclusively in Europe, and the bulk of the material is exported in a raw and largely unprocessed form.

The picture that emerges is thus of patents playing a central, but not overwhelming role in the strategic positioning of foreign companies in the devil's claw market. Existing patents have enabled firms to develop value-added products through extracts which, as Figure 3 describes, represent the lion's share of the value chain. Although Southern African firms are not precluded from utilizing many of these patents, their mere existence has acted as a perceptual barrier of risk for many local firms. This has been exacerbated by the domination of five to 10 companies in the European trade, the most central being the German Martin Bauer GmbH & Co., estimated to control 75 per cent of world trade in devil's claw. Important subsidiaries established under the Martin Bauer umbrella in-

clude Paul Muggenburg, responsible for supplying and sourcing raw material; Plant Extract, which produces extracts; and Finzelberg GmbH & Co., which manufactures herbal extracts for the pharmaceutical industry. Other key players include Serturner-Lichtwer (France/Germany), SalusHaus (Germany), Strathmann (Germany), Indena (Italy), A.M. Todd (US), Bioforce (Switzerland), Organic Herb Trading (UK) and Arkopharma (France). The dominance of German pharmaceutical companies is, of course, far from coincidental, reflecting in part the German colonial legacy of control in Namibia, early demand from German consumers for devil's claw (a market for extracts that has been ongoing for 30-40 years) and the substantial investment made by Germany in clinical trials, IP protection, processing technology, and R&D (Krugmann *et al*., 2003).

The dominance of European firms in the devil's claw trade is enhanced to a large extent by a lack of cohesion and coordination among Southern African suppliers of devil's claw. Rather than align strategically, Southern African exporters typically undercut one another in pricing, and compete intensely for clients. This has led to what has been described as a "divide and rule" situation, where importers play off exporters against one another, and secure rock-bottom prices (Krafft, 2002). This is also reflected in the highly volatile nature of the partnerships developed, illustrated by the fact that since 1996 most of the principal importers of devil's claw have changed their suppliers (Lombard, 2003). The situation is made all the more complex by the fact that devil's claw straddles the border of at least four countries (Namibia, Angola, South Africa and Botswana), and that coordination between these countries is poor. Supply control in one country thus leads to demand shifting to another country. Moreover, the lack of quality standards gives price negotiating power to buyers (Cole and Bennett, 2007). While tools such as geographic indications represent a potential avenue to overcome such constraints, in practice they require a substantial body of infrastructure and capacity to implement effectively.

Under these conditions there is very little incentive for foreign firms to develop license agreements with local firms. As one South African firm commented: "We come from a very weak position and they [German firms] don't even entertain us. They have adequate material and suppliers will even undercut prices. They have registered products; they have market position; they are untouchable. We need to work together to play the international markets and present a united front".

While market access is a crucial factor that impedes value addition, so too is technical capacity. As described above, there are numerous opportunities to add value to devil's claw through existing patents that are not applicable in Southern Africa, but few examples where these are taken up. This can be attributed to a number of factors. One reason is that a stand-alone facility to extract only devil's claw would be inefficient and simply not feasible. Other products would be required to spread the risk, as well as substantial volumes to make the plant viable. One South African extract firm commented: "The process is not an easy one. You need to raise the capital, you must develop the technology and you need a marketing position. The moment you start manufacturing extracts strong analytical capacity would be needed, requiring work with universities

and subcontractors. In a country like Namibia this would be very limited and would therefore require a regional approach. You would also need raw material suppliers to align themselves with the project".

In conclusion, there are a number of patents that have a restricting impact for Southern African countries, but these do not comprise the *raison d'être* for the almost negligible local value addition for devil's claw. Low value adding stems from a complex variety of different factors, including market access, buyer dominance, a lack of strategic alignment amongst Southern African producers, insufficient technical and financial capacity and a multitude of patents and applications that detract potential investors. The next case study, that of *Hoodia*, reveals an equally complex but altogether different picture.

Box 1. Misconceptions about Patents

There is widespread lack of knowledge as well as misunderstanding about patents and the patent system, which leads to negative views such as "every time we come up with something new it is always covered by patents from elsewhere".

Typical misunderstandings relate to:

The scope of patent protection. Patents have territorial effect. They are only legally effective in the country where they are granted. If an invention is not patented in any particular country, it can be used in that country and products can be exported to any other non-patent country.

The difference between granted patents and published patent applications. Most of the readily available documents are patent applications, not granted patents. Some applications will not be granted and many will be granted with narrower scope of protection for the invention than in the claims of the published application. Searches should be carried out to determine where a patent application has been filed, if it has been granted, and, if so, if it has been maintained or dropped. Only then can its significance to proposed commercial activities be determined.

The myth of the "international patent". There is no such thing. A document published by WIPO under a number such as WO2008/12345 is not an international patent (that is, a document that is legally effective in all countries). It is merely a patent application that establishes a holding position for filing subsequent applications in the applicant's choice of countries by a defined deadline. Because of the costs of patenting, an international application may often be pursued in a few countries only or may even not be pursued at all nationally.

4. *HOODIA*

4.1. Overview

The pivotal role played by patents in stimulating research, development and trade, and the importance of traditional knowledge in contributing toward these factors, is vividly demonstrated in the case of *Hoodia* species, succulent plants indigenous to Southern Africa and long used as food and to stave off hunger and thirst by the indigenous San peoples, the oldest human inhabitants in Africa (White and Sloane, 1937). This knowledge was published by colonial botanists (Marloth, 1932) and led to the inclusion of *Hoodia* species in a 1963 project screening 300 edible wild plants of the region for their nutrient content and safety for use as bush foods by the South African-based Council for Scientific and Industrial Research (CSIR), one of the largest research organizations in Africa.

In 1997, following nine years of confidential development, a patent application was filed in South Africa by the CSIR that included the use of plant extracts and the active constituents of the plant responsible for suppressing appetite and treating obesity. This was done without the consent of the San, the original holders of knowledge about these properties, although the CSIR was eventually pressurized to enter into negotiations with the San and to develop a benefit-sharing agreement (see Box 2). The CSIR proceeded in 1998 to grant a license for the further development and commercialization of the patent to Phytopharm, a small UK company specialized in the development of phytomedicines (Phytopharm, 1997). The agreement granted Phytopharm an exclusive worldwide license to manufacture and market *Hoodia*-related products and to exploit any other part of the CSIR's IPRs relating to *Hoodia* species. Through a program dubbed "P57", Phytopharm developed this drug to a more advanced stage, leading to a license and royalty agreement in August 1998 with Pfizer, the US-based pharmaceutical giant, for further development and commercialization. However, the closure of Pfizer's Natureceuticals group led to the later withdrawal of Pfizer from the agreement.

In 2004, Phytopharm granted the consumer giant Unilever PLC. an exclusive global license for *Hoodia* gordonii extracts, with their likely incorporation into existing food brands as a functional weight-loss product for the mass market (Phytopharm, 2004) (Figure 4). Under the terms of the agreement, Unilever would buy exclusive rights to the product for an initial 6.5 million pounds sterling, rising to 21 million pounds sterling once it had achieved certain milestones. Phytopharm would also receive an undisclosed royalty on sales of all products containing the extract. Developments included clinical safety trials, manufacturing and the cultivation of some 300 hectares of *Hoodia* in South Africa and Namibia (Povey, Unilever research and development program director, pers. comm., 2007). Agreement was also reached between Unilever and the chemical company Cognis to develop a R750 million extraction facility for *Hoodia* in the Western Cape, South Africa (Department of Trade and Industry, 2008). This situation changed significantly in November, 2008, with the announcement by Unilever that it was to abandon plans to develop *Hoodia* as a functional food, because of safety and efficacy

concerns. Phytopharm will now seek other partners to further develop *Hoodia* and bring products to market (Phytopharm, 2008) although it is still too early to predict what this would imply for value-adding.

Much is at stake if a successful product is developed: the global value of functional foods, defined as "any modified food or food ingredient that may provide a health benefit beyond the traditional nutrients it contains" (Bloch and Thomson, 1995) is estimated at US$65 billion (Phytopharm, 2007), with the market value for the dietary control of obesity at over US$3 billion per annum in the US alone (Phytopharm, 2003). The growth potential of functional foods is predicted to be 50 per cent from 2005 to 2010, with an accelerating trend toward new products. Potential profits are thus highly significant, and could result in substantial returns not only for the companies involved, but also for the impoverished San.

A parallel *Hoodia* market has also emerged since 2001, based on trade in raw material (Figure 5). The CSIR patent covers *Hoodia* extracts (including pressed sap), but not non-extracted raw material. The publicity generated by the CSIR-Phytopharm-Unilever agreements, the marketing opportunities of San use of the plant, and the CSIR patent led to a frenzied interest in *Hoodia* amongst plant traders. By 2004 concerns about the threats posed to natural populations through unregulated collection led to the inclusion of *Hoodia* species in Appendix II of the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES, 2004).

By 2006 trade had escalated exponentially – in many cases illegally – from just a few tons to more than 600 tons of wet, harvested material per year, sold as ground powder for incorporation into non-patented dietary supplements. In North America in particular, dozens of *Hoodia* products were being advertised on the Internet and sold in drugstores and pharmacies as diet bars, pills, drinks and juice, all traded by a myriad of companies "free-riding" on the publicity and clinical trials of Phytopharm and Unilever. Most products were of dubious authenticity, contained unsubstantiated quantities of *Hoodia*, made unfounded claims, and in many cases implied association with the San, who received no benefits. Concerns led to closer analysis of products by the Food and Drug Administration (FDA), which revealed many to have little or no *Hoodia*, and to lack adequate evidence of safety (FDA, 2004). The US Federal Trade Commission (FTC) also brought action against spammers sending e-mail messages about *Hoodia* weight-loss products, alleging that the claims made for the products were false and unsubstantiated (FTC, 2007). In South Africa and Namibia, illegal trade and harvesting of *Hoodia* resulted in a number of prosecutions and arrests; the high prices commanded for the dry product of up to US$200 per kilogram had led to the incorporation of the plant into a global underground network of diamonds, drugs and abalone (Wynberg and Chennells, 2009).

Increasingly, however, concerns about the quality and safety of material sold as *Hoodia*, joined with over-harvesting concerns and recognition of the need to ensure the sustainability of a supply of *Hoodia* have led to a more regulated industry based on cultivated material. Greater vigilance on the part of the FDA and FTC as well as the American

Herbal Products Association is rapidly reducing the number of illegitimate products on the US market, and regulators in South Africa, Namibia and Botswana have introduced permitting procedures which prohibit wild harvesting of *Hoodia*, require its transparent cultivation, and set in place mechanisms to track trade across borders.

Figure 4. License and Benefit-Sharing Agreements Developed Between the San, CSIR, Phytopharm and Unilever

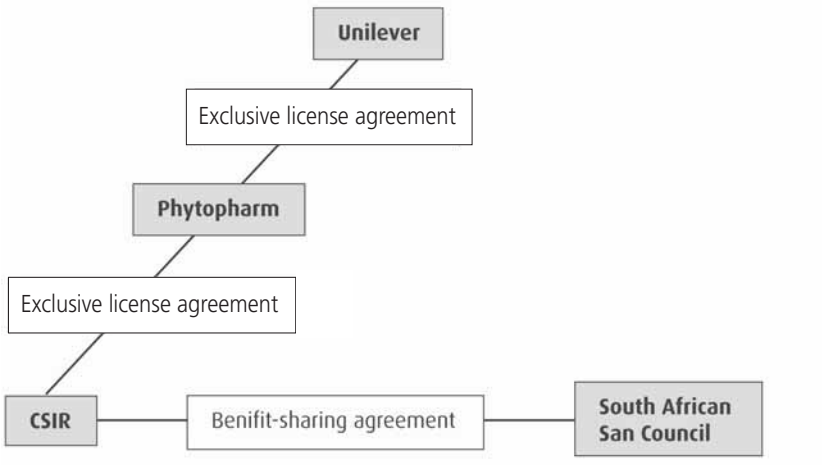
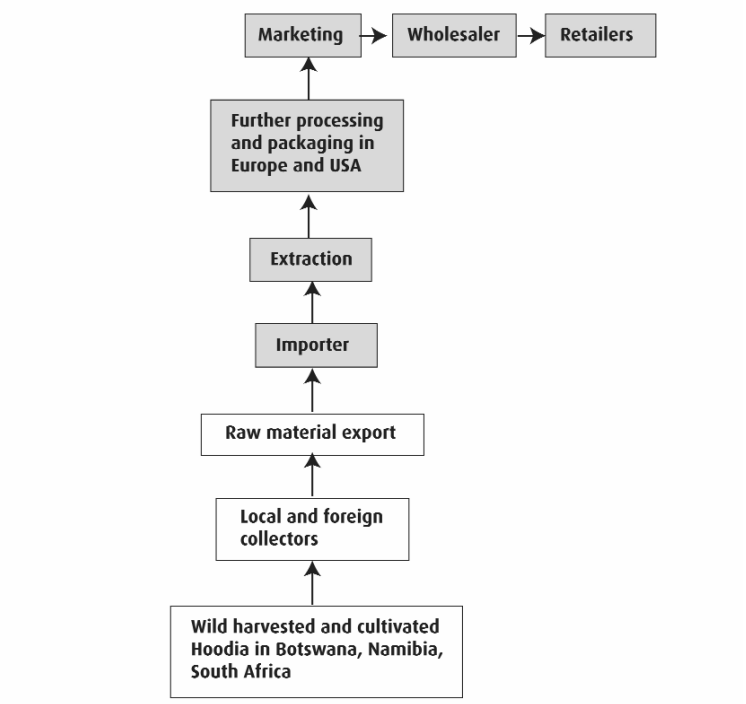


Figure 5. *Hoodia* Value Chain Based on a Non-Patented Dietary Supplement



4.2. *Hoodia* Patents and Patent Applications

Hoodia is atypical and possibly unique in that all commercial activity results from a single patent application. According to the esp@cenet database, the initial CSIR South African application was followed by an international application that was pursued in 81 countries (either directly or via regional applications such as a European application), including the US, Europe, South Africa and other African countries. A filing program of this extent is highly unusual. Often applications are filed in the applicant's home country only. More extensive programs typically extend only to about three to six countries.

The international application includes claims to processes for preparing a *Hoodia* extract comprising an appetite suppressant agent either by using a solvent for extraction or by pressing sap from solid plant material; extracts produced by the processes; extracts obtainable from *Hoodia* and containing a defined appetite suppressant steroidal glycoside; compositions containing the extracts: use of the extracts and compositions for appetite suppression and treatment of obesity. Also claimed are the appetite suppressant steroidal glycoside itself and other compounds in the same chemical family, chemical processes for producing the claimed steroidal glycosides; chemical intermediates used in the processes; and compositions containing the appetite suppressant steroidal glycosides; use of the steroidal glycosides and compositions for appetite suppression and treatment of obesity. Foodstuffs and beverages containing the extracts and steroidal glycosides are also claimed.

It is unusual to have all these different features claimed in one patent application. Usually, extracts and extraction methods for plant material known to have traditional uses form a "first generation" of patent applications, with the identification of active chemicals, their modification and chemical synthesis in a "second generation". In some cases, knowledge of the pharmaceutical activity of the chemical family to which the identified compounds belong can lead to proposals for new uses of the plant extracts unrelated to the traditional uses.

Because of the varied nature of the claims, in many countries it has been necessary to "divide" the application, so in some countries there may be several separate applications each directed to a different category of claim. This may include for example extracts and extraction processes, steroidal glycosides and processes for their production and chemical intermediates. Patents for some aspects of the invention have been granted in Europe and the US, but in both territories there are still applications pending.

In Europe, only one patent has been granted to date[8], with claims directed to the use of a *Hoodia* extract containing a defined appetite suppressant steroidal glycoside in the treatment of obesity and for reducing total calorific intake of a human or animal. There are pending divisional applications on other aspects of the invention.

In the US there are two granted patents to date, one claiming an extract obtainable from *Hoodia* (by solvent extraction or as pressed sap) which comprises a defined ap-

petite suppressant - steroidal glycoside, compositions containing the extract and the use of the extract for treating obesity and appetite suppression, the other claiming a method of appetite suppression using the defined appetite suppressant, steroidal glycoside. The first application also claims the appetite-suppressant steroidal glycoside itself, compositions containing the glycoside and processes for its chemical synthesis. Divisional applications are directed to other aspects of the invention.

Reasons for the extensive filing program are unknown but may be related to the fact that *Hoodia* products can be used in the pharmaceutical sector for treatment of clinical obesity and in the non-pharmaceutical sector for weight loss. Obesity is not just a problem in the Western world; it is becoming a universal problem with the adoption of Western diets and lifestyles. Furthermore, there is increased desirability to be slim. By adopting an extensive filing program the CSIR has kept open the opportunity for its ultimate licensee to exploit the appetite-suppressant properties of *Hoodia* worldwide.

4.2.1 Subsequent Patent Applications

Since the publication of the CSIR application, 22 further applications or families of applications have been filed, by various companies.

Two early families of applications (filed in 1999 and 2000), relating to the use of *Hoodia* extracts or the steroidal glycosides for treatment of gastric conditions and for diabetes treatment, were filed by Phytopharm (the CSIR's licensee) and then assigned to Unilever. Some patents have been granted, including in South Africa.

Seven applications were filed by Unilever in 2006. Three relate to formulations for nourishing appetite-suppressant products containing a steroidal glycoside, for example, in the form of a *Hoodia* extract. Two relate to processes for producing improved *Hoodia* extracts containing steroidal glycosides, and two relate to processes for preparing an aqueous edible dispersion of steroidal glycosides, preferably starting from a *Hoodia* extract. These applications are still in their international phase, with deadlines for national phase entry in 2008 and 2009.

Cognis (Cognis IP Man GmbH, Germany) filed four applications in 2006, relating to various cosmetic and/or pharmaceutical compositions, compositions for oral or topical administration and chewing gum compositions, all containing *Hoodia* extracts or the steroidal glycosides.

The remaining applications were filed by different applicants. There is one German-only application (Aquapharm Health and Nutrition) for a process to produce a *Hoodia* extract. A UK-originating application was directed to cultured *Hoodia* cells, but it was dropped.

In two recent patent applications, WO2008/074656 and the corresponding US 2008/0253762, Unilever claims a process for harvesting plants from the Apocynaceae family (which includes *Hoodia*) comprising:

(a) removing the plants from the soil;
(b) leaving the intact plants to cure to a moisture content of less then 90 per cent by weight;
(c) cutting up the cured plants; and
(d) further drying the cut plants, to obtain dried plant material comprising a steroidal glycoside of a specific defined formula (formula 2).

The "curing" step does not require any special processing. According to the patent application, the plants "are simply left until they have achieved a moisture content of less than 90 per cent by weight". The plants can be left on the soil from which they were removed, or under a shade net or in a building. The minimum suggested time is one day, the maximum 150 days.

The Unilever claim appears to cover what is done in harvesting and processing *Hoodia* in Southern African countries where it occurs naturally. Harvesting, generally of intact plants, is carried out by hand and may stretch over several days. This means that the harvested plants are left to lie outside or in a shed for several days until cutting into strips or slices starts. Cutting is a tedious process and it can take several weeks before the last of the harvested plants has been processed. During the time before the plants are cut, they will inevitably lose moisture, i.e. they will "cure". The cut pieces are then dried.

If the Unilever claim does indeed cover typical harvesting and processing of *Hoodia*, and those processes are not carried out under conditions of confidentiality, a consequence is that the claim is potentially invalid because of the public "prior use" of the process. In many countries public "prior use", wherever in the world it occurred, is an admissible ground for challenging a claim. However, a notable exception is the US, where public "prior use" is admissible only if it occurs in the US. Public prior use in Namibia or South Africa would thus be irrelevant. Investigations into the practice of US *Hoodia* growers are currently underway.

If the US patent application were to be granted, which is far from certain given the relevant documents on file, it could interfere with the ability of Southern African *Hoodia* producers to export their product to the US. Unilever's recent decision to abandon *Hoodia* development may, however, nullify this concern.

4.2.2 Appetite-Suppressant or Weight-Reduction Compositions

Other applications are directed to appetite-suppressant or weight-reduction compositions. Although the applicants may intend to use non-extracted *Hoodia* products that do not fall within the CSIR patent, it is not always easy to determine if the *Hoodia* material

used does actually fall within the CSIR use of the term "extract", which includes pressed sap as well as extracts obtained using solvents. For example, some applications refer to the use of a "juice" or "puree" of plant material. If a puree is homogenized whole plant material, it is arguably not an extract. However, a "juice" arguably could be. Some applications specifically refer to dry material (e.g. a milled plant), which does not fall within the CSIR claims.

Fleischner (US, US application only) proposes compositions and methods for body weight reduction using defined amounts of *Hoodia gordonii* and other defined compounds and extracts. The *Hoodia* material to be used consists of whole plants without the roots. No further details are given, but this presumably refers to dried, milled material.

Rifkin (US, US application only) describes appetite satiation and hydrating beverages containing various components including an extract, a concentrated powder, a puree or a juice of *Hoodia*. Of these, the puree may be non-extracted material.

Century Systems (US, US application only) claims a herbal composition for appetite suppression containing defined amounts of *Hoodia gordonii* and Cassia nomane and optionally further components. The *Hoodia* used is any part of the plant, preferably prepared by drying and milling (i.e. non-extracted material). It is stated that not all sources of *Hoodia* gordonii are equally effective. A preferred variety is available from a firm in Texas.

Shatkina (US, US and European patent only) relates to a replacement meal including an appetite suppressant containing various components including an extract from *Hoodia* that can be dry powder, juice or pulp. It is not clear if the dry powder is a powdered extract or powdered non-extracted material. Pulp and juice may or may not be considered an extract as is pressed sap.

Holt (US, Canadian application only) claims a herbal composition that contains various components including *Hoodia* material that is preferably powdered material from the whole plant, referring to Fleischner (see above) for use of the whole plant, not just extracts.

Smartburn Formulations Ltd. (US, US, European patent and Australian applications) relates to compositions for rapid weight loss and appetite control containing various components including *Hoodia*. In the description, the *Hoodia* material is described as *Hoodia* extracts that do not contain extracts of root material, but the example refers to "plant without roots". It is not clear, therefore, if an extract or dry material is used.

Soft Gel Technologies Inc. (US, PCT only) claims compositions containing a pine nut oil and a *Hoodia* extract.

4.3. Intellectual Property and Value Addition

As described above, the commercial development of *Hoodia* is based on two approaches: (1) a patented *Hoodia* extract, under development by Phytopharm and, until recently, Unilever as a functional food (Figure 4); and (2) commercialization of *Hoodia* as a raw, ground-up, non-extracted material through incorporation into herbal supplements (Figure 5), which does not fall within the CSIR patent.

The industry sectors that develop and commercialize *Hoodia* material are thus very different, the former representing the food industry, represented by the largest consumer company in the world; the latter the herbal supplements market, which is characterized by a large number of relatively small players with extremely divergent policies and ethics.

The economics between these sectors are also vastly different. For Unilever, the focus was on safety and efficacy and the company placed emphasis on having sufficient active material to achieve effective weight loss. This was estimated by Unilever to be orders of magnitude greater than the amounts currently sold in herbal supplements (K. Povey, Unilever, pers. comm., 2007). Thus Unilever required vast amounts of material, and had planted several hundred hectares of *Hoodia* prior to its decision to withdraw from *Hoodia* development. Far less material is used for the herbal supplement market and this, combined with the fact that it comprises a much larger group of smaller growers and traders, means that the *Hoodia* industry operates using different economies of scale. This could lead to the emergence of two price structures for consumers, as has happened for plant sterols: (1) a higher price for supplements, based on low volumes; and (2) a lower price for food, based on high volumes (K. Povey, Unilever, pers. comm., 2007). For *Hoodia*, much will depend on how much active ingredient is needed for efficacy and consumer demand for the product.

What does this mean in respect of value addition? A key question is to assess the different ways in which value is added to the variety of products, and the influence of the original CSIR patent and later patents on these processes. Here the main distinguishing feature is whether or not products incorporate extracts. Non-extracted *Hoodia* plant material, for example, that is dry, milled or powdered, can be produced freely in Southern Africa as the only applications that have been filed and patents granted in South Africa, are the initial CSIR application and the two Phytopharm applications (for treatment of gastric conditions and diabetes). All three patents relate to *Hoodia* extracts, not to non-extracted material, though it should be noted that the extracts include pressed sap.

Non-extracted *Hoodia* can also be exported freely to any country where there are no patents or applications that relate to the use of such material. However, some countries such as the US have patents or applications to pharmaceutical, herbal or nutritional compositions that utilize non-extracted *Hoodia* material.

In many countries, including the US, it is "indirect" (or "contributory") infringement to import, sell or offer for sale a product that is not itself patented but that will be used for

something that is patented. For example, it is potentially indirect infringement to import or sell or dry *Hoodia* material where a patent relates to the appetite-suppressant composition containing this material.

If the item that is imported or sold can only be used for the patented purpose, the situation is clear: there is indirect infringement. As a general rule, if the item that is imported or sold has substantial other, non-infringing uses, as is the case with *Hoodia*, then these circumstances will be taken into account. If the item is imported or sold with the knowledge that it will or could reasonably be used for the patented purpose, there will be indirect infringement.

The potential infringer is the party that imports the item into the country with the patent. Under British law, property will pass from a vendor to a buyer where and when the vendor and the buyer have agreed that it shall. Other legal systems may have different approaches, but in those countries where the legal system is based on British law this approach should apply. To remove potential ambiguities, it is good practice to specify in a sales agreement where and when the ownership of the property is transferred.

An exporter may therefore be able to avoid infringement by ensuring that the sale takes place under terms such that the ownership of the property passes from the exporter to the importer outside the country where the relevant patent exists, for example, in the exporter's home country. The same considerations apply if the exporter sells to a trader who then sells on to an importer. Transfer of ownership in the exporter's home (patent-free) country may avoid infringement. In the case of *Hoodia*, none of the appetite-suppressant and weight-reduction patent applications relating to non-extracted material referred to above appear to have been filed in Southern Africa so, provided the ownership of *Hoodia* material passes to the purchaser in Southern Africa, the exporter should not infringe.

Compositions containing non-extracted *Hoodia* material can be produced in Southern Africa and exported to any country where there is no patent (or, to be safe, pending application) for that particular composition, or for the use of that composition. The US compositions described above all contain various defined components in addition to the *Hoodia* material. There will only be infringement in the US if the composition contains all the defined components.

4.4. Value Adding Experiences

This analysis is to a large extent borne out by experiences within South Africa. The existence of the CSIR patent has meant that no firms which sell *Hoodia* as a dietary supplement currently manufacture extracts. However, some local firms are exploring their own intellectual property to look at other angles of value addition such as the manufacture of final products such as pills or food bars.

In fact, far from constraining value adding and local economic development, the influence of the original CSIR patent and later patent applications seem to have catalyzed an entire industry based on a product previously unexploited. Without the patents and the considerable research and development associated with this process it is unlikely that the herbal supplements sector, characterized by numerous small firms, would have developed the *Hoodia* industry at all.

The value adding impacts of the CSIR patent have also been substantial. The licensing of the patent by the CSIR has provided an important – albeit undisclosed – source of revenue for the CSIR and has been used to finance other projects. The license agreement also originally led to the construction of an FDA-approved medicinal plant extraction facility at the CSIR for the manufacture of material for use in *Hoodia* clinical trials, as well as the establishment of a Botanical Supplies Unit – both the first of their kind in the world. South Africa and Namibia are also the main locations for cultivation of *Hoodia*, generating employment opportunities. As evidenced by the initial interest in Cognis to develop an extraction facility for *Hoodia* in South Africa, there are also opportunities for technology development, although continued ownership of such facilities by foreign investors has led to questions about whether such transactions are genuine technology transfers of the kind that would result in widespread technology adoption in South Africa. Nonetheless, extraction in South Africa is certainly better than extraction in Germany, as occurs with devil's claw, as local people would be employed and local economies stimulated. While one product is unlikely to change South Africa's ability to become a conducive environment for technology transfer, it can catalyze a longer-term process of state support and investment in the natural products industry. Whether this is a sufficient condition for value addition is the topic for the third and final case study, that of the *Rooibos* tea industry in South Africa.

Box 2. Hoodia, the San and Benefit-Sharing

An issue that has dominated the case has concerned the way in which the San will benefit from commercialization of their traditional knowledge.[9] Up until 2001, the San remained oblivious to the fact that their knowledge of *Hoodia* had commercial application, and that this knowledge had led to research, scientific validation, and the filing of international patents by the CSIR. They were, moreover, excluded from lucrative deals being struck to develop commercial products. In 2003, however, following intense negotiations, an agreement was reached between the CSIR and the San, to give the San a share of royalties from product sales. In terms of the agreement,[10] the San will receive 6 per cent of all royalties received by the CSIR from Phytopharm as a result of the successful exploitation of products. This will be for the duration of the royalty period or for as long as the CSIR receives financial benefits from commercial sales of the products (Provisions 1.5 and 2). The San will also receive 8 per cent of the milestone income received by the CSIR from Phytopharm when certain performance targets are reached during the product development period. In the event of successful commercialization, these monies will be payable into a trust

set up jointly by the CSIR and the South African San Council to raise the standard of living and well-being of the San peoples of Southern Africa.[11]

In addition to spelling out the details with respect to benefit sharing and administrative aspects such as accounting, the agreement also broadly covers IP issues and, importantly, sets out comprehensive measures to protect and indemnify the CSIR. "Knowledge" is defined as "the traditional knowledge on the uses of the *Hoodia* plant that occurs in Southern Africa, originally in the hands of the San people". Provision 4 of the Agreement specifies that "any intellectual property that may be developed or created by the CSIR, including any patent, trademark or plant breeder's right, as a result of any use of the traditional knowledge, shall be and remain vested in the CSIR". Moreover, the San Council has no right to claim any co-ownership of the patents or products derived from the patents.

Despite acknowledgement by the CSIR that San traditional knowledge led to the commercial development of *Hoodia*, a different picture has emerged at the Board of Appeal of the European Patent Office (EPO). Indeed, the CSIR European patent application was initially refused, based on the belief that use of *Hoodia* for appetite suppression, weight loss and treatment of obesity was based on traditional knowledge of the San people. This was strongly refuted by the CSIR, whose arguments are set out clearly in the file history of European Patent Application EP0973534. The case went to appeal, and the Board of Appeal at the EPO accepted the CSIR's arguments and allowed claims to the use of a *Hoodia* extract that contains an effective amount of a defined appetite-suppressant steroidal glycoside in the manufacture of a medicament for treating, preventing or combating obesity, and to a non-therapeutic method of reducing total calorific intake of a human or animal by administering a *Hoodia* extract containing the defined appetite-suppressant steroidal glycoside. (Further applications claiming other aspects of the invention are still pending.)

The CSIR's position at the Appeal was that statements that may have been made after the filing date of its initial (priority) patent application by or on behalf of their exclusive licensee, Phytopharm PLC, and repeated by the media, embellishing with hindsight the prior traditional knowledge of the indigenous peoples of Southern Africa and that the teachings of the documents relating to such knowledge raised during examination of the European patent application, were fabrications issued without the authorization of the CSIR. The Board of Appeal held that there was no convincing evidence that documents published after the filing of its patent application reflect the reality about what was known before the application was filed and therefore did not consider those documents, but only the ones published before the application was filed.

The CSIR's position was that, to the extent that *Hoodia* was eaten by the San, it was as a bush food, to satisfy hunger and thirst. The only documented use of *Hoodia* in this context is that *Hoodia* was said to "quench" hunger and thirst for extended periods. The CSIR maintained that "quenching" hunger was simply the effect of eating

a filling and slowly digestible food, not a pharmacological effect on appetite, and that the periods are only extended in the context of the normal periods between meals for San people. The CSIR produced supporting evidence in this regard from a person who had been involved with the San for many years.

The CSIR produced evidence that the discovery of the appetite-suppressant effects was a result of screening hundreds of varieties of bush food for their nutrient content. One of the responses looked for in the testing, as an indication of toxicity, was suppression of appetite and loss of weight of the test animals. In the case of *Hoodia*, however, a pharmacological suppression of appetite was observed that turned out not to be associated with toxicity, which is unusual and therefore surprising. Testing in humans confirmed the appetite-suppressant effect. Analysis of the extracts and further testing resulted in identification of active steroidal glycoside compounds, and further work led to their chemical synthesis. Plasma levels of the major active compound that were found to reduce daily calorific intake in humans after administration of the chemical were compared with those resulting from sucking the sap or eating 50g of plant material. Low plasma levels resulting from eating a typical amount of *Hoodia* or sucking its sap suggested that the active compound obtained through typical San usage of the plant was too low to have any pharmacological appetite suppression effect.

The CSIR also pointed out that its invention has led to widespread imitation and considerable commercial activity by others. It indicated that the sudden eruption in imitations of the invention was strongly indicative that the invention was not obvious over traditional knowledge. If it had been obvious, it argued, the commercial potential would have prompted others to market *Hoodia* extracts for treatment of obesity, but this did not happen prior to the invention.

5. *ROOIBOS*

5.1. Overview

Rooibos tea is one of South Africa's oldest and most successful indigenous plant products, and has been cultivated on a commercial basis since the 1920s. The industry is based upon *Aspalathus linearis*, a leguminous plant indigenous to western parts of South Africa, the area where production is still centered. *Rooibos* has a long history of traditional use, having been harvested, prepared and consumed by the Khoi and perhaps the San for centuries (Thunberg, 1795; J. van Pitten, pers. comm.). Today, *Rooibos* is seldom prepared in the traditional way but rather in much the same way as Ceylon tea. Additionally, *Rooibos* has become increasingly popular as a health tea as it contains no harmful stimulants and is caffeine-free. Health-related qualities of *Rooibos* tea are ascribed mainly to its low tannin content, the presence of various minerals (albeit limited), and the antioxidant properties of several unique flavonoid C-glycosides such as aspalathin and nothofagin (von Gadow *et al*., 1997a; von Gadow *et al*., 1997b; Erickson,

2003), thought to protect against free radical damage that can lead to cancer, heart attacks and strokes. Increasingly, *Rooibos* tea is also used as an ingredient in cosmetics, slimming products and as a flavoring agent in baking, cooking and cocktails.

One of the most interesting aspects of the *Rooibos* industry is the extent to which it has received government support. Following the collapse of the domestic *Rooibos* market due to oversupply and renewed competition from imported teas after the Second World War, producers established the Clanwilliam Tea Cooperative in 1948. In 1954, at the request of the Cooperative, the Minister of Agriculture instituted the *Rooibos* Tea Control Scheme, a statutory, one-channel marketing system and for nearly 40 years its Board acted as the sole buyer from producers and also as the sole seller to approved exporters and tea processors. Through the establishment of the *Rooibos* Tea Control Scheme, the *Rooibos* industry could be assured of direct government protection and support, including subsidies for affiliated producers, research and the provision of extension services. This had clear ramifications, not only for the *Rooibos* industry which entered a period of substantial growth and development, but also for producers excluded from the scheme which in apartheid South Africa meant the mostly colored farmers who had traditionally gathered and cultivated *Rooibos* tea. In 1993 the Control Board was abolished and the Clanwilliam Tea Cooperative was transformed into a public company called Rooibos Ltd., which took over the assets and many of the functions of the Control Board. Since this deregulation the *Rooibos* tea industry has changed dramatically. Privatization, combined with the lifting of sanctions with the advent of a democratic South Africa, has opened up the industry not only to new producers, processors, packers, and distributors, but also to new marketing channels and investment opportunities (Hayes, 2000).

Rooibos tea has now emerged as a global product, highly sought after by health-conscious consumers, accounting for about 10 per cent of herbal tea sales globally (Snyman, 2004). Over the past 50 years *Rooibos* tea sales have grown from an average of 500–600 tons in the 1950s to a 20-fold increase of over 10,000 tons in 2003. Although domestic consumption has increased steadily, representing about 18 per cent of the South African tea market in 2004, export sales have been spectacular, exceeding local sales for the first time in 2001, with an annual growth rate of more than 30 per cent (Snyman, 2004). Volumes of organic *Rooibos* have increased in parallel and *Rooibos* tea is also the only Southern African species widely traded as a fair-trade product and certified as such. Today, more than 5,000 people are employed in South Africa by the industry, which in 2004 traded about 9,500 tons and had a domestic turnover of some 475 million rand (US$74 million), excluding export sales and non-tea products such as cosmetics and extracts (Snyman, 2004).

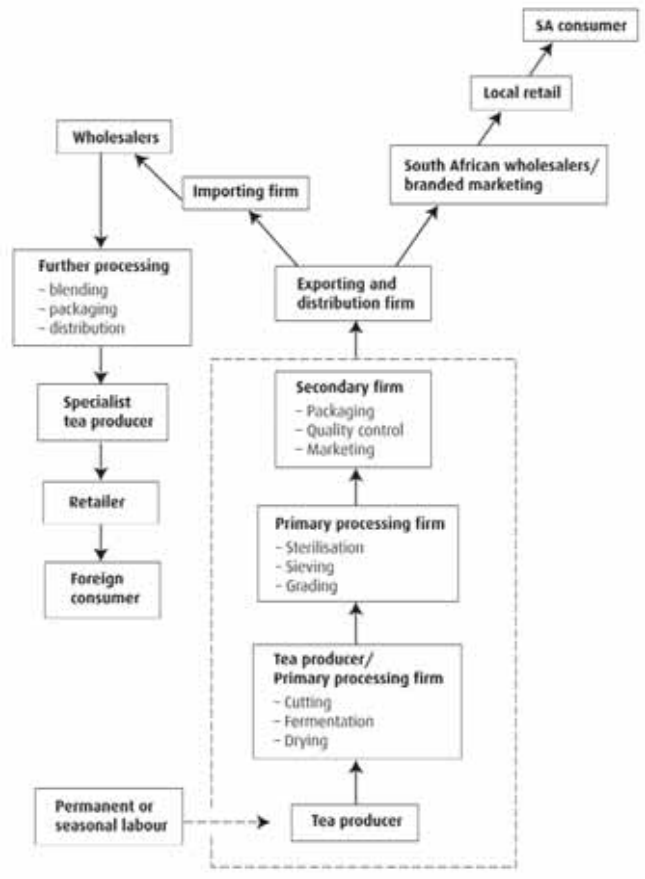
Like many other commodities, the *Rooibos* value chain is characterized by the variety of ways in which the original product, the leaf of the *Rooibos* plant, can be processed, blended, packaged and distributed. Key steps include:

- the cultivation and harvesting of the tea and its transport to a tea court;
- the cutting, fermentation and drying of the tea on a tea court;
- the sterilization, sieving and grading of the tea;

- tea packaging;
- the distribution of the tea, either to local wholesalers and retailers, or through export and import;
- further processing, blending, packaging and distribution;
- retail of the tea; and
- its final consumption.

Figure 6 illustrates a typical *Rooibos* value chain for conventional tea. These steps vary considerably depending on the final product (e.g. tea, extract, cosmetics), the different players and commercial actors involved, the location of producer and processing facilities, the different types of value adding that occur in various locations, and the varied markets (e.g. organic, conventional and fair-trade) across the world. Green tea, for example, will bypass the fermentation stage, and material for the cosmetic industry will typically pass through an extraction process (Tiedtke and Marks, 2002). Bulk tea exports will likely change hands more frequently than packaged tea.

Figure 6. A Typical Value Chain for Conventional Rooibos Tea



After Wynberg (2006).

5.2. Rooibos Patents and Patent Applications

The patents and applications relating to *Rooibos* have a very different filing pattern from *Hoodia*, where all patenting activity followed the initial South African patent application of the CSIR for *Hoodia* extracts, active compounds in those extracts and the use of the extracts and compounds. According to the esp@cenet database, the pattern of patenting activity is similar to, but even more extreme than, that for devil's claw. The *Rooibos* applications are predominantly for compositions exploiting properties of *Rooibos* and its extracts, with a small number of applications for new processes.

5.2.1 Categories of Application

The 95 entries for *Rooibos* in the esp@cenet database fall into the following categories:

- processes for producing *Rooibos* extracts (13)
- teas and similar beverages, health foods and processes for their production (23)
- pharmaceutical compositions and uses (24)
- cosmetic compositions and uses (15)
- deodorant compositions and uses (8)
- weight-loss compositions and uses (2)
- foods (5)
- smoking (1)
- others (3)
- unknown (1)

5.2.2 Geographical Range of Patenting

Of these 95 *Rooibos* applications, 67 were filed by Japanese companies, representing a remarkable predominance from that country. This may in part result from the relative cheapness of an initial Japanese application (significant costs can be deferred for several years).[12] Of those 67 applications, 15 were granted and appear to be in force, 10 are pending, and 42 were withdrawn or rejected, or were granted and have ceased.

Of the remaining 28 entries, the breakdown by country of applicant is as follows: the Republic of Korea (13), Germany (3), South Africa (4), the US and Canada (2), Russia, Greece, Bulgaria, joint Germany/Denmark (1).

Eighty-four of the applications were filed only in the home country of the applicant. Of the 11 applications filed in more than one country, one was dropped and two are still in the international phase.

5.2.3 Process Patents and Applications

Two of the process applications originate in South Africa. The first (ZA9306388), filed in 1993 by Forever Young CC, claims a method for producing a *Rooibos* extract that involves the use of enzymes to achieve at least partial destruction of fiber and cellulose tissue of the needles and chips. It is not known if this patent is still in force. The second, filed initially in South Africa in 2004 by the University of Stellenbosch Agricultural Research Council and then as an international application, appears to have been pursued in Europe only. It also relates to the use of enzymes in the production of a *Rooibos* extract and is having problems at the EPO. There does not appear to be a corresponding South African patent. A German-originating application filed in 2005 by Raps GmbH and pursued in Germany, Canada and at the EPO, relates to a solvent extraction process. The German application has been granted but the other two are still pending.

A Japanese patent, filed in 1986 by Shisheido and now ceased, relates to an antioxidant produced by a specified process. Two Japanese-only applications filed in 1993 by Nippon Ruibosuteii Honsha KK (one granted but ceased, the other withdrawn) relate to the use of an alkali or alkaline salt in the production of *Rooibos* extract. A further Japanese application, filed in 1994 by Asugen Seikyaku KK and now withdrawn, is directed to a simple extraction process. A patent filed in the name of Mitsui Norin KK in 1994 and granted in Japan, Europe and the US relates to a process for preparing an antiviral agent from *Rooibos*. Inabata Koryo Co. Ltd. has a granted Japanese patent, filed in 1997, to a process for obtaining *Rooibos* tea. Arita Noria filed a Japanese application in 2000 to a method for extracting minerals from *Rooibos* tea, but the application was withdrawn. A Korean-only application filed in 2000 by Dodo Corp. uses an aqueous/alcoholic extraction. Another Japanese-only application, filed in 2002 by Iwahara Masayayoshi, describes forming an epidermal powder by mixing *Rooibos* plant stems while rubbing them together, thereby peeling the epidermis and powdering the peeled epidermis. The application was rejected. A Korean-only application by Hanacos Co. Ltd, filed in 2002, relates to an extraction process involving a Sephadex purification step.

5.2.4 Composition Patents and Applications

Of the 82 patents and applications that relate to compositions of various kinds, 59 were filed by Japanese and 11 by Korean applicants. Of those 70 applications only two were filed in more than just the home country. One is in the name of Shirimatsu Shinyaku Co. and Itochu Fine Chemical Corp. and relates to an antimicrobial composition. Patents have been granted in the US and, via a European application, in France, Germany, Italy and the UK. The other is in the name of Mitsui Norin KK, and relates to an anti-viral and anti-cancer agent comprising an extract of *Rooibos*. Patents have been granted in Australia, Europe (France, Germany, Italy, Netherlands, Switzerland and the UK), the US and applications appear to be pending in Canada and China.

Of the other 12 composition applications, three, including a South African application, were filed in several countries including Europe and the US. The South African application, assigned to Gardian CIPLA (PTY) Ltd. is pending in South Africa, the US, Europe and, possibly, Australia. It relates to food supplements comprising an extract of *Rooibos*. A family of applications filed by Neutrogena Corp. has claims that have been amended, in Europe at least, and no longer include *Rooibos* as an ingredient. A joint application by Cortex Technology APS and Daimler Chrysler AG is pending in Europe and the US. Two further applications (Accelis Formulations and Symrise GmbH) are still in the international phase.

5.3. Intellectual Property and Value Addition

What are the links between these patents and value adding in South Africa? Despite strong government control and support of the *Rooibos* industry, and the effective creation of a monopoly prior to 1994, this has not led to enhanced value adding in the export market and South African companies have had little success with exporting branded and packaged products. Less than 5 per cent of *Rooibos* exports in 2003 accounted for value-added products, most of the remaining 95 per cent being bulk exported for use as a filler for herbal teas or, to a very limited extent, packaged by importers as teabags and sold as *Rooibos* tea (Snyman, 2004).

However, it is clear that the reasons for this low value adding cannot be attributed to patents. Most patent applications have been filed in the applicant's home country only, particularly Japan and the Republic of Korea, and existing patents thus present few restrictions to local value adding. In fact, it could be argued that far from impeding local value adding, existing patents provide commercial opportunities for production in South Africa and for export to all except the applicant's home country, and even there the product can be exported if the patent or application has been dropped, as is the case with many of the Japanese applications. As explained previously, if an application has not been filed in a country, the claimed invention can be worked in that country by using the patented process or by making the patented composition. Similarly, the product can be exported to any country where the application has not been filed. Even where an application has been filed in more than one country, the filing programs for *Rooibos* are not extensive, leaving many markets open.

Aside from patents, a complex mix of market and price constraints prevents local companies from adding value to *Rooibos* tea. One of the most prevalent is dominance by a handful of key international tea brokers. Most *Rooibos* is exported to Germany, Japan, Netherlands, the UK and the US which accounted for a combined total of about 81 per cent of all international *Rooibos* sales in 2008. Of these sales, Germany occupies a dominant position, representing 50 per cent of all *Rooibos* traded. In the German market, 15 to 20 tea agents buy *Rooibos* and redistribute it to blenders and packers, and the firms Hälssen & Lyons and Martin Bauer in particular play leading roles (Hayes, 2000). The dominance of German traders and tea brokers is a characteristic prevalent in many herb

and tea commodity chains, aided often through historical links and relationships. For example, the giant German herbal trader Salus Haus was given exclusive rights by the *Rooibos* Tea Control Board to trade *Rooibos* in the late 1950s (Department of Agriculture, 1958), and still plays a prominent role in the trade.

Other factors constraining value adding include high entry barriers into foreign markets, and import tariffs on retail-packed teas (Hayes, 2000; Snyman, 2004). These factors are exacerbated by the fiercely competitive nature of the *Rooibos* industry, more especially in the bulk market. Hayes (2000) remarks on the "senseless rivalry" that characterizes the industry, and the willingness with which South African *Rooibos* exporters are prepared to undercut other exporter's quotations to enable survival in a highly competitive and monopolized environment. These comments are remarkably similar to those expressed by different players in the devil's claw industry.

Further analysis of the *Rooibos* value chain highlights the significance of packaging in value adding. Table I summarizes findings from a 2005 study to compare value adding across different *Rooibos* value chains and illustrates that the bulk export of both conventional and fair-trade organic *Rooibos* tea results in South Africa capturing just 7 per cent of total value. Products that are packaged, in contrast, result in South Africa capturing 36 to 43 per cent of the retail price.

Increasingly, the local *Rooibos* industry is reacting to such trends through vertical integration and increased attempts to establish total control over its supply base. There are also growing innovations within the local industry through the development of *Rooibos* extracts, an instant *Rooibos* tea, new types of drink, and more aggressive entry into niche markets. The reliance on patents for such innovations, however, is questionable. One of the only local firms to hold a patent for an extraction process for *Rooibos* noted that "the patent was not really necessary but it gave us a competitive edge in the initial stages and kept other players out of the market". Other local firms have displayed little or no interest in using patents as an opportunity for value adding, despite good commercial prospects. Patenting in countries such as Japan and the Republic of Korea could also be fruitful in view of the apparent interest there in *Rooibos* products.

Despite little focus on patents in the local *Rooibos* industry, much attention has been given to the possibilities of using geographical indications to protect products. This followed registration of the name "*Rooibos*" as a trademark in the US, effectively thwarting export attempts to the US from South Africa, and leading to litigation in the US courts. Although the case was settled out-of-court following a district court ruling, it has contributed toward the motivation to amend IP law to allow trademarks and geographical indications to be able to provide protection of certain names and features associated with traditional knowledge such as *Rooibos* tea (Troskie, 2007). Such initiatives offer valuable ways to enhance the local industry but their more detailed consideration falls outside the focus of this paper[13].

Table 1. *Rooibos* Value Chain, Indicating Proportional Value Captured by Each Player, Within Different Trade Models

Value Chain	Conventional *Rooibos* (local sale conventional tea, value adding South Africa)		Organic *Rooibos* (bulk export)		Fair-trade *Rooibos* through intermediary (value adding South Africa)		Fair-trade *Rooibos* through intermediary (bulk export organic)		Fair-trade direct (value adding South Africa)	
	Selling price (US$ per kg)	% value captured	Selling price (US$ per kg)	% value captured	Selling price (US$ per kg)	% value captured	Selling price (US$ per kg)	% value captured	Selling price (US$ per kg)	% value captured
Producer/ harvester	2,53	15.8	2,75	4.2	2,48	6.3	2,48	3.0	2,89	3.7
Producer organization	-	-	-	-	1,46	3.7	1,46	1.8	11,94	15.3
Middleman/ local trader	5,79	36.2	1,56	2.4	10,54	26.6	2,05	2.5	19,03	24.0
SA retailer	5,72	35.7	-	-	-	-	-	-	-	-
SA VAT	1,97	12.3	-	-	-	-	-	-	-	-
FLO premium	-	-	-	-	-	-	-	-	0,82	0.8
ATO premium	-	-	-	-	1,45	3.7	0,6	0.7	3,28	4.2
European trader	-	-	40,62	62.6	16,02	40.4	59,14	71.8	35,83	46.0
European retailer/ Netherlands worldshop	-	-	15,72	24.2	5,49	13.9	11,98	14.5	-	-
European/ Netherlands VAT	-	-	4,24	6.5	2,25	5.7	4,66	5.7	4.41	5.7
Total	16,01	100.0	64,89	100.0	39,69	100.0	82,37	100.0	78,00	100.0
Net value captured by producer country (US$)	16,01	100.0	4,30	7.0	14,48	36.0	5,99	7.0	33,86	43.0
Net value captured in Europe	0	0	60,59	93.0	25,21	64.0	76,38	93.0	44,14	57.0
Consumer price as multiple of producer price	6		24		16		33		27	

All figures are converted to US$ and pertain to 2004.

Figures are derived from a survey conducted of players within each value chain and from Wynberg and Custers (2005) and Wynberg (2006). The FLO and ATO premiums refer to the premiums paid by FLO or an ATO to producer organizations. In 2004 this was 10 per cent of the free-on-board (FOB) price.

6. DISCUSSION AND CONCLUSIONS

Results presented from these case studies demonstrate that patents can both hinder and promote value adding in the Southern African natural products sector, and that it is difficult to be definitive about the specific role played by patents in value adding at a generic level. While there are certain patents that restrict particular devil's claw extraction techniques in specific territories, other extraction techniques are available to local industry to enable similar extracts to be made within Southern Africa. However, such subtleties are not always recognized by local firms who typically give up in the face of perceived restrictions. Similarly, the *Hoodia* case has demonstrated that patents do restrict certain extraction techniques, but that without such patents the industry is unlikely to have existed in the first place. For *Rooibos*, patents simply play no role at all at present in inhibiting value adding in the local industry.

The question as to whether patents stimulate industrial activity in the natural products sector is less definitive. Certainly for devil's claw and *Hoodia* patents have played a catalytic and positive role in stimulating trade, research and industrial activity. Although the *Rooibos* industry has thrived without the overt influence of patents, its substantial development would not have been possible without strong government support. Having said this, the suite of *Rooibos* patents and applications in Japan and the Republic of Korea for example, could open up markets and products for local exploitation. This is an opportunity that has not yet been seized by local firms.

It is also clear that the significant research, marketing and IP investments made over the past 50 years have contributed substantially to the growth of the Southern African natural products sector and the realization of its benefits. However, without prior traditional knowledge in all of the cases examined there would probably have been no industry at all. This is a factor that has been underplayed in the sector, although increasingly it is being recognized through benefit-sharing agreements and attempts to include traditional knowledge holders more actively within the local industry.

Findings have also been presented that demonstrate extremely low levels of awareness of the importance of intellectual property and technology transfer in local firms. Typically, local firms do not comprehensively investigate the extent to which they are free to operate and, where patents exist, need to be convinced that their mere existence does not necessarily constitute a business risk and indeed that they may not be valid at all. PhytoTrade Africa, a company that trades a variety of African natural products on behalf of small producers, remarks that investors are often scared off by the presence of patents – even if these are not legally effective. "Patents muddy the waters for investors wanting to do research and development, even if applications are not granted. A big investor would be put off [by patent applications] as the territory is too murky and unsure. The quality of the patent is key as it is often very poor. This has an impact on development as the burden of proof rests with those trying to take it forward." Moreover, little attention has been given to the possibility of licensing-in as a strategy for companies to start upgrading themselves technologically.

An important conclusion from this research thus points toward the need to design industry-specific interventions such as talks, seminars and courses to raise awareness and capacity among local firms about the nature and application of patents and their implications. Issues of liability and risk are especially crucial for local firms, including ways in which "indirect or contributory" infringement is interpreted and the options open to them to pass on ownership of raw material in Southern Africa – and thus minimize risk. It is also important for any party using, or considering the use of, patents and applications to monitor the intellectual property regularly. A patent may lapse in a country due to non-payment of renewal fees, an application may be dropped or rejected, or the claims may be narrowed so they are no longer relevant. If so, the claimed product can be exported to that country. Because applications are not published until 18 months after the initial filing date, searches should be updated regularly as there may be relevant applications in the pipeline.

Finally, all three cases reveal that in addition to the existence of an IP option, factors that influence value adding are complex and interdependent. Key factors accounting for low levels of value adding in the Southern African natural products sector stem from restricted market access, buyer dominance, a lack of strategic alignment amongst producers, and insufficient technical and financial capacity to meet quality control standards. Local firms would do well to build long-term strategic relationships with both competitors and commercial partners whilst enhancing their awareness of the IP environment to facilitate local value addition.

Notes

1 The exploration of biodiversity for commercially valuable genetic and biochemical resources.

2 A further database, providing comprehensive information on international patent applications filed under the Patent Cooperation Treaty (PCT) is PatentScope, the WIPO on-line database, available at: *www.wipo.int/pctdb/en*.

3 "Biopiracy" has emerged as a term to describe the ways that corporations from the developed world claim ownership of, free ride on, or otherwise take unfair advantage of, the genetic resources and traditional knowledge and technologies of developing countries (Dutfield, 2004).

4 Note that this is according to the esp@cenet database. Information regarding patent applications filed at the South African Patent Office is not available on-line and has not been checked.

5 Newnham x 2, von Beckerath, Moati, Sincholle, Weisman and Moreau.

6 This estimate is based on 2002 data and assumes an average retail price of US$200 per kg, based on an Internet survey of existing devil's claw products sold by companies such as the Organic Herb Trading Company, available at *http://www.iherb.com* and Solgar. However, this figure varies considerably, depending on the product sold, its quality and the type of processing, and may be as high as US$350 per kg. (but is likely not as high as the US$700 per kg. proposed by GRAIN (2000)). An example of one calculation follows:
- Solgar sells a bottle of 60 devil's claw vegecaps for 13.35 pounds sterling.
- Each pill comprises a 300 mg. extract of devil's claw and 150 mg of raw devil's claw powder.
- The industry standard extraction rate for devil's claw is 6:1
- Thus each bottle comprises ((300 mg. X 6) + 150 mg.) X 60 = 117,000 mg
- This equates to 114 pounds sterling per kg., or US$200 using 2002 exchange rates.

7 Because of the notoriously secretive nature of the devil's claw trade, these figures are at best an approximation. A more comprehensive analysis of the value captured at specific steps along the processing and manufacturing chain and the margins secured at each point has not been possible, largely due to reluctance on the part of industry players to divulge this information. However, it is important to recognize that the manufacturing and retail components of the chain in themselves comprise myriad steps and variations. For example, the manufacture of devil's claw pills may typically be subcontracted by pharmaceutical firms, and then distributed wholesale before reaching the retailer. Products may also have margins associated with the use of brand names. Different extraction and processing techniques will also have different sets of associated costs. This information is vital for a fuller analysis of the value chain to be undertaken.

8 i.e. by 1 June 2008

9 See Wynberg, 2004, and Wynberg and Chennells, 2008, for a detailed account of this issue.

10 Benefit-Sharing Agreement between the CSIR and the South African San Council, March 2003.

11 Deed of Trust of the San *Hoodia* Benefit-Sharing Trust.

12 The official fees on filing a Japanese patent application are only 15,000 yen (about 90 euro or US$140). In contrast, the basic official fees on filing a European Patent application are in the order of 1,230 euro (US$2,000), on filing a US application about US$515 for a small entity, i.e. a person, small business concern or non-profit organization or US$1,030 for a large entity, and on filing a PCT (international) application in the order of 2,610 euro to US$3,365 (all fees as at June 1, 2008).

13 On this issue, see Chapter 3 by Biénabe *et al*.

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References

Biswas, T. and J. Potts, 'Grounds for Action: Looking for a Sustainable Solution to the Coffee Crisis', *Bridges* 7(2), 17–18, 2003.

Bloch, A. and C. Thomson, 'Position of the American Dietetic Association: Phytochemicals and Functional Foods', *Journal of the American Dietetic Association*, 95(4):493–6, 1995.

Chen, Y. and T. Puttitanum, 'Intellectual Property Rights and Innovation in Developing Countries', *Journal of Development Economics* 78:474-493, 2005.

Chrubasik, S., C. Zimpfer, U. Schutt and R. Ziegler, 'Effectiveness of *Harpagophytum procumbens* in Treatment of Acute Low Back Pain', *Phytomedicine* 3, 1–10, 1996.

CITES, 'Amendments to Appendices I and II of CITES, Proposal to the Thirteenth Meeting of the Conference of the Parties, Bangkok, Thailand, October 2–14, 2004', available at *http://www.cites.org/common/cop/13/raw_props/BW-NA-ZA-Hoodia.pdf* (accessed April 7, 2006), 2004.

Cole, D. and B. Bennett, 'Trade, Poverty and Natural Products: Lessons Learned from Namibian Organic Devil's Claw', unpublished report prepared for Namibian Trade and Poverty Programme, DfID, 2007.

Commission on Intellectual Property Rights, 'Integrating Intellectual Property Rights and Development Policy', Commission on Intellectual Property Rights, available at *http://www.iprcommission.org/graphic/documents/final_report.htm*, London, 2002.

Convention on Biological Diversity, *Gap Analysis, Draft Report prepared for the Ad Hoc Open-Ended Working Group on Access and Benefit Sharing*, UNEP/CBD/WG-ABS/5/3, Montreal, October 8-12, 2007.

CSIR, 'Adding Value to South Africa's Biodiversity and Indigenous Knowledge through Scientific Innovation', available at *http://www.csir.co.za* (accessed February 4, 2002), 2001.

Department of Trade and Industry, Address by the Minister of Trade and Industry, Mandisi Mpahlwa to the National Council of Provinces, 29 May 2008, *http://www.thedti.gov.za/article/articleview.asp?current=1&arttypeid=2&artid=1575*

Diederichs, N. (ed), *Commercializing Medicinal Plants. A Southern African Guide*, SUN Press, Stellenbosch, 2005.

Dutfield, G., *Intellectual Property Rights, Trade and Biodiversity: Seeds and Plant Varieties*, Earthscan, London, 2000.

Dutfield, G., 'What is Biopiracy?' Paper presented at the International Expert Workshop on Access to Genetic Resources and Benefit Sharing, Cuernavaca, Mexico, available at *http://www.canmexico.com/documents/papers/I.3.pdf*, October 24-27, 2004.

Endangered Wildlife Trust, 'The Biodiversity of South Africa 2002. Indicators, Trends and Human Impacts', Struik, Cape Town, 2002.

Erickson, L., '*Rooibos* Tea: Research into Antioxidant and Antimutagenic Properties', *HerbalGram* 59:34–45, 2003.

FDA, '75-Day Pre-Market Notification of New Dietary Ingredients', US Food and Drug Administration, Washington D.C., available at *http://www.fda.gov*, 2004.

FTC, 'FTC Stops International Spamming Enterprise that Sold Bogus *Hoodia* and Human Growth Hormone Pills', Federal Trade Commission, available at *http://www.ftc.gov/opa/2007/10/Hoodia.shtm* (accessed April 5, 2008) Washington D.C., October 10, 2007.

Gebhardt, M., 'Sustainable Use of Biodiversity by the Pharmaceutical Industry?' *Int. J. Sustainable Development* 1(1):63–72, 1998.

Geldenhuys, C.J. and B.E. Van Wyk, 'Indigenous Biological Resources of Africa', in *Rebirth of Science in Africa. A Shared Vision for Life and Environmental Science,* H. Baijnath and Y. Singh (eds.), Umdaus Press, Pretoria, 116–132, 2002.

Gibbon, P. and S. Ponte, 'Trading Down. Africa, Value Chains, and the Global Economy', Temple University Press, Philadelphia, US, 2005.

Giess, W. and J.W. Snyman, 'The Naming and Utilisation of Plantlife by the Žu'hõasi Bushmen of the Kau-kauveld', in *Contemporary Studies on Khoisan* 1, R. Vossen and K. Keuthmann (eds.), *Quellen zur Khoisan-Forschung*, Helmut Buske Verlag, Hamburg, Germany, 1995.

GRAIN, 'Biodiversity for Sale. Dismantling the Hype about Benefit Sharing. Global Trade and Biodiversity in Conflict', Issue no. 4, available at *http://www.grain.org/briefings_files/benefitsharing.pdf* (accessed April 10, 2006), 2000.

Grünwald, J., 'Expanding the Market for Devil's Claw in Europe', report prepared for the Namibian National Devil's Claw Situation Analysis, 2003.

Hayes, P.B., 'Enhancing the Competitiveness of the *Rooibos* Industry', M.Phil. thesis, University of Stellenbosch, 2000.

Hersch-Martinez, P., 'Commercialization of Wild Medicinal Plants from Southwest Puebla, Mexico', *Economic Botany* 49(2):197–206, 1995.

Kaplinsky, R. and M. Morris, 'A Handbook for Value Chain Research', prepared for the IDRC, available at *http://www.ids.ac.uk/ids/global/valchn.html#manuals* (accessed March 30, 2006), 2001.

King, S.R., E.N. Meza, T.J.S. Carlson, J.A. Chinnock, K. Moran and J.R. Borges, 'Issues in the Commercialization of Medicinal Plants', *Herbalgram* 47:46–51, 1999.

Krafft, M., 'Namibian Export Issues', in the Proceedings of the First Regional Devil's Claw Conference, 122–124, Windhoek, February 26-28, 2002.

Krugmann, H., D. Cole and P. du Plessis, 'Access and Benefit-Sharing Mechanisms for the Use of Botanical Resources in Namibia', DEA research discussion paper no. 66, Directorate of Environmental Affairs, Namibia, 2003.

Laird, S. and R. Wynberg, *Access and Benefit-Sharing in Practice: Trends in Partnerships Across Sectors*, Volumes I, II and III, CBD Technical Series 38, Secretariat of the Convention on Biological Diversity, Montreal, 2008.

Lanhers, M.C., J. Fleurentin, F. Mortier, A. Vinche and C. Younos, 'Anti-Inflammatory and Analgesic Effects of an Aqueous Extract of *Harpagophytum procumbens*', Planta Medica 58:117–123, 1992.

Lettington, R.J.L., 'Access to Genetic Resources in the Republic of Kenya', in *African Perspectives on Genetic Resources: A Handbook on Laws, Policies, and Institutions*, K.R. Nnadozie, C. Lettington, S.B. Bruch and S. King (eds.), Environmental Law Institute, Washington, 2003.

Lombard, C., 'Identification of Important Devil's Claw Export Trade Issues in Namibia', report prepared for the Namibian National Devil's Claw Situation Analysis, 2003.

Marloth, R., *The Flora of South Africa*, Volume III, 94, Cape Town, London, 1932.

Maskus, K, Intellectual Property Rights in the Global Economy, Institute for International Economics:123, Washington D.C., 2000.

Moussard, C., D. Alber, M.M. Toubin, N. Thevenon and J.C. Henry, 'A Drug Used in Traditional Medicine, *Harpagophytum procumbens*: No Evidence for NSAID-Like Effect on Whole Blood Eicosanoid Production in Humans', *Prostaglandins Leukotrienes and Essential Fatty Acids*, 46:283–286, 1992.

Neumann, R.P. and E. Hirsch, *Commercialization of Non-Timber Forest Products: Review and Analysis of Research*, Centre for International Forestry Research, Bogor, Indonesia, 2000.

Phytopharm, 'Phytopharm to Develop Natural Anti-Obesity Treatment', press release June 23, 1997, available at *http://www.phytopharm.co.uk/press/Rel10final.htm* (accessed April 10, 2006), 1997.

Phytopharm, 'Annual Report and Accounts for the Year ended 31 August, 2003', available at *http://www.phytopharm.co.uk/press/annualreport2003.pdf* (accessed April 10, 2006), 2003.

Phytopharm, 'Interim Results for the Period to 29 February 2004', press release May 5, 2004, available at *http://www.phytopharm.co.uk/press/Interim2004.pdf* (accessed April 10, 2006), 2004.

Phytopharm, 'Phytopharm Initiates Stage 3 Activities of Joint Development Agreement for *Hoodia* Extract with Unilever', available at *http://www.phytopharm.com/news/newsreleases/?id=7324* (accessed April 5, 2008), September 24, 2007.

Phytopharm, 'Preliminary Results for the period ended 30 September 2008', 27 November, 2008, available at *http://www.phytopharm.co.uk/news/newsreleases/?id=16517*

PhytoTrade Africa, PhytoTrade Africa's Approach, available at *http://www.PhytoTradeafrica.com/about/approach.htm* (accessed April 6, 2006), 2006.

Snyman, S., 'Customised Sector Program Report for *Rooibos* Sector', Trade & Investment South Africa, Department of Trade and Industry – Agroprocessing, August 2004.

Southgate, D., M. Coles-Ritchie and P. Salazar-Canelos, 'Can Tropical Forests be Saved by Harvesting Non-Timber Products? A Case Study for Ecuador', in *Forestry,Economics and the Environment*, W.L. Adamowicz (ed.), 68–80, CAB International, Wallingford, UK, 1996.

Terre Blanche, M. and K. Kelly, 'Interpretive Methods', in *Research in Practice. Applied Methods for the Social Sciences,* M. Terre Blanche and K. Durrheim (eds.), 123–146, University of Cape Town Press, Cape Town, 1999.

Thunberg, C.P., *Travels in Europe, Africa and Asia, Made Between the Years 1770 and 1779,* Volume 4, Third edition, F. & C. Rivington, London, 1795.

Tiedtke, J. and O. Marks, '*Rooibos* – the New "White Tea" for Hair and Skin Care', *Euro Cosmetics*, 6:16–19, 2002.

Troskie, D., 'Geographical Indications at the National Level. A Variety of Approaches and Institutional Aspects', paper presented at the International Symposium on Geographical Indications organized by WIPO and the State Administration for Industry and Commerce of the People's Republic of China, WIPO/GEO/BEI/07/1, 2007.

Volk, O.H., *'Zur kenntnis von Harpagophytum procumbens DC', Deutsch Apotheker-Zeitung* 104:573–576, 1964.

Von Gadow, A., E. Joubert and C.F. Hansmann, 'Comparison of Antioxidant Activity of Aspalathin with that of Other Plant Phenols of *Rooibos* Tea *(Aspalathus linearis)*, alpha-tocopherol, BHT and BHA', *J. Agric. Food Chem.*, 45:632–638, 1997a.

Von Gadow, A., E. Joubert and C.F. Hansmann, 'Comparison of the Antioxidant Activity of *Rooibos* Tea *(Aspalathus linearis)* with Green, Oolong and Black Tea', Food Chem., 60(1):73–77, 1997b.

Watt, J.M. and M.G. Breyer-Brandwijk, *The Medicinal and Poisonous Plants of Southern and Eastern Africa,* Second edition, Livingstone, London, 1962.

White, A. and B.L. Sloane, *The Stapelieae*, Vol III, Second edition, Pasadena, California, US, 1937.

Wynberg, R., 'Bioprospecting, Access and Benefit-Sharing in South Africa: toward a Strategic Assessment', a paper prepared for the National Botanical Institute as a contribution toward the Southern African Biodiversity Support Program and National Biodiversity Strategy and Action Plan, available at *http://www.environment.gov.za* (accessed April 4, 2006), 2004.

Wynberg, R., 'Identifying Pro-Poor, Best Practice Models of Commercialization of Southern African Non-Timber Forest Products', PhD thesis, 343 pp., University of Strathclyde, Glasgow, 2006.

Wynberg, R. and S. Custers, 'Determining a Fair Price and Equitable Benefit for Small-Scale *Rooibos* Tea Producers. An Analysis of the Costing and Pricing of Small-Scale Production of Organic and Fair-trade *Rooibos*, and Benefit Flows along the *Rooibos* Value Chain', report prepared for Fair-trade Assistance, Netherlands, October 2005.

Wynberg, R. and R. Chennells, 'Green Diamonds of the South. A Review of the San-*Hoodia* Case', in *Indigenous Peoples, Consent and Benefit-Sharing. Learning from the San-Hoodia Case,* R. Wynberg, R. Chennells and D. Schroeder (eds.) Springer, Berlin, Forthcoming 2009.

CHAPTER 3
AN ECONOMIC ANALYSIS OF THE EVOLUTION IN INTELLECTUAL PROPERTY STRATEGIES IN THE SOUTH AFRICAN AGRICULTURAL SECTOR: THE ROOIBOS INDUSTRY

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Abstract

The food consumption trend toward more diverse products with a strong cultural value is creating opportunities for producers to move away from low-value agricultural production into niche markets. The ability of local communities and enterprises to benefit from the commercial exploitation of their heritage crucially depends on their capacity to collectively define, market and protect these specific resources. This is the context of the paper as it sets out to explore how IP strategies are evolving in the South African *Rooibos* industry in response to changing consumer demand and threats of misappropriation. The subject is approached through an analysis of the private and collective quality signaling and management through the use of IP strategies. It approaches intellectual property from a marketing and labeling perspective and focuses, as such, on the use of trademarks and geographical indications within individual and collective reputation and quality signaling strategies in the *Rooibos* industry. From an economic perspective the focus falls on the move from individual or restricted group strategies of utilization of existing IP options to the incorporation of a collective approach to IP protection and how quality objectives are pursued through this. The paper proceeds by providing a legal background to geographical indications and trademarks in South Africa. This is followed by a discussion on the development of the South African *Rooibos* industry and its main features. The current IP strategies developed by the different role players in the *Rooibos* industry with respect to marketing and quality labeling associated with the name and product "*Rooibos*" are then documented. Based on this, the key dimensions and potential impacts of developing a collective IP strategy at industry level are discussed.

1. INTRODUCTION

Trends in the food sector in recent years indicate that consumers are increasingly placing value on products they can associate with a certain place and/or specific means of production (Ilbery and Kneafsey, 1998). This growing demand for authentic, traditional, wholesome and traceable food is the result of various factors such as higher awareness of food safety, the socio-cultural status of consuming certain foods and renewed interest in and nostalgia for culinary heritage (Ilbery and Kneafsey, 2000).

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This food consumption trend toward more diverse products with a strong cultural value is creating opportunities for producers to move away from low-value agricultural production into niche markets. Geographical indications for agricultural and agrifood products institutionalize the tacit reputation which consumers confer on some geographic or cultural attributes. This could potentially lead to an increase in prices paid to producers, higher profitability and spill-over effects on the local economy (local employment generation; rural economic and cultural vitality).

The commercial value of geographical names is confirmed by the increasing number of trademarks being registered which incorporate regional names, in an attempt by firms to identify and link their products to names and regions of high reputation. With this comes the threat of misappropriation, as producers not even remotely linked to the geography or the values and images of the region, exploit regional names for profit.

The ability of local communities and enterprises to benefit from the commercial exploitation of their heritage depends crucially on their capacity to collectively define, market and protect these specific resources. The South African agricultural landscape has however, been characterized by a clear lack of collective action both at local and national level for improving production, commercialization and competitiveness. Commercial farmers as well as processors are accustomed to acting on an individual basis, and emerging and resource-poor farmers are generally little involved in local farmers' organizations.

This is the context of the paper as it sets out to explore how IP strategies are evolving in the South African *Rooibos* industry in response to changing consumer demands and threats of misappropriation. The subject is approached through an analysis of the private and collective quality signaling and management through the use of IP strategies. It approaches intellectual property from a marketing and labeling perspective and will, as such, focus on the use of trademarks and geographical indications within individual and collective reputation and quality signaling strategies. Given the interesting features of the *Rooibos* industry in this regard, the analysis is based on the evolution and use of a variety and combination of IP strategies within this industry. From an economic perspective the focus falls on the move from individual or restricted group strategies of utilization of existing IP options to the incorporation of a collective approach to IP protection and how quality objectives are pursued through this. The paper proceeds by providing a legal background to geographical indications and trademarks in South Africa. This is followed by a discussion on the development of the South African *Rooibos* industry and its main features: we document the current IP strategies developed by the different role players in the *Rooibos* industry with respect to marketing and quality labeling associated with the name and product *Rooibos*. Based on this, we discuss the key dimensions and potential impacts of developing a collective IP strategy at industry level.

2. BACKGROUND

There are varying definitions for geographical indications in the different legal instruments that exist in different regions of the world (e.g. EU Regulation 510 of 2006, Indian Geographical Indication of Goods Act of 1999). Section 3 of the TRIPS Agreement defines geographical indications as:

> "Indications which identify a good as originating in the territory of a Member [of the WTO], or region or locality in that territory, where a given quality, reputation or other characteristic of the good is essentially attributable to its geographic origin."

The TRIPS Agreement sets out the minimum standards of protection that WTO Members are bound to comply with in their respective national legislation. Article 22 also states that Members shall provide "the legal means for interested parties to prevent (a) […] the use of any means […] which misleads the public as to the geographical origin of the good […] or (b) any use which constitutes an act of unfair competition […]". A debate ensued the implementation of the TRIPS provisions on geographical indications, with the US and the EU at its helm and in opposing positions. Put simply, the US is arguing that geographical indications are sufficiently protected under trademark laws whereas the EU insists that they need a *sui generis* registration system.

In contrast with Southern European countries, South Africa does not have a cultural history of GI protection. However, as a founding member of the WTO, South Africa must comply with the minimum requirements for the protection and enforcement of IPRs, as provided for in TRIPS. South Africa complies with the TRIPS provisions through a combination of consumer protection and unfair competition laws, its trademark registration system and an administrative scheme for the protection of its geographical indication for wine (Laing, 2005). South Africa thus essentially follows the US example of protecting geographical indications under trademark laws and the only means to obtain registration in South Africa remains under the Trade Marks Act (No.194 of 1993).

The industry's legal battle in the US, however, highlighted the specific role of GI protection and served to a large extent as a catalyst for the shift occurring in the South African *Rooibos* industry toward the incorporation of collective strategies. The origins of the dispute date back to 1994 when a South African company, Forever Young, registered the mark "*Rooibos*" in the US in connection with, among other things, herbal teas. This in effect gave Forever Young the exclusive right to market products under the name "*Rooibos*" in the US. As all *Rooibos* products are marketed as *Rooibos* (i.e. under its generic name) this gave Forever Young a virtual monopoly over the marketing of *Rooibos* products in the United States. The rights to the mark were subsequently assigned to a US citizen, Virginia Burke-Watkins, principal owner of Burke International. No longer able to market its products under the name "*Rooibos*" in the US, a South African company, Rooibos Ltd., instituted legal action in the US in order to cancel this registration on the basis that it was generic and therefore non-distinctive. After years of expensive litigation the dispute finally came to a head in 2005 when Burke-Watkins, faced with mounting legal costs and several additional lawsuits pending, agreed to voluntarily surrender her rights to the trademark.

The dispute highlights two legal options with respect to the assertion of exclusive rights in the name "*Rooibos*". The first option would be protection under trademark law.[1] In this respect, it should be noted that registrability of a trademark depends on it being distinctive and not descriptive. This prevents the registration of terms which are or have become generic, as was found to be the case for *Rooibos* in the US dispute. A distinction should however be made between registration of an individual trademark on the one hand and registration of a collective or certification mark on the other. In terms of South African trademark law[1] it is possible to register a geographical indication as a collective mark which serves to distinguish the members of an association from persons who are not members. It may further, in certain circumstances, be possible to register a geographical indication as a certification mark, which distinguishes goods with respect to, among others, geographical origin. Therefore, although there is a prohibition on registration of a geographical indication as an individual trademark, no such prohibition exists with respect to registration as a collective or certification mark. It is important to note, however, that by providing for the protection and registration of geographical indications under the Trade Marks Act, they are treated as a species of trademarks and not a geographical indication *per se*.

The second legal option to asserting exclusive rights in the name "*Rooibos*" entails protection as a geographical indication under a *sui generis* system. In order to better appreciate the choice/difference between the two strategies, it is necessary to grasp some fundamental differences between the two forms of intellectual property. Both trademarks and geographical indications serve as distinctive signs whose purpose is to distinguish products and who are capable of acknowledging the link between a product and its origin. At a fundamental level, however, there is a difference in terms of what the distinctive sign is signifying (Rangnekar, 2003a). Trademarks are distinctive signs identifying the relationship between the proprietor of the mark and his goods or services, and thus not limited by any territorial link. In contrast, "geography is at the heart of geographical indications" (Moran, 1993) – they being distinctive signs identifying goods as originating from a particular geographical area. Geographical indications thus show a link between the goods and their place of origin. As the definition indicates, this form of intellectual property claims that the unique qualities of certain products derive from a combination of features of the natural environment and traditional practices of the people living there. Fundamental to this claim is that these characteristics cannot be produced elsewhere. This forms the basis of one of the most fundamental differences between trademarks and GI, in that the latter cannot be delocalized and therefore never sold as in the case of trademarks. This is in line with the good-place link on which GI protection is based and which prohibits the transfer of the indication to producers outside the demarcated area. In contrast, the right to assign or license is available to trademark proprietors. This is inconsistent with the GI philosophy which is based on collective, regional ownership.

As mentioned, South African law does not provide for protection of geographical indications *per se*. However, in this paper it will be shown how the *Rooibos* industry has, despite the absence of an appropriate domestic legal framework, moved toward embracing

collective strategies based on the GI philosophy. Although this move toward GI protection has its foundations in the threat of misappropriation (as reflected in the US dispute), the emphasis is increasingly shifting to reservation of the term "*Rooibos*" for its use as a valuable marketing tool.

3. THE *ROOIBOS* TRADE AND INDUSTRY DEVELOPMENT

Rooibos is the fermented and dried leaves of the plant *Asphalathus linearis* that is mainly used as a pure herbal tea or in many different types of blends. A wide variety of flavored *Rooibos* products is also available. It is of reddish color and is considered to be a good substitute for black teas and coffee, due to its health benefits and to its versatility and variety. *Rooibos* is also used as an ingredient, especially in the cosmetic industry. It is packaged in, and available as, loose leaves, various tea bags and powders, ready-to-drink products, self-brewed iced teas, cosmetics and shampoos, in tins, glass, cartons, cardboard boxes, cans and bottles. New innovative product applications include green (unfermented) and organically produced *Rooibos*.

According to projections by the UN Food and Agriculture Organization (FAO) in 2000, world tea production will reach an estimated 3.4 million tons in 2010, with black tea accounting for 2.4 million tons, green teas for 900,000 tons, and herbal/fruit teas for about 100,000 tons. Consumer demand for herbal, green and other health teas is likely to outstrip production and could see an upward trend in price levels. In Britain, the world's biggest tea drinker apart from Turkey, black tea sales fell from 127 million kilograms of tea bags in 1997 to 114 million kilograms in 2002, whilst sales of fruit and herbal teas rose by almost 50 per cent. The hot drinks sector in the Netherlands declined by 0.5 per cent in the 2001/2002 sales period, yet the market value of tea increased by nearly 4 per cent through the sales of herbal and fruit infusions. Germany, the world's largest importer of herbal tea products has a mature tea market with intense competition. Despite this, the tea sector grew by 10 per cent in terms of volume in 2002, purely through fruit and herbal teas. As a herbal tea with strong health properties, *Rooibos* is increasingly claiming its share of this growing market, with international demand surging since 2001. In 2005, total exports were 5,500 tons of which 4,000 tons were exported to Germany (70 per cent), 550 tons to the Netherlands (10 per cent) and 400 tons to Japan (6 per cent). Other significant export markets include Australia, the UK and the US.

The turnover of the *Rooibos* tea industry was estimated at 180 million rand in 2004 (corresponding to 22.5 million Euros). The export market represents more or less 60 per cent of the production against 40 per cent for the domestic market (TISA 2004). Contrary to the domestic market which has remained quite stable, the export market has seen huge growth over the past decade. The export growth and exploitation of the *Rooibos* market potential can, to a large extent, be attributed to the marketing initiatives of the recent entrants as well as to new consumer trends in the main export markets. Popularity of *Rooibos* among consumers at international level appears to be strongly linked to its health attributes. The rise in production and consumption can also be related to

the dynamics of innovation in the industry[2] and the increasing product range (not only the blended herbal and green teas but also cosmetics, soft drinks, *"cappuccino" Rooibos, "espresso" Rooibos*…). And according to Gress (2004) among others, *Rooibos* still has a huge market potential before reaching saturation in its main export markets.

Most *Rooibos* is exported in bulk, in loose leaf format (i.e. approximately 95 per cent). *Rooibos* export marketing and supply chains are dominated by a few leading European tea importers based in Germany who are the largest tea brokers in the world. These firms buy *Rooibos* in bulk for blending and resale to other countries. Given the almost monopsonistic situation faced by the South African role players on this market, competition is tough and the market is very price sensitive. A huge volume of *Rooibos* is sold in bulk on annually negotiated contracts within existing relationships. In addition, bilateral agreements take place on a case-by-case basis. Importantly, there is no significant market determining the price and there is generally a lack of transparency in the transactions. New relationships are being established as new markets are opening in other countries (e.g. Argentina). As these markets are still in their infancy, they are not specifically addressed in this paper.

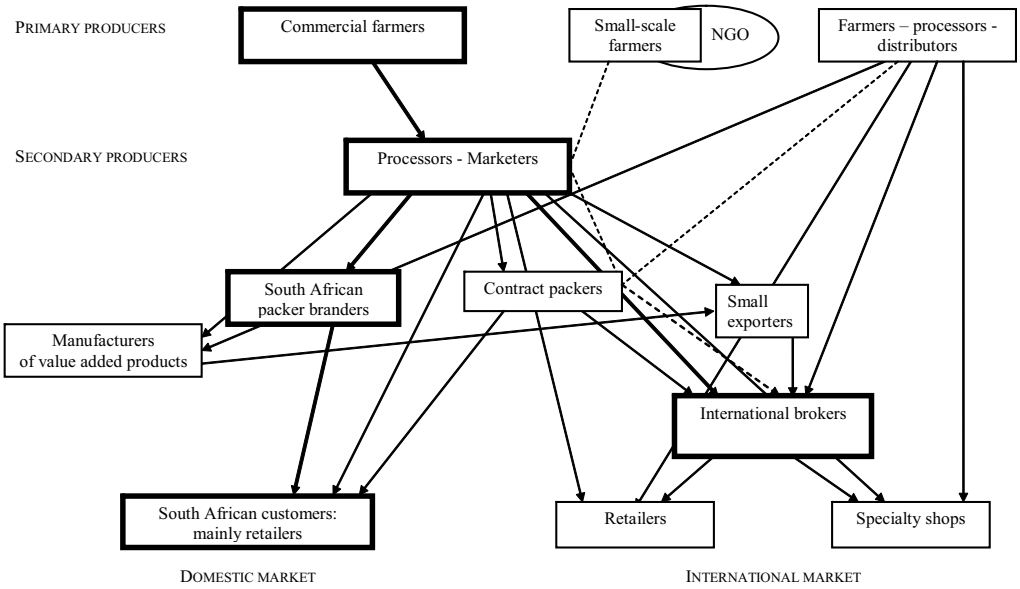
On the South African side, one large player has historically been dominating the industry and the market, and is still retaining the biggest market share domestically and at the export level as further depicted below. *Rooibos* has been used and harvested from the wild at least since the 19th century in the Cedarberg Region of South Africa and its first marketing took place in 1904 in Europe under the Eleven O'Clock brand which is still in use. However, the development of the *Rooibos* industry proper started with its cultivation in the 1930s. In 1948, in reaction to a crisis in the marketing of *Rooibos*, the Clanwilliam Tea Cooperative was established forming the basis of the Rooibos Control Board, which was appointed by the Minister of Agriculture in 1954. Until the 1990s, this state organization was the one and only actor engaged in processing and marketing *Rooibos*. Then, the voluntary dissolution of the Rooibos Control Board in 1993 transformed the industry from a regulated monopoly into a deregulated industry. As a result, on the one hand, a public company still mostly owned by producers was established based on the physical and intellectual assets of the control board. On the other hand, as indicated by Snyman (2007), many farmers broke away to form their own firms with King's Products (Pty) Ltd. being the first to establish a processing plant in 1996.

Following the emergence of a number of new players in the last 10 years, the *Rooibos* supply chain has become quite complex (see Figure 1 below) with some actors specializing in one particular function and others integrating different segments.

Rooibos tea production involves cultivation and harvesting of the plant; first-level processing that transforms the wet unfermented tea into red-brown tea at the tea court and is predominantly done at the farm level; second-level processing that includes pasteurization, sieving, dust extraction and is done at a processing plant by the processors; and then packing that can be done by different actors as explained below.

There are between 350 and 550 *Rooibos* farmers (Snyman, 2007; Hansen, 2006). These consist of a number of small-scale farmers, with many of them being organized into two tea cooperatives that account for about 100 members actively involved in *Rooibos* farming. Each of these cooperatives owns 33.3 per cent of shares in a *Rooibos* packing facility in Cape Town (Snyman, 2007). These cooperatives have been specializing in marketing organic and fair-trade *Rooibos* for the export market. The combined output of the small-scale farmers, including the two cooperatives, is estimated to be about 2.5 per cent (225-250 tons), of which about 50 tons is produced by one small-scale *Rooibos* producer (TISA, 2004).

Figure 1. The Rooibos Supply Chain



Adapted from Biénabe and Troskie (2008)

On the other hand, there are a few large farmers who cultivate up to 5000 hectares. Among these large-scale farmers, some are marketing their *Rooibos* directly under their own brand names. These include The Big Five Rooibos Company (Pty) Ltd. which is the largest independent producer[3] with its brand African Dawn, but also Biedouw Valley, *Oudam* Farming and *Ouhuis*. Some farmers are currently developing alternative marketing strategies, i.e. Skimmelberg, whose strategy is founded on environmentally friendly practices by linking *Rooibos* production to conservation areas. An estimated 40 per cent of all farmers have experimented with organic production or have implemented organic production principles on some of their plantations. Nevertheless, one tends to find both organic and non-organic production on the same farms except for the members of the two cooperatives who produce exclusively organic *Rooibos*.

About two thirds (i.e. approximately 250) of *Rooibos* farmers still deliver their crops to one processor, Rooibos Ltd., being both shareholders and suppliers. The second biggest producer grouping is Cape Natural Tea Products (Pty) Ltd. with approximately 40 farmers as shareholders (Snyman, 2007). It was established as a joint partnership between *Rooibos* farmers and marketers. A further role player (i.e. the second biggest processor) is the Khoisan Tea Company which consists of three separately registered companies: Khoisan Farming, Khoisan Tea and Khoisan Tea Import Export. Together they form a full service business, capable of farming *Rooibos*, fulfilling primary and secondary production, and distributing bulk *Rooibos* and *Rooibos* products globally. Although the company farms some *Rooibos* itself, it buys its largest share from approximately 100 contracted farmers. The rest of the tea is sold to other processors and buyers, mostly through annual contracts.

The South African *Rooibos* tea supply chain is currently dominated by eight large processors equipped with the facilities to undertake secondary processing. These eight main South African players (i.e. Rooibos Ltd., Khoisan Tea, Coetzee & Coetzee, Cape Natural Tea Products (CNTP), King's Products, Red T Company, Big Five Rooibos Company and Maskam Redbush) control an estimated 90 per cent of total annual supply and sales (Snyman, 2007) and are involved in all levels of the supply chain in South Africa to some extent. They collect and transform *Rooibos*, and either sell it to intermediaries who market it or market it directly. Most second-level processors have also positioned themselves as marketers as further developed below. Four of the processors have their own in-house packing facilities and also offer contract packing services, namely Rooibos Ltd, Red T Company, Khoisan Tea, and King's Products.

There also exist packers, which are companies that specialize in end-consumer packaging. These consist of packer/branders with the larger being National Brands Ltd., a wholly-owned subsidiary of Anglovaal Industries, and of contract packers that service local brand owners and exporters without packing facilities, as well as private label customers (e.g. supermarket brands). In addition, one new Black Economic Empowerment (BEE) packing plant, Fair Packers (Pty) Ltd., was recently established in Cape Town for packaging tea from the small-scale farmers' cooperatives for the fair-trade market as previously mentioned.

After packaging, distribution, both on a local and international scale, is done by roughly 25 enterprises within South Africa. Most of these enterprises are also involved in business with other natural products, ranging from honeybush, other herbal teas and medicinal herbs to wine and cosmetics.

In addition to the herbal tea industry, several other types of actors and companies are using *Rooibos* as an ingredient and are marketing *Rooibos*-based products, thereby using the name "*Rooibos*" in one sense or another. Snyman (2007) indicates that there are currently three main manufacturers specializing in value-added products like extracts, instant powders, flavors, etc. (i.e. Afriplex (Pty) Ltd., Benedict Technology Holdings (Pty) Ltd., Cape BioCeuticals (Pty) Ltd.). In cosmetics, the market leader is Annique Skincare Prod-

ucts (Pty) Ltd. which is affiliated with Forever Young (Pty) Ltd., the company which sold the "*Rooibos*" name to Burke International and which was central in the US dispute. Generally, *Rooibos* cosmetics, toiletries, iced teas, etc. are contract manufactured and only form a small portion of suppliers' operations.

4. INSIGHTS INTO MARKETING/QUALITY SIGNALING STRATEGIES

Developments on the export market have recently been related to product differentiation dynamics. Various private marketing and branding strategies are emerging inside South Africa, especially oriented toward the export market. In addition, the recent emergence of smallholder farmers' cooperatives with fair-trade and organic labeling strategies have led to increased certification in the industry. However, as described below these strategies are still limited in their scope and application, only representing a very small percentage of production.

Rooibos Ltd. still controls overall about 75 per cent of the market and more than 90 per cent of the domestic market. On the domestic market, Rooibos Ltd. operates mainly by providing bulk tea. It supplies Unilever Foods (Pty) Ltd. and National Brands Ltd., who are major players in the South African consumer goods industry. These two companies own the leading *Rooibos* brands (mainly Freshpak, Eleven O'Clock, Lipton, Joko, Glen)[4] with a combined market share of between 75 per cent and 85 per cent and they supply *Rooibos* to most of the supermarket chains for their house brands. Rooibos Ltd. further supplies Joekels Tea Packers, which has become the third biggest tea packaging company out of the 23 companies operating in South Africa since buying Rooibos Laager, a well positioned *Rooibos* brand in the country, from Unilever Foods in December 2003. Joekels also supplies and packs the *Rooibos* house brand of Shoprite-Checkers, the second biggest supermarket chain in South Africa. Rooibos Ltd. is also working with CTC/Pioneer Foods (Pty) Ltd. and Vital Health Foods (Pty) Ltd. (Snyman, 2007). The only other player with significant influence in the local *Rooibos* market is Cape Natural Tea Products with a 5 per cent market share, selling in bulk locally and supplying mainly the SPAR supermarket chain.

Rooibos has been sold for many years inside South Africa and branding is an important dimension of consumer demand with two brand owners dominating the market and Rooibos Ltd. enjoying almost a monopolistic situation as shown above. However, Snyman (2007) also points out that the "market is showing signs of 'commoditizing' with low-end products perceived as becoming a threat to established brands that carry substantial marketing investments over many years". The domestic market has seen an annual growth of less than 5 per cent over the past decade and it appears to be becoming quite saturated (Snyman, 2007). Domestically *Rooibos* is often considered as an inexpensive alternative to other (mostly imported) hot beverages. *Rooibos* competes in a very price-sensitive market.

On the export side, three South African players account for more than 80 per cent of annual sales volumes. After Rooibos Ltd., the second largest exporter is Khoisan Tea with approximately 20 per cent, followed by Coetzee & Coetzee with about 10 per cent of market share (Snyman, 2007). Khoisan Tea mostly sells *Rooibos* in bulk. It started packaging some of its *Rooibos* only very recently (about 3 per cent) but committed not to market under its brand, in particular in the German market which represents its major outlet. Coetzee & Coetzee Distributors Company is supplied by contracted farmers from across the Western Cape. It exclusively distributes and markets its products, which include honeybush, buchu and devil's claw, as well as *Rooibos*. Its customers include tea traders and importers, who mainly trade the products without adding value. It also has its own agent/broker in Germany, who acts as a contact with the importers but does not concentrate on branding its product.

Another significant role player is Cape Natural Tea Products (CNTP), which provides custom-blending and product development facilities to suit specific customer requirements.[5] CNTP sources, processes and exports a range of indigenous African herbal teas and botanicals in bulk and branded, including *Rooibos*, honeybush tea, rose-hip, devil's claw, lemon grass, etc. CNTP also offers flavored *Rooibos*. Most of its *Rooibos* is still exported or sold locally in bulk, but its pre-packaged tea is gaining importance. Red T Company, as well as King's Products, offers processing services to independent producers or agents. Red T Company also contracts its packaging capacity to a number of independent producers that sell *Rooibos* under their brand such as Biedouw Valley. King's Products specificity is its focus on high quality organic *Rooibos* to meet the increasing demand for it in Europe. The company sells *Rooibos* produced on its own estate as well as procured from independent farmers. It was the first ever producer of organically grown *Rooibos*.[6] However, despite its quality focus, it sells *Rooibos* in bulk to overseas customers. Maskam Redbush has also positioned itself in the high-quality tea segment being located in a well-known high-quality production area. Forty per cent of its *Rooibos* is ECOCERT® organic certified. It is also using the estate concept as a promotion device and has introduced a vintage for its product. Its branding strategy is currently under development.

Also of particular interest are the independent farmers who are marketing *Rooibos* under their own brands. Among these, the largest is the Big Five Rooibos Company which specializes in farming, processing and distributing only *Rooibos* from its own farm and is promoting its product as being "estate" *Rooibos*, using the concept of estate wines as a sign of quality and focusing on its capacity to guarantee excellent quality control, sustainability and traceability of its product. Ninety-nine per cent of the company's business lies in exports, of which 90 per cent is sold in bulk, but its focus also lies on adding value to the products and to marketing more of its own branded products. Except for retail packaging all other tasks are handled by the company. Most of the independent producers' branding include some reference to South Africa either through use of the Afrikaans word (e.g. *Oudam* Farming, *Ouhuis*) or South African place name located in the *Rooibos* production area (e.g. Biedouw Valley).

It should be noted that it is mainly the smallest South African players that are developing differentiating strategies based on branding and labeling. Interestingly, these brands and labels are not based on the name *Rooibos* but arise from other reputational indicators.

Below are some insights on the German and UK markets which are among the most significant. As already mentioned, the leading European tea importers and largest tea brokers in the world are based in Germany. The German wholesale market for tea is dominated by 10 to 15 trading companies, the most prominent being Martin Bauer GmbH, Haelssen & Lyon, Gebr. Wollenhaupt GmbH and Kräuter Mix GmbH. These companies are tea traders or importers, buying tea directly from the producer and adding value to the product through blending, flavoring and packing it. The German tea consumer market is relatively fragmented with many different companies offering a multitude of different teas (Arnold *et al*., 2007). The market leaders for branded teas in Germany are the specialized tea companies Teekanne GmbH and the Ostfriesische Teegesellschaft GmbH (OTG) with their brands Messmer and Milford. This segment also includes companies that sell products to wholesalers, central buying cooperatives and tea specialty shop chains under their own brands or unbranded. They either purchase their tea from the above-mentioned trading companies or include this function and deal directly with the producers. Some of the companies create their own blends and flavors; others buy the tea ready prepared to their instructions. Packaging can be in-house or outsourced to specialized packers. Twenty-five per cent of the market consists of trademarks or private labels produced for supermarket or discounter chains. Interestingly, there are many names used for *Rooibos* in Germany with the two most common being "*Rooibos*" and "rotbush" (Arnold *et al*., 2007). Others are *"rooitea", "rooibusch", "redbos", "massaitee", "buschmanntee", "redbuchsie"*, "Koopmans-Tea" reflecting the relatively long German history in trading and consuming *Rooibos*.

The market for tea in the UK is dominated by a small number of very well-established brands relying on strong advertising in mainstream media (Arnold *et al*., 2007). Among these, Tetley is the UK market leader in black tea. However, despite recent investment and growth in the herbal and fruit tea markets, Tetley still lags behind Twinings and Clipper (Arnold *et al*., 2007). It is worth pointing out that it has recently launched "Tetley-Redbush" which it procures directly from Rooibos Ltd. with the Rooibos Ltd. logo being included on the packaging and being used as an indication of authenticity and direct sourcing from the growers.[7] Interestingly, the other leading tea supplier, PG Tips, does not, to the knowledge of the authors, offer *Rooibos* tea.

Twinings offers *Rooibos* tea as part of its herbal classical range as well as a pineapple and *Rooibos* tea under its brand. No indication could be found as to the sourcing of the product in the case of Twinings. Another well-positioned company in the herbal and fruit tea market as already mentioned is Clipper Teas which offers organic *Rooibos* tea certified by the Soil Association (the main certifier for organic foods in the UK).[8] Otherwise, the UK herbal and specialty tea market is dominated by a large number of small suppliers. Dragonfly is offering organic *Rooibos* under the Tick Tock brand.[9] It appar-

ently has historical connections to the early cultivation and commercialization of *Rooibos* tea (Arnold *et al*., 2007). It also offers a range of *Rooibos* blends including, mint, breakfast and Earl Grey. Initially specialized in health food shops, Dragonfly teas are now found in supermarkets. Whittards of Chelsea focuses on the specialty and green tea sectors, but also offers fruit and herbal teas with a range of approximately eight *Rooibos* teas listed on its website. This firm markets its products through a network of small-scale high street shops. The Redbush Tea Company is specialized in marketing a variety of *Rooibos* teas and soaps through UK supermarkets and health food shops.[10] The firm is offering *Rooibos* teas with different flavor blends as well as an organic version. According to Arnold *et al*. (2007), the Redbush Tea Company indicates on its website that its tea is specially blended for it by estates in Clanwilliam.

Regarding the UK market, it is worth concluding by highlighting what Arnold *et al.* point out: "consumers of 'new' teas tend not to be product or brand loyal, unlike consumers of traditional black tea. As befits their experimental behavior, they are more likely to buy on impulse or for a particular occasion, rather than on an habitual basis. Indeed, herbal and fruit teas are often drunk on an occasional, supplementary basis to standard black tea, rather than as a regular substitute for it. They also tend to be interested in particular flavors or blends rather than brands, which poses a challenge for suppliers of specialty teas, who may not have the marketing capability to make their brands stand out in consumers' minds."

5. EVOLUTION OF IP STRATEGIES

This section explores the current status of IP use related to the name "*Rooibos*" in the *Rooibos* industry. This is approached by compiling an inventory of current IPRs with respect to the *Rooibos* name and, based on it, to explore the different quality signaling strategies developed by the different role players. This constitutes the point of departure from which the move toward a collective strategy is further explored.

The development of the database started by consulting the South African trademark register, with the aim of identifying trademarks consisting of or incorporating the name "*Rooibos*" or its use *Rooibos* in translation (redbush). Internationally, the online records of the main export markets for *Rooibos*, i.e. Australia, Germany, Netherlands, the UK and the US, were consulted.[11]

Interestingly, the results of the searches (contained in Annex A) indicate that it is not necessarily the main actors identified above that are pursuing IP strategies surrounding the name "*Rooibos*".

It is evident from the tables in Annex A that only two South African companies, Rooibos Ltd. and Annique Skincare Products (Pty) Ltd. appear to be pursuing an IP strategy around the name "*rooibos*" in international markets. Annique Skincare Products (Pty) Ltd. is mainly active in the cosmetic industry as already mentioned. Although it is not a

major player in the industry, its appropriation of the name "*Rooibos*" in the US led to the US trademark dispute. It is interesting to note that it is still one of the main registrants of trademarks surrounding the name "*Rooibos*". However, this name *Rooibos* is no longer used in isolation but in combination with other descriptive matter.

Rooibos Ltd. appears to be the most aggressive registrant of trademarks including or consisting of the word "*Rooibos*". This is in line with the fact that it is historically the largest player in the industry and it has been acting as a custodian of the name. Its role as custodian of the name can be traced back to the US trademark dispute in which it played a key role in reclaiming it. It has since been pursuing trademark registration for "*Rooibos*" internationally. Its strategy surrounding these registrations can be interpreted as not being based on individual appropriation but rather on defensive registrations to prevent similar situations, as that encountered in the US, and the associated expenses. As a consequence, Rooibos Ltd's strategy appears to be to register trademarks including the word "*Rooibos*" as widely as possible, coupled with a disclaimer to any exclusive rights to the word itself. This serves the purpose of making it more difficult for other potential registrants to obtain exclusive rights.

Apart from the firms shown in the tables, various smaller players from different countries outside South Africa are registering trademarks around the name "*Rooibos*". For a comprehensive layout of the different trademarks applied for/registered by various players in the different territories, the reader is referred to Annex A. Annex B provides a clarification of the different classes under the Nice International Classification system. Importantly, however, these firms appear to be using the name "*Rooibos*" in a descriptive manner and not as distinctive markers.[12] The use of the name as a descriptor is probably a major reason for the relatively few trademarks that consist of or include the name "*Rooibos*". This is particularly relevant in the South African context where the name is descriptive of the product.

The *Rooibos* industry's change toward the use of intellectual property is largely the consequence of its experience and near loss of its name in the US. The lengthy and costly legal battle illustrated the importance of a proactive strategy and served as the incentive for a move toward protecting the industry's collective intellectual property in view of potential global threats. This battle has been instrumental in establishing the South African Rooibos Council, which is a collective body representing the whole South African *Rooibos* industry (with participants elected from the small and commercial producers, laborers, processors, packagers, etc.) and which is intended to drive collective action processes. The US case highlighted the possibility of acting offensively against misappropriation by setting out to expunge irregularly registered trademarks. With the growing awareness surrounding irregular trademark registration, the threat of misappropriation is lower and the cases observed do not seem significant, as is evident from the tables.

Although trademark law in the US allowed South African producers to claim back the rights to market *Rooibos* in the US, it did not really allow them to claw back the legal

rights to the name. It only prevented others from having exclusive rights. Existing legal shortcomings in addressing the public good aspect of the name "*Rooibos*" under trademark law led the industry to explore the second legal approach, namely GI protection (as set out in the background section), to asserting exclusive rights in the name for legitimate use by the industry (i.e. only production originating from South Africa and adhering to agreed standards should be defined as *Rooibos*). The development of a GI strategy is intended to be complementary to individual trademark registrations that do not necessarily include the name *Rooibos* per se. This could be equated with strategies followed in marketing wine where there are different levels of branding.

6. QUALITY-RELATED QUESTIONS

The entrance of new players especially inside South Africa in the last decade in connection with the new export developments has been associated with increased quality-related problems being reported inside the industry with, in particular, some brands being used to package and market products foreign to the brand proprietor and of low quality.

The lack of uniform quality standards on *Rooibos* across the industry associated with the lack of transparency in the supply chain is favoring opportunistic behavior, both from South African processors and traders and from the dominant European buyers, on export tea quality. The South African processors and traders have to contend with Rooibos Ltd.'s dominant position on the supply side and are not able to compete effectively based on price. A particularly important attribute of *Rooibos* quality is determined by the quantity of sticks[13] in the tea. Indeed, sticks increase the volume but can degrade the quality in terms of color, aroma and taste. This parameter is used in defining different grades but up to now these have been company-specific and not explicitly shared throughout the industry. Even though differences in grade definition are not necessarily significant, the lack of shared commitment to comply with certain standards contributes to putting *Rooibos* quality at risk.

Quality issues in the industry are complicated especially at the export level by the number of players along the supply chain that impact on the quality of the final product and by the distance between the production area and the places of consumption. Indeed not only is the raw material produced by the farmers instrumental in determining the final *Rooibos* product quality but so too are the sorting, blending and grinding processes that can be performed by different players in the supply chain, up to the stage where the tea is packaged for consumption. In the *Rooibos* industry, most of the production destined for the export market is sold in bulk by South African processors and traders, which means that players downstream in the supply chain can still modify the quality of the final product, in particular by changing the proportion of sticks. With more than 90 per cent of the production sold in bulk and the European market (the main buyers of *Rooibos*) being dominated by a few international tea brokers from Germany, control on overseas markets is very difficult. Currently, very few traceability systems are in place. According to Arnold *et al*. (2007), trust in the firms' reputations and certain connec-

tions seem to constitute the basis of the wholesale business with no specific certification beyond ISO, HACCP, IFS and other general protocols. Arnold *et al*. (2007) further point out that only one company (Teekanne) has developed a tailor-made quality label for consumer reassurance. The general practice is to print the charge code on the package.

The problem of quality control and traceability is exacerbated by the fact that a significant part of the *Rooibos* production is blended with other teas or aromas. As pointed out by Raynaud *et al*. (2002), Barcala *et al*. (2006) and Ponte and Gibbon (2005), the length of the supply chain and the relationships between quality signal owners and the different suppliers in the chain significantly impact on quality signaling. Raynaud *et al*. (2002) find that, in cases where there are numerous players in the supply chain, quality signaling in final markets involves higher contractual hazards in the downstream transactions with suppliers. This is taking an increasingly important role in the *Rooibos* industry.

The risk of quality degradation, and thus of loss of reputation, is perceived as an important threat especially by the major actors in South Africa. With the expansion and opening of new markets, need for standardization becomes critical. It becomes more and more necessary for the commercial viability of the industry to define what can be called *Rooibos*[14] and ensure that only the agreed minimum level of quality is sold.

Another quality dimension that has assumed importance in the *Rooibos* industry recently concerns the emerging quality differentiation strategies. Issues arise mainly because *Rooibos*, as many other agrifood products, not only exhibits search attributes that can be verified at the time of purchase but also characteristics of experience and in some respects, credence. Its actual quality is not observable before consumption and some attributes of *Rooibos* may not even be evident after consumption (Nelson, 1970). The latter attributes include aspects such as fair-trade and organic certification but also specific origin inside the *Rooibos* production area with its own reputation such as the Biedouw valley or *Rooibos* from estate producers. These different quality attributes have given rise to diverse product differentiation strategies which underlie the segmentation of the market. Some of the players in these differentiation strategies are benefiting from a significant price premium (e.g. according to Nel *et al*. (2007) the producer price of the two cooperatives which sell *Rooibos* as organic and fair-trade is 23 rand/kg. compared with the conventional producer price of 14 rand/kg). Where significant asymmetric information holds between producers and consumers, reputation and distinctive signs (private brands, labels) are important in signaling a certain level of quality and supporting producers' investments in offering high-quality products (Akerlof, 1970; Klein and Leffler, 1981; Shapiro, 1983); and there is a need for developing trustworthy and credible mechanisms to guarantee these quality levels (McCluskey, 2000; Raynaud *et al*., 2002, 2005). As pointed out by Rangnekar (2004), "with the development of brands and advertising, the rationale for trademark protection has been modified". It has moved beyond indicating source toward protecting the investments undertaken to develop brand names and build reputation attached to them (Grossman and Shapiro, 1988). Misappropriation of a trademark affects both the consumer, by generating confusion as to the link between previous experiences of the product, perception of reputation and ex-

pectation of quality and the trademark owner by diluting its reputation (Rangnekar, 2004).

This discussion points out the need for proper quality management and control at both individual and collective levels.

7. TOWARD A COLLECTIVE STRATEGY: GI DEVELOPMENT

Discussion on developing a specific GI protection system in South Africa was raised through an initiative of the Western Cape Department of Agriculture about a decade ago. This provincial department intended to establish a *sui generis* GI system for products other than wines and spirits. This initial phase, even if inconclusive, largely contributed to raising awareness of and interest in GI, especially among other provincial departments of agriculture, as well as from some research institutions and private players. The increased incidence of usurpation of agricultural food products has also been playing an important role in this regard. The promotion and development of a specific system of protection for non-wine and spirit products is currently being debated again in the political arena.

Following the dispute in the US and in relation to a research program on GI potential for adding value to local production and improving rural communities' access to markets and livelihoods - the IPR DURAS project coordinated by the University of Pretoria - the *Rooibos* industry started investigating the possibility of reserving the name "*Rooibos*" and protecting its collective reputation and intellectual property through GI labeling with a particular view to obtaining recognition from the EU. If the interest for geographical indications was already present throughout the industry, actual discussions and activities about it took place mainly as a result of the research program when a consultation process was undertaken with a number of selected industries. Relations were established between the research team and the South African Rooibos Council (SARC).

At the outset of the SARC, there were mainly the processors with their supplier bases; and efforts for organizing and improving coordination among *Rooibos* producers and processors mainly concerned research aspects as had been the case historically under the Control Board. However, this is evolving in particular with the increased awareness of the need to protect their product and markets and the perceived risks of quality degradation. Furthermore, they are encouraged by public institutions to cooperate. Even if still in its early stages, this organization is enjoying increasing support from the industry. The small-scale farmers' community has recently become part of it.

Reservation of the name "*Rooibos*" was reaffirmed as one of the key strategic objectives of the SARC, and a specific Task Team was appointed by the industry at its 2006 Annual General Meeting to explore the potential for developing a geographical indication. This Task Team consists of representatives of commercial farmers, small-scale farmers, processors and marketers as well as a representative from the NGO sector. It is actively sup-

ported by researchers from the Western Cape Department of Agriculture (Provincial Department), the University of Pretoria, CIRAD (the French Agricultural Research Centre for International Development) and Cape Nature (the Nature Conservation Parastatal body of the Province). Different collective and territorial issues are becoming important at industry level, especially in relation to the need to codify practices. Interestingly, the recent idea of developing a geographical indication has appeared to constitute a relevant framework for discussion and negotiation around some of these issues. In particular, the Task Team is exploring the potential for using geographical indications as a tool for implementing the industry's biodiversity strategy. Indeed, *Rooibos* being an endemic species from the highly biodiverse *fynbos biome*, it is a very specific plant indigenous to South Africa. This strongly supports its potential as a geographical indication but also has significant implications from an ecological point of view. Indeed, the expansion of the cultivation area and the intensification of production constitute a threat to biodiversity. In addition to the development of biodiversity best practices as part of the *Rooibos* industry biodiversity strategy, the core biodiversity elements are being incorporated into the product specification for *Rooibos*.

The main stakes and incentives for developing an appropriate GI strategy, according to the industry, are (1) to reserve the name "*Rooibos*"; (2) to prevent potential production de-localization outside South Africa; (3) to ensure better control over quality and (4) combine the geographical indication and the biodiversity strategy. These points have already been well explored and debated as part of the Task Team activity; the biodiversity dimension in particular has been the object of a broad consultative process with farmers from the different areas of production.

It is worth pointing out that the GI strategy being pursued by the *Rooibos* industry can be clearly associated with "Regulation of Product Reputation" strategies as defined by Pacciani *et al*. (2001). Such strategies focus on managing the reputation of the product and its quality, the process is generally led by the supply chain firms themselves and the specification focuses primarily on aspects of the product and production process. This is in contrast to so-called "Territorial Quality Strategies", which focus primarily on territorial promotion and the concept of *terroir* and is often driven by local public institutions. The GI *Rooibos* strategy is essentially a supply chain strategy, the initiative being clearly driven by the South African supply chain players, in particular the processors, and the focus being mostly on reserving the name for the industry and defining a collective minimum quality standard. A number of territorial strategies do exist inside the industry with, in particular, a *Rooibos* heritage route[15] that has recently been developed through the Greater Cederberg Biodiversity Corridor (GCBC) mostly with the involvement of small-scale farmers and support from NGOs and local government institutions. Many other *Rooibos* producers have developed tourist activities on their farms such as The Big Five Rooibos Company which receives over 1,000 tourists per annum. However, these are not considered as part of the GI initiative. As suggested by Tregear *et al*. (2007), this supply chain (or regulation of product reputation) strategy characterizing the *Rooibos* qualification process can be related to the South African socio-economic context characterized by a strong "individualistic competition convention".

Use of the name "*Rooibos*" and its reputation by related industries such as the cosmetic industry does not appear to concern the mainstream herbal tea industry. Indeed this presents a secondary market for utilization of off-cuts. Specific provisions are being made to regulate the use of the name "*Rooibos*" by these secondary industries. A local law firm was recently instructed to take the necessary legal steps toward ensuring appropriate GI protection domestically.

As already pointed out, a key challenge for the industry, apart from name reservation, is to deal with quality problems and associated risks of loss of collective reputation, especially on the export market. Winfree and McCluskey (2005), following the seminal work from Tirole (1996), assimilate the collective reputation problem as one of a common property resource extraction. Assessing collective reputation for regional or specialty products, they show that, with positive collective reputation and no traceability to specific firms or producers, there is an incentive to maximize profits by producing a lower quality. Furthermore, they find that as the number of firms in the producer group to which the collective reputation is attached increases, the incentives to provide quality decrease. The increasing number of South African players in the industry and the development of new markets at the export level have raised new quality problems, observed by many South African players; and the increased complexity of the supply chain both increases the need for traceability and renders it more difficult.

However, given the diverse positioning, capacity and current quality signaling strategies of the players in the *Rooibos* industry, not everyone faces the same incentives to extract from or build on the collective reputation and thus provide lower or higher quality. Winfree and McCluskey (2005) and Carriquiri and Babcock (2007) argue that introducing traceability and developing minimum quality standards could provide solutions to the common good problem of collective reputation. The *Rooibos* industry's current GI development initiative tends to support this argument. The Task Team is close to finalizing a product specification that will make provision for quality, traceability and inspection concerns. In developing the GI product specification, emphasis has been put strongly on ensuring that a minimum quality standard is enforced across the industry. Indeed, the geographical indication is intended to protect the name "*Rooibos*" *per se* and not a specific quality or *terroir* of *Rooibos*; and it is thus to include all the South African production that will respect the minimum quality conditions for it to be called "*Rooibos*". The expected impact of the industry GI strategy is its improved ability to control and enforce quality standards along the supply chain as well as to ensure the origin of the *Rooibos*. This would be supported by the industry obtaining GI protection in the EU, which requires a high level of collective commitment and definition of proper standards, but then provides support in enforcing these quality standards and the traceability procedure associated with them.

It is interesting to highlight how the current industry organization with a major role player, *Rooibos* Ltd., together with a number of recent entrants has influenced the dynamics toward this collective strategy. Rooibos Ltd., which is in a clearly dominant position at the processing level, has been instrumental in the move toward the GI strategy

with a strong focus on developing a proper quality standard and the ways to control it. As was previously suggested, Rooibos Ltd. is at least partly assuming the role of custodian with regard to name protection. This role as well as its efforts to set up a more stringent collective quality management system can be explained by it being the industry's single largest player, and thus being more exposed to risks associated with loss of reputation. Furthermore, Rooibos Ltd. already has a sophisticated quality management system. It is therefore unlikely to be a costly process to implement a collectively agreed quality-management system. On the other hand, it is mainly producing conventional quality *Rooibos* in bulk without differentiating through branding and/or labeling in most cases.

The differentiation of *Rooibos* from other herbal teas stands to benefit the entire industry in view of its positioning *Rooibos* as a distinct herbal tea in the international market. The increased risk of low quality *Rooibos* reaching the market poses a serious threat to everyone through the concomitant loss of reputation. In this respect, it is clear that individual and collective strategies have a complementary role to play. As observed in the wine industry, a combination of private and collective differentiation strategies can be harnessed to protect both individual firm and collective industry reputations. Despite seemingly wide heterogeneity of producers, which has been argued by Tregear *et al*. (2007) to be associated with conflicts in product qualification, discussions regarding the GI qualification process have been characterized by constructive debates, and a consensus over most of the GI specification was reached relatively easily. This can be linked to the homogenous production practices at processor level, with these practices being considered as the most significant for the GI specification and the processors leading most of the discussions.

An aspect which has not been explored thus far is the question of designing collective differentiation strategies within the broader GI initiative. This would entail designing a so-called sub-specification under the GI umbrella (as in the case of the PGI Tomme des Pyrénées in France, for example). It is difficult to predict at this stage whether such a strategy would be adopted by the industry. The relevance of such a strategy derives from strong terroir elements within the *Rooibos* production area being proclaimed by various players, which allows for further differentiation. This GI-based collective qualification could complement existing differentiation within the industry, which has up to now been managed through individual or restricted collective strategies. This could have a strong impact in particular for the resource-strapped small-scale farmers. Indeed, even if many of them have succeeded in better penetrating markets through alternative marketing channels (i.e. fair-trade and organic labeling), their equity participation is still not secure inside the industry, due mainly to their financial and land constraints and their small volume of production compared with the major companies. Their positioning in the fair-trade market could be challenged if some large *Rooibos* plantation were recognized as fair-trade certified and marketed its products under this label. *Rooibos* constitutes the main resource of these two communities of small-scale farmers. It is envisioned that, if the GI label were considered as an umbrella under which could be defined different specifications to account for the different qualities, *terroirs* and processes of production,

this could reinforce small-scale farmers' communities. Indeed, their communities by being located in recognized high-quality areas have potential for strengthening their position and identity in the market by benefiting from the recognition of their specific quality through GIs. They are settled in one of the best *terroirs* for *Rooibos* production. However, it is worth mentioning that this has not yet been widely discussed inside the industry, which is first concentrating on properly establishing a geographical indication for the name "*Rooibos*".

8. CONCLUSION

The recent global food quality trends have triggered the development of significant differentiation strategies in the agrifood sector, which have been supported by different types of IP protection. While these have mainly consisted in South Africa in individual or limited collective strategies based on trademarks, the current initiative toward developing geographical indications in South Africa which is based on significant collective features could have important implications, not only at the industry level but also at the level of the individual players in different sectors. To obtain deeper insights into these trends, we have been focusing on the set of alternative IP and quality management strategies in the *Rooibos* industry and how these strategies have been evolving. The South African *Rooibos* industry constitutes an interesting case in terms of the use of IPRs and how these are related to different quality management strategies. It presents a good illustration of recent food-quality trends and its implications on IP strategies. It is more and more an export-driven industry facing increasing misappropriation of intellectual property; it has moved from a control board to a deregulated industry with the entrance of new companies and the proliferation of IP strategies from South African and foreign actors; it is the first industry taking steps toward explicitly establishing a geographical indication in South Africa; and it is exhibiting significant tendencies toward collective action.

Being the most advanced initiative at the industry level and the only industry that has formally taken steps toward developing a geographical indication in South Africa, the *Rooibos* industry is, to a large extent, serving as a pilot case in South Africa. Even internationally, if successful in drafting its application, it will be among the first non-EU industries to apply for registration of its geographical indication with the EU. Up to now, only the Colombian coffee producers very recently succeeded in obtaining recognition from the EU of the name "Colombian Coffee" as a Protected Geographical Indication.

It is envisaged that recognition of the name "*Rooibos*" as a Protected Denomination of Origin in the EU could impact on the governance in the supply chain through the definition and enforcement of the associated quality standards. The standards, being defined by the *Rooibos* producers and processors locally as part of the PDO specification could give them greater control in the supply chain and the ability to manage quality and fight against IP misappropriation.

Notes

1 Possibility of registering collective and/or certification trademarks differ across jurisdictions.

2 On innovation and use of patents in the *Rooibos* industry, see Wynberg *et al*. (this publication).

3 With approximately 350 to 500 tons of *Rooibos* per year, it is the third largest single producer in South Africa.

4 Freshpak Rooibos is the most popular brand (26.3 per cent), followed by Joko (23.2 per cent), Eleven O'Clock (18.7 per cent), Five Roses (17.7 per cent) and 14.1 per cent shared by Glen, Laager, Vital, Southhalls, Twinings, and Phendula Tips respectively (South African Advertising Research Foundation Study, quoted in Snyman, 2007).

5 Available at *http://www.Rooibostea.co.za*.

6 Website of the Perishable Products Exports Control Board 2003.

7 Available at *http://www.mad.co.uk/BreakingNews/BreakingNews/ Articles/c55e37e26cce49b3a189ea18b8a38d4c/ Tetley-launches-Redbush.html* and *http://www.tetley.co.uk/Our-Products/Ranges/New-Tetley-Redbush*.

8 Available at *http://www.clipper-teas.com*.

9 Available at *http://www.dragonflytea.com*.

10 Available at *http://www.redbushtea.com*.

11 It should be noted that these databases have not been designed as comprehensive trademark searching facilities and the accuracy of our database is therefore subject to the accuracy and comprehensive ness of the official records at the time of research.

12 This information is not always ascertainable from the Internet databases consulted.

13 Sticks are the woody remnants of stems added to or remaining in the product after sorting. A low proportion of sticks is required in order to ensure acceptable quality as sticks contribute poorly to aroma, taste and color.

14 According to the industry, not all herbal teas derived from the *Aspalathus linearis* plant can be defined as *Rooibos*. Implicit minimum quality standards are adhered to by the industry.

15 This route features biodiversity and scenery, adventure activities, cultural activities, *Rooibos* products and the people of the region.

References

Akerlof, G., 'The Market for Lemons: Qualitative Uncertainty and the Market Mechanism', Quarterly Journal of Economics 84(1):488–500, 1970.

Arnold, R., M. Ness and A. Tregear, 'Report on the UK and German Markets for *Rooibos* Tea', SINER-GI Report, University of Edinburgh, Edinburgh, 2007.

Barcala *et al*., 'The Governance of Quality: the Case of the Agrifood Brand Names', Work paper 4, University of Paris, available at *http://atom.univ-paris1.fr/documents/2006_WP4_Fernandez_Gonzales_Raynaud.pdf*, 2006.

Barjolle, D. and B. Sylvander, 'PDO and PGI Products: Market, Supply Chains and Institutions', Final Report FAIR, European Commission, Brussels, June 2000.

Biénabe, E. and D. Troskie, '*Rooibos* Case Study', SINER-GI Project Report, p. 57, 2008.

Carriquiri, M. and B. Babcock, 'Reputations, Market Structure and the Choice of Quality Assurance Systems in the Food Industry', American Journal of Agricultural Economics 89 (1):12-23, 2007.

Gress, T., 'South African *Rooibos* Industry. Opportunities and Constraints with Special References to the German Consumer Market', School of Management Studies, Master of Business Science:298, University of Cape Town, Cape Town, 2004.

Grossman, G.M. and C. Shapiro, 'Counterfeit-Product Trade', American Economic Review, 78:1, 1988.

Josling, T., 'The War on Terroir: Geographical Indications as Transatlantic Trade Conflict', Journal of Agricultural Economics, 57(3):337-362, 2006.

Klein, B. and K.B. Leffler, 'The Role of Market Forces in Assuring Contractual Performance', Journal of Political Economy 89:615-41, 1981.

Nel, E., T. Binns and D. Bek, 'Alternative Foods and Community-Based Development: *Rooibos* Tea Production in South Africa's West Coast Mountains', Applied Geography (27), 112-129, 2007.

Nelson P., 'Information and Consumer Behaviour', Journal of Political Economy, 78 (March-April):311-329, 1970.

Pacciani, A., G. Belletti, A. Marescotti and S. Scaramuzzi, 'The Role of Typical Products in Fostering Rural Development and the Effects of Regulation (EEC) 2081/92', paper presented at Policy Experiences with Rural Development in a Diversified Europe, 73rd EAAE Seminar, Ancona, Italy, June 28-30, 2001.

Ponte, S. and P. Gibbon, 'Quality Standards, Conventions and the Governance of Global Value Chains', Economy and Society, 34 (1):1-31, 2005.

Rangnekar, S., 'Demanding Stronger Protection for Geographical Indications: The Relationship between Local Knowledge, Information and Reputation', UNU-INTECH Discussion Paper (No 2004-11), Maastricht, Netherlands, 2004.

Raynaud, E., L. Sauvée and E. Valceschini, 'Governance of the Agri-Food Chains as a Vector of Credibility for Quality Signalization in Europe', Exploring Diversity in the European Agri-Food System, 10th EAAE Congress, August 28-31, 2002, Saragossa, Spain.

Rooibos Trade and Investment Report, CSP Development for *Rooibos* Tea, unpublished report, 2002.

Rooibos Ltd., website at *http://www.Rooibosltd.co.za*, 2007.

Shapiro, C., 'Premiums for High Quality Products as a Return to Reputations', Quarterly Journal of Economics, 98(4):659-679, 1983.

Snyman, S., 'Subsector Study: *Rooibos* Tea', Report completed for the National Agricultural Marketing Council, Pretoria, 2007.

TISA, 'CSP Development for *Rooibos* Sector', Trade and Investment South Africa, Pretoria, 2004.

Tirole, J., 'A Theory of Collective Reputation', The Review of Economic Studies, 63(1):1–32, 1996.

Tregear, A., F. Arfini, G. Belletti and A. Marescotti, 'Regional Foods and Rural Development: The Role of Product Qualification', Journal of Rural Studies, 23 (1):12-22, 2007.

Wilson, N.L.W., 'Cape Natural Tea Products and the US Market: *Rooibos* Rebels Ready to Raid', Review of Agricultural Economics, 2005.

Winfree, J. A. and J. McCluskey, (2005). 'Collective Reputation and Quality', American Journal of Agricultural Economics, 87:206-213.

ANNEX A
DIFFERENT TRADEMARK APPLICATIONS/REGISTRATIONS IN DIFFERENT TERRITORIES

Table 4. UK Applications/Registrations for *Rooibos* and/or Redbush

Trademark*	Proprietor	Filing Date	Registration Date/Status	Image	Classes
The Rooibos People Health And Skincare	Annique Skincare Products (Pty) Ltd. (South Africa)	August 9, 2006	registered		03, 05, 35, 44
The Redbush Tea Company	The Redbush Tea Company Ltd. (UK)	April 16, 2003	registered		03, 16, 30, 32, 43
Redbush Tea	The Redbush Tea Company Ltd. (UK)	March 2, 2005	registered		03, 16, 30, 32, 43
Redbush Tea	The Redbush Tea Company Ltd (UK)	March 2, 2005	registered		03, 16, 30, 32, 43
Redbush The Redbush Tea Company	The Redbush Tea Company Ltd. (LUK)	October 16, 2003	new application		03, 16, 30, 32, 43, 44
Redbush	The Redbush Tea Company Ltd. (UK)	October 16, 2003	new application	(word mark)	03, 16, 30, 32, 43, 44
Rooibos	Rooibos Ltd. (South Africa)	February 15, 1996	registered		05, 30
Rooibos	Rooibos Ltd. (South Africa)	November 11, 2003	registered		05, 30, 32
Eleven O'clock Rooibosch Tea	National Brands Ltd. (South Africa)	December 15, 1988	registered		30
The Rooibos Tea Company	Wistbray Ltd. (UK)	August 21, 2006	registered		30
Lixi Rooibos Iced Herbal Tea	AZANIA FOOD INNOVATIONS LIMITED (UK)	16 October 2006	Application		30
Greenfield HONEY ROOIBOS	"KARAVAN" LTD (Russian Federation)	8 May 2007	Application		30
Rauch Nativa Redbush Tea	Rauch Fructsafte Gesellschaft mbH (Austria)	6 February 2001	registered		30, 32

* Word mark or verbal elements of picture mark

Table 5. US Applications/Registrations for *Rooibos* and/or Redbush

Trademark*	Proprietor	Filing Date	Status	Image	Nice Classification
Greenfield Honey Rooibos	Karavan Ltd . (Russian Federation)	May 8, 2007	registered		30
Rooibos Therema Tea	Cott Beverages Inc.	July 21, 2006	application		30
Rooibos	Burke - Watkins (US)	June 30, 2005	registered	ROOIBOS	30
Rooibos	Burke - Watkins (US)	June 30, 2005	registered	ROOIBOS	03
Rooibos	Burke - Watkins (US)	June 30, 2005	registered	ROOIBOS	05
Awimoweh Zulu Nectar South African Rooibos Tea	Stones Throw Enterprises (US)	March 7, 2005	registered		30
African Red Tea Rooibos	Broomberg Michael (US)	August 23, 2000	registered		30
Sunnrooibos	SunnGroup LLC L td. (US)	January 24, 2003	application	[Typed drawing]	03
Rooibos Ala Moana	Teavana Corporation (US)	January 8, 2008	application	ROOIBOS ALA MOANA	30
Rooibos Tropica	Teavana Corporation (US)	January 8, 2008	application	ROOIBOS TROPICA	30
Rooibos Rose Garden	Teavana Corporation (US)	July 20, 2007	application	ROOIBOS ROSE GARDEN	30
Rooibos Sweet Amore	Teavana Corporation (US)	July 20, 2007	application	ROOIBOS SWEET AMORE	30
Cloud 9 Rooibos	Teavana Corporation (US)	July 19, 2007	application	CLOUD 9 ROOIBOS	30

* Word mark or verbal elements of picture mark

The Rooibos People Health And Skincare	Forever Young (Pty) Ltd . (South Africa)	January 12, 2007	application		01, 03, 05, 35, 44,
Rooibos The Red Tea	Rooibos Ltd . (South Africa)	March 6, 2007	application		05
Rooibos	Rooibos Ltd . (South Africa)	October 26, 1995	registered		05

Table 6. Australian Trademark Applications/Registrations for *Rooibos* and/or Redbush

Trademark*	Proprietor	Filing date	Status	Image	Nice Classification
Freshpak 40 Rooibos Teabags Nature's Health Tea	National Brands Ltd. (South Africa)	October 7, 1994	registered		30
Rooibos	Rooibos Ltd. (South Africa)	April 20, 1995	registered		05, 30
The Rooibos People Health & Skincare	Annique Skincare Products (Pty) Ltd. (South Africa)	October 16, 2006	registered		03, 05, 35, 44
Greenfield Honey Rooibos	Karavan Ltd. (Russian Federation)	May 8, 2007	registered		30
The Rooibos People Health & Skincare	Annique Skincare Products (Pty) Ltd. (South Africa)	September 12, 2007	application		30

* Word mark or verbal elements of picture mark

Table 7. Trademark Applications/Registrations for *Rooibos* and/or Redbush in Germany

Trademark*	Proprietor	Filing Date	Status	Image	Nice Classification
Freshpak Rooibos Teabags	National Brands Ltd. (South Africa)	July 10, 2007	registered		30
Rooibos	Alpenlandisches Krauterhaus Gmb H & Co. (Germany)	December 12, 2000	registered		30
Rooibos	Rooibos Ltd. (South Africa)	October 25, 1993	registered		05
Rooibos Cappucino	J Bunting Teehandelshaus GmbH & Co . (Germany)	July 16, 2003	registered		30
Rooibos Produkte Annique	Biesemeier Gisela (Germany)	November 11, 2004	registered		03, 30, 32

* Word mark or verbal elements of picture mark

Table 8. Trademark Applications/Registrations for *Rooibos* and/or Redbush in South Africa (images not electronically available)

Trademark	Proprietor	Filing date	Status	Nice International Classification
Rooibosch Tea Eleven O'Clock	National Brands Ltd. (South Africa)	April 11, 1940	registered	30
Oude Kaap Traditional Rooibos Tea	Natural Formulas Ltd. (British Virgin Islands)	February 26, 1979	registered	30
Freshpak Rooibos Tea	National Brands Ltd. (South Africa)	August 9, 1985	registered	30
Cederberg Rooibos Kafeienvrye Rooibostee	SADPRO (Sentraal Kooperatief Ltd.) (South Africa)	July 12, 1988	registered	30
Rooibos Connection Die Rooibos Konneksie (The)	Forever Young (Pty) Ltd. (South Africa)	August 24, 1993	registered	05; 30;31
Suiwer.Pure Rooibos Die Tee Van Afrika	Rooibos Ltd. (South Africa)	March 7, 1995	registered	30
Eleven O'Clock/The Original Rooibosch Tea	National Brands Ltd. (South Africa)	May 10, 1995	registered	3 0
Rooibos The Tea Of Africa	Rooibos Ltd. (South Africa)	November 13, 1998	registered	30
Red Bush Beverages	Sinkel Trading CC (South Africa)	November 30, 2000	accepted	30

ANNEX B
INTERNATIONAL CLASSIFICATION OF GOODS AND SERVICES FOR THE PURPOSES OF THE REGISTRATION OF MARKS (NICE CLASSIFICATION), 9TH EDITION

Class 05	Pharmaceutical and veterinary preparations including vitamins; sanitary preparations for medical purposes; dietetic substances adapted for medical use, food for babies; plasters, materials for dressings; material for stopping teeth, dental wax; disinfectants; preparations for destroying vermin; fungicides, herbicides.
Class 30	Coffee, tea, cocoa, sugar, rice, tapioca, sago, artificial coffee; flour and preparations made from cereals, bread, pastry and confectionery; ices; honey; treacle; yeast, baking powder; salt, mustard; vinegar, sauces (condiments); spices; ice.
Class 32	Beers; mineral and aerated waters and other non-alcoholic dinks; fruit drinks and fruit juices; syrups and other preparations for making beverages.
Class 33	Alcoholic beverages (except beers).
Class 35	Retail and wholesale services including supermarket services for the provision of food; export and import services.
Class 42	[Until the 6th edition, contained services that are now falling under classes 35 and 43.]
Class 43	Services for providing food and drink including restaurant, café and delicatessen services.

CHAPTER 4
THE DEVELOPMENT AND MANAGEMENT OF AN INTELLECTUAL PROPERTY STRATEGY IN A DEVELOPING COUNTRY CONTEXT: THE CASE OF SASOL

HELENA BARNARD* and TRACY BROMFIELD**

Abstract

A coherent IP strategy is one of the characteristics of multinational corporations (MNCs), especially in science-based industries. The paper tracks the evolution of the IP strategy of Sasol, a South African petrochemicals and the largest R&D spender in the country, from its origins to its gradual transformation into an MNC. While in its early days Sasol relied on the use of foreign technology and on secrecy as its main strategy for appropriating the results of its own research, the company gradually started experimenting with the patent system in a subsequent phase. The paper shows a clear evolution toward a more coherent patenting strategy combined with an active use of publications, to enhance the international technological credibility of the company.

Using the case of Sasol, it is shown that the ability to create intellectual property is significantly different from that required to manage it. Indeed, the alignment of motives that spurred the mutually beneficial interactions between Sasol and its foreign connections around technological and scientific capability creation generally did not spill over to developing competence in IP management. Hence, much of the evolution of Sasol's IP management function was essentially through costly in house trial-and-error, until the formation of a global joint venture dramatically accelerated the refinement of their IP management processes. This finding reconfirms the potential value of learning from more experienced firms, particularly with respect to aspects like the strategic role of intellectual property, the complementary roles of patenting and publishing in scientific journals, and the need to think strategically about the purpose of a given patent before deciding where to patent. In sum, the case analysis points to the value of a platform where firms that are grappling with the issues raised by the introduction of formal intellectual property can share their knowledge and experience.

1. INTRODUCTION

A coherent IP strategy is one of the characteristics of MNCs, especially in science-based industries. Apart from the exclusive market position granted by patents and the direct financial benefits that firms can realize through the licensing of patents, patents and scientific publications also act as signals of technical competence and legitimacy in the

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field. For large developing country firms operating in such industries, the importance of IP may evolve as they develop and enhance their technological and management capabilities, from their early stages of heavy reliance on intellectual property from external sources to the gradual development of their own internal capabilities. In the early stages, while they may benefit from lax IP protection and easy access to foreign technology for undertaking imitative development, strong IP may enhance access to technology by making it more attractive for the cutting-edge technology creators to enter into partnerships and transfer their technology (Arora, Fosfuri and Gambardella, 2004). As the companies upgrade their technological capacity and develop protectable assets, IP management takes on an increasingly important role.

This chapter examines the development and management of intellectual property at the petrochemical firm Sasol in South Africa, with a special focus on the role of foreign partnerships. Sasol's experience suggests that it is important to separately consider the related but distinct processes of creating new intellectual property and managing it. For each process, the characteristics of the different stages of evolution are defined and the nature of interactions with foreign partners are outlined. In the case of technological development, Sasol evolved through a process of incubation to consolidation and harvesting of capabilities before undertaking processes of diversification and internationalization. At the same time, its IP management process was dominated first by local and then foreign experimentation, and subsequently, local and then foreign models of governance were introduced.

2. LITERATURE REVIEW

Three concepts are helpful for understanding the evolution in the development and management of intellectual property at Sasol and the role played by foreign partners in that process: the nature and role of foreign partnerships, the relationship between intellectual property and technological upgrading, and, finally, the purpose of formal IP processes.

2.1. The Nature and Role of Foreign Partnerships

An extensive body of literature, starting with the work of Dunning (1958), documents how interaction with partners from more developed countries can help countries at lower levels of development to accelerate learning. The mechanisms include exposure to more sophisticated demand, privileged access to new technologies and easier commercialization of inventions (Lall, 2001b; Narula and Dunning, 2000). International business connections can be primarily internalized (e.g. through alliances or the entry of MNCs) or externalized, e.g. through franchising or licensing (Lall, 2001b), and can even occur through the flow of people (Saxenian, 2002; Vang and Overby, 2006).

The most successful examples of upgrading in the recent era, the Asian "tigers", were all outward-looking in their orientation, although the specific development strategies of the

economic regions differed. Singapore relied heavily on the entry of foreign MNCs, while the Republic of Korea on subcontracting to foreign MNC networks, and more recently on outbound foreign direct investment (FDI) (Lall, 1996).

However the connections take place, common themes emerge in studies of how the contact with the managerial and technological innovations of foreign partner(s) help accelerate local development. Contact with foreign partners provides access to new technologies, and provided that the foreign investment does not crowd out the local productive base, it can increase the total productive base in the developing country (Lall, 2001b). The learning that takes place through more sophisticated supply factors as well as in meeting the challenges posed by more sophisticated demand are also typical benefits of interaction with foreign partners (Blomström, Kokko and Globerman, 2001; Dunning, 1958).

There are two qualifications to the importance of the role of foreign linkages. First, foreign inputs cannot take the place of local commitment and local investment in development. There is by now an extensive body of literature documenting that learning or "spillovers" from foreign investment occur best where there is also investment in the local capacity base (Blomström *et al*., 2001; Haddad and Harrison, 1993; Marin and Bell, 2006). .

Second, foreigners engage in the upgrading of developing country MNCs in the course of pursuing their own goals, and their contribution is greatest when there is convergence between the goals of the different parties (Narula and Dunning, 2000). It is easy to see how both partners benefit when an MNC from the developed world upgrades its production facilities in a developing country, but in the case of IP management the mutual benefit is less clear.

In fact, although there is recognition of the potentially positive role of foreign partners, much of the debate around IP management also demonstrates a concern about the potentially negative effects of foreigners' greater technological and economic capacity. The much larger technological, human and financial resource base of foreign firms may help developing country companies to accelerate their own learning and upgrading, but they may also be at risk of having their contribution appropriated by partners who better understand the purpose and functioning of IP management strategies.

This chapter investigates how Sasol navigated that complex relationship. Although Sasol had a very strong inward orientation – its purpose was to increase domestic fuel self-sufficiency – it nonetheless had very strong foreign links, having been founded in order to exploit the German Fischer-Tropsch (FT) technology for generating fuel from coal and gas, and with strong reliance on foreign consultants. Interactions with foreign partners evolved over the years with important effects on the development and management of IP by the company.

2.2. The Relationship between Upgrading and Intellectual Property

The literature on "absorptive capacity" (Cohen and Levinthal, 1990) documents the constant interaction between learning and innovation, but in the case of large developing country firms, it is possible to identify a shift in emphasis in the importance of each. In Kim's (1999) view, firms shift from imitation to innovation. Initially, most of their technological upgrading efforts are directed at assimilating external technologies and only as they mature, does the creation of new knowledge become more important. Another dimension of this evolutionary process of learning and upgrading of developing country MNCs is in how learning takes place: firms learn first through informal "learning by doing", and only later through more systematic knowledge-creation processes (Bell and Pavitt, 1992; Kumar, 1998; Miotti and Sachwald, 2001). In consequence, little formal intellectual property is developed in developing country firms' initial years.

Formal R&D is seen as one of the more robust indicators that firms have achieved a level of maturity in their evolutionary process (Pack, 2000). In addition, formal R&D has long been recognized as a critical input in innovation (Griliches, 1984; Mairesse and Mohnen, 2005) and the co-variance between innovation, patenting and R&D has led researchers to interpret R&D as an input and patenting as an output of the innovation process (e.g. Acs and Audretsch, 1989, 1991; Almeida and Phene, 2004). In fact, some researchers regard them as different indicators of the same underlying construct – innovative activities (Hagedoorn and Cloodt, 2003). However, although technological capabilities and IP management skills are closely related and co evolve – firms become more aware of the value of intellectual property as they develop more valuable technologies – they involve distinct capabilities, and the expertise needed to manage intellectual property is not the same as that needed to create it. To give a concrete example: it is necessary to understand chemistry to create new gasification knowledge, whereas an understanding of law and economics is needed to manage that new intellectual property.

Previous studies have investigated innovation and the evolution of R&D of developing country firms, but there has thus far been little focused investigation into the evolution of the capacity to formally manage intellectual property. Although formalized IP management is the norm among MNCs in the developed world, IP protection has long been a contested topic (Oddi, 1987; Sell, 1995) and is sometimes seen as an exclusionary measure that makes it harder for less-advanced firms to get a foothold in the global economy.

Insight into the simultaneous distrust and valuing (in the developed world) of formalized IP regimes is provided by Murmann (2003) in his study of the emergence of the chemical industry. For firms with few of their own capabilities and intellectual property, formal protection was a barrier to their upgrading – those firms benefited from freely imitating existing technologies. However, once firms had developed their own intellectual property, a formalized IP management regime emerged. This is because formal IP management allowed them to reap the benefits of their technological advances not only within but also outside the firm. Indeed, scholars who examine the historical evolution of IP systems consistently point out the correlation between higher levels of development and formal IP pro-

tection (Granstrand, 2004; Lerner, 2002). In other words, for a firm like Sasol, the emergence of an IP management strategy is an indicator that the firm has achieved an adequate level of technological advance to justify a formal governance process. This is also because formal intellectual property facilitates interaction with other knowledge-creating firms, allowing them to use their intellectual property as an enabler of further technological development.

2.3. The Purpose of IP Processes

A key element in learning to manage intellectual property is developing an understanding of its purpose. Some form of formal IP process has been in existence for centuries, and so have concerns about the purpose of IP protection. In a review of the controversy surrounding patenting in the 19th century, Machlup and Penrose (1950) identified recurring arguments against the use of intellectual property, a study that is usefully contextualized by more recent work on the theoretical justification of patenting by Mazzoleni and Nelson (1998). Machlup and Penrose documented a concern about the validity of property rights for ideas and resistance to the very idea of intellectual property, a concern that has largely disappeared from the contemporary debate.

However, in terms of the incentives offered by patenting, the terms of the debate have hardly changed. A belief that emerged in the 19th century and is still held today is that inventors are entitled to just reward, tempered by a concern that the temporary monopoly offered by patenting may not be the best way to reward invention. This concern is heightened when considering the issue at the societal level, where the social costs of patenting could potentially outweigh the social benefits, especially when less developed countries are involved. There is likewise tension between the perceived benefits of disclosure versus keeping information secret: patent protection requires technological information to be disclosed and broadly disseminated. In addition, because intellectual property deals with emerging knowledge, there is no clear idea of what the optimal balance between disclosure and secrecy should be. The concern about secrecy in the IP debate is especially heated in developing country contexts where wider disclosure can arguably help accelerate development.

Appropriation is often invoked as an important reason for patenting, but firms' secrecy, investment in brand building and exploiting a first-mover advantage (e.g. through lead times and learning curve effects) are all documented to be highly effective mechanisms to appropriate the benefits of innovation (Levin, Klevorick, Nelson and Winter, 1987). Indeed, a far more nuanced use of patenting emerges in studies of how experienced patentor firms use patents, with a difference in the purpose of patenting in "discreet" and "complex" industries. In "discreet" industries, of which the chemical industry is a typical example, patents may be used to block rival developments (Cohen, Nelson and Walsh, 2000) and to build a "fence" around an invention, thus increasing the value of the invention as a whole (Reitzig, 2004). In "complex" industries like semiconductors, patents are typically used to encourage rivals into negotiations about shared knowledge. In extreme situations, these

can become "thickets". In all these examples, IP disclosure provides a structured way to facilitate knowledge exchange.

Patents are often used not directly as appropriation devices, but to signal competence – codified evidence of capability that serve as bargaining chips in a "club" of knowledge creators (Hall and Ziedonis, 2001; Schmookler, 1953). Indeed, in that way one of the purposes of patenting is very similar to the purpose of publishing scientific publications. As with patents, scientific publications signal the existence of knowledge assets, but they differ in that they do not function to confer appropriability. Instead, journal articles serve as the currency needed for signaling technical knowledge within the scientific community (Hicks, 1995). Thus, scientific publications strengthen the reputation of the firm as an innovator in its field (Muller and Pénin, 2006) and serve as an important precursor for establishing research partnerships (Lhuillery, 2006). In addition, defensive publications, including in scientific journals, can be used to prevent others from appropriating (i.e. patenting) a given technology.

In short, both patents and scientific publications serve an important purpose as signals of competence, signals for which developing country MNCs arguably have particular need. This complex set of purposes contrasts sharply with the typical and far more "naïve" pattern of patenting in developing countries. Da Motta and Albuquerque (2000) documented that developing countries have a much larger share of individuals patenting, with little company involvement and a lack of continuity in patent activity. In addition, inter-firm technological division or specialization is limited. It is clear that a developing country MNC has to go through a learning process not only in terms of the technology it produces, but also in terms of how best to deploy formal IP protection mechanisms to optimally benefit from its technology.

For a long period, many of these considerations did not seem to be relevant to Sasol. Sasol was operating in a technological niche area and had access to the technology it needed. Only about 30 years after its founding, once Sasol started to diversify (increasing its need for access to new technology) and when the worldwide anti-apartheid pressures were threatening its previous sources of technology, could these considerations be seen as relevant. How Sasol responded provides interesting insights into the use of patents.

3. METHODOLOGY

The study investigates the case of Sasol, the only South African firm on UNCTAD's list of the top R&D spenders in the world (516th worldwide) with an R&D spend of US$91 million in 2003 (World Investment Report, 2005). Sasol is a useful setting for the research question because it is a science-based firm where technology creation is key to competitiveness, and it has over the course of its history diversified into a range of chemicals. Moreover, as a petrochemical firm, it is in an industry where IP disclosure, especially patenting, has been found to be of particular importance (Mansfield, 1986).

Because this study argues that an understanding of the purpose of patenting and scientific publications happens in concert with, but separately from, technological capacity, it is necessary to find an indicator of technological competency independent of two often-used proxies, patents and scientific publications. We discuss Sasol's synthetic fuel reactors as physical evidence of the firm's ability and effectiveness in its core technology, transforming coal into fuel and chemicals. Given the significant investment in human and financial resources required to develop a fuel-from-coal reactor, these plants can be seen as embodying the most advanced technology of the firm at the time. Using the development of new plants as milestones, the Sasol history can be divided into five eras (see Table 1), initially corresponding to the development of different plants and, in the latest period, to the decision to internationalize.

Table 1. Technological Eras in Sasol from Founding to 2005

	Era	Achievements
± 1950–1975	1st (Synthol) era	• German Arge reactor or Low-Temperature Fischer-Tropsch process replicated. • Kellogg reactors or the High-Temperature Fischer-Tropsch process commercially developed.
± 1976–1985	2nd (Secunda) era	• Four-fold upscaling of Synthol-based plant in each of Sasol II and Sasol III.
± 1986–1990	3rd (SAS™) era	• 16 existing reactors replaced with eight SAS™ reactors with lower capital cost, increased flexibility, lower operating costs and greater capacity than the earlier reactors.
± 1991–2000	4th (SPDTM) era	• SPDTM reactor with six times the capacity of German Arge reactors. • Diversification into higher value chemicals: n-butanol, anode coke, ethylene recovery, propylene and polypropylene plants.
± 2001–2005	5th (Globalization) era	• Acquisition of German Condea. • Research partnerships with the University of Twente (Netherlands) and the University of St Andrews (UK).

This study traces the trajectory of IP disclosure both of patents and of scientific publications over the five eras. Sasol had no formal IP function or strategy for the bulk of its history, and limited IP disclosure – it filed its first patent only in 1968. The study tracks how the disclosure and governance of intellectual property changed over the course of the five eras at Sasol.

Findings are contextualized through annual reports from the founding of formal R&D at Sasol in 1957 through to 2005, as well as newspaper clippings and company histories (e.g. Collings, 2002). The increasing sophistication of not only technology production, but also IP management is examined by looking at a range of measures. The value of patents is measured through the use of forward citations of patents (Harhoff, Scherer and Vopel, 2003). In the case of scientific publications, the average impact factor of the journal is used as an indicator. Journal impact factors are a measure of the frequency of citation of articles published in a specific journal over a three-year period. They are often used as a proxy for the relative importance of a journal to a particular field, and have proven to be reliable indicators of long-term journal influence in finance and economics (Borokhovich, Bricker and Simkins, 2000), as well as in science (Fok and Franses, 2007).

By global standards, Sasol has a small patent portfolio. The entire portfolio of patent applications filed or acquired by the Sasol Group of Companies during the 50-year period from 1955 to 2005 amounted to 835 patent applications filed in any of 95 countries worldwide[1]. When considering the number of patents per era, the numbers are small and only limited statistical analysis is possible. The study therefore makes use of descriptive statistics.

Patent data was sourced from an internally maintained Access database that contains filing dates, countries and technology classification data per patent. Although it is customary to refer to USPTO data for these studies, many of the early Sasol patents were not filed in the US at all, hence the reliance on the internal database in this instance. Patent citations were based on a Delphion database search of Sasol patents. The results from the Delphion search were imported into Aureka (a patent analysis tool) in order to perform mapping and citation analysis. Data on publications in academic journals was obtained from the 2005 Chemical Abstract (CAS) Database.

Studies that use measures like patenting as an indicator of innovation (e.g. Almeida, 1996; Cantwell, 1995) are characterized by an awareness of the imperfections of patenting as a measure of technological advancement. In this study, the "imperfections" themselves are of interest: to the extent that seemingly small events (e.g. the appointment of a patenting advisory board) have a disproportionate impact on patenting and scientific publication activity, it suggests the importance of IP management strategies (in addition to the underlying technological capabilities of the firm) in shaping the nature and extent of IP disclosure.

4. RESULTS

4.1. Technological Growth at Sasol

This section serves to contextualize the more detailed analysis of Sasol's IP management processes by providing a high-level overview of the political and economic context within which Sasol operated, and its technological advancement over the five eras from 1955 to 2005. The subsequent section focuses in more depth on how Sasol learnt to manage intellectual property and the role of foreigners in that process.

4.1.1 The First (Synthol) Era: Incubation (± 1950–1975)

Sasol was created in 1950, two years after the National Party came to power with its apartheid policies and very strong inward orientation. The desire of government to increase national self sufficiency was central to the creation of the firm and guided Sasol's strategy for many decades. For example, it only started to explore international markets in the 1990s.

The main concern and main achievement of Sasol during its first period was to take root in South African soil. International expertise laid the foundation for Sasol and the company often sought the advice of a range of foreign consultants. Members of the South African Liquid Fuels Advisory Board and the eventual director of Sasol visited German, UK and US

scientists before deciding on German reactors and technology (a joint venture between Ruhrchemie Aktiengesellschaft and Lurgi Gesellschaft für Warmetechnik) for the production of chemicals and wax, and MW Kellogg Corp. technology for transportation fuels. A number of German and US technicians and engineers came to South Africa to commission the units since there was no local expertise available. In fact, early annual reports refer to them as the "American" and the "German" syntheses respectively, reflecting the strong association with the foreign suppliers of the technology.

The Kellogg reactors were never built on a commercial scale, and problems were experienced not only during commissioning, but also in realizing the full production potential of the design. After researchers from Germany, the UK and the US, contractors from MW Kellogg and a US expert "of world repute on catalysis" (Annual Report, 1957) proved unable to solve the problem, and, in keeping with the spirit of self-sufficiency that spurred the founding of Sasol, in 1957 its engineers and scientists decided to take over responsibility for the US unit. They made significant changes to the original Kellogg design, which culminated in the Sasol Synthol circulating fluidized bed reactor technology (Dancuart and Steynberg, 2004).

This also triggered the founding of a formal R&D department, ending the practice of conducting *ad hoc* research at external laboratories. During its very long initial period, Sasol deepened its understanding of the FT process and established the basic structure of the organization, e.g. the R&D department, technical training units and plants. This time is best regarded as an "incubation" period while the firm focused its efforts on transplanting foreign technology to South Africa.

4.1.2 The Second (Secunda) Era: Consolidation (± 1976-1985)

The second era for Sasol took place during the global oil crisis, and was characterized by a deepening resistance against apartheid, both locally and abroad. The South African government developed an increasingly inward-looking and defensive mindset, and, in 1974, announced that Sasol's Synthol technology would be scaled up four-fold for the Sasol II plant. In the light of the global oil crisis in 1978, the government went ahead with plans for Sasol III, a duplication of the Sasol II plant. In order to raise the funds necessary for expansion, Sasol was privatized and listed on the Johannesburg Stock Exchange in 1979, the highest listing in South Africa until that point. However, the government still exerted a strong influence over Sasol policies, for example through tariff protection for Sasol.

Most learning during this phase consisted of incremental learning-by-doing in the course of production rather than significant technological advances. For example, construction of Sasol III took only three years, compared with the five years or 100 million man-hours required for Sasol II. Managing the inadequate human resource base proved to be a significant challenge. Nearly 10,000 unskilled laborers were trained as fully skilled and many thousands more as semi-skilled workers for Sasol II. In 1978, productivity at Sasol I dropped by 8.6 per cent, because of the combined effects of the loss of expertise to Sasol II and demotivation of the remaining workforce. In fact, the corporation defined its main task in 1980 as the restoration of full operational and technical competence at Sasol I (Annual

Report, 1979), and by the end of 1983, the cost of training was expected to exceed 63 million rand, representing almost 5 per cent of the annual turnover for that year.

Sasol II and III placed substantial demands on Sasol – a type of "crisis construction" (Kim, 1998) that resulted in extensive organizational learning. But whereas internationalization played a central role in the crisis construction and learning process of Hyundai documented by Kim, the crisis prompting Sasol's learning was a deepening local orientation: whereas the internationalization of Hyundai resulted in an upgrading of capabilities, the outcome of learning at Sasol in this era was the consolidation of existing local operating capacity. Technology development projects tend to have long time-frames, and a number of initiatives were ongoing. However, the expansion forced Sasol to shift its main focus from creating new knowledge to expanding the application of existing knowledge. The cost of this set of choices only became clear in the next era, when the anti-apartheid struggle was at its most violent and the world responded by limiting international contact.

4.1.3 The Third (SAS™) Era: Harvesting (±1986-1990)

The year 1986 marked the beginning of official international economic sanctions against South Africa, accompanied by an academic boycott. Foreigners risked global censure and worse for continuing economic and intellectual engagement with South African firms. As a firm with close ties to the South African government, this presented an especially serious threat to Sasol.

At first glance, it seems that Sasol managed to overcome the constraints of its close association with a tainted government, and to sustain impressive technological growth. The first SAS™ reactor was commissioned in 1995 and by 1999 all 16 Synthol reactors were replaced by eight SAS reactors. SAS™ are Fixed Fluidized Bed reactors with approximately five times the capacity of the Circulating Fluidized Bed Synthol reactors, have lower capital cost and are cheaper to maintain.

Sasol also developed world-class polypropylene and propylene capabilities. It utilized its FT product as feedstock into the propylene plants of AECI (later acquired by Sasol, becoming Sasol Polymers). This technology had been patented by AECI prior to its acquisition by Sasol. Great strides were made with anode coke produced from pitch, and the production of better fuels and an improved catalyst led to a substantial increase in the production of hard wax. But there is of course a time-lag between doing research and reaping economic benefits from it, and the technological advances of which Sasol reaped the benefit during the late 1980s reflect the culmination of work done in both that and the previous era – a type of "harvesting" of its efforts.

In order for a firm to remain competitive, harvesting must be followed by rejuvenation, and the forced isolation was increasingly threatening Sasol's future technological advancement and thus rejuvenation. Sasol's desired technological advances increasingly required in-house technology development (Annual Report, 1990) but these developments continued to require greater research capacity than Sasol had. Sasol was therefore involved in a number of ongoing initiatives for which access to foreign expertise was essential. For

example, Sasol leveraged its relationship with Badger/Raytheon in the US for the development of Sasol Fixed Fluidized Bed reactors, and ultimately the commercial development of the HTFT SAS™ reactors (Collings, 2002). The joint filing of patents in the field of gasification technology by teams of German and South African experts from the Sasol Lurgi joint venture also bears witness to this (see Western European original filings in Figure 1, 1986-1990). These important relationships were being threatened by the global resistance to apartheid.

In short, the political context was threatening to delay Sasol maturing into a company that was technologically advanced enough both to contribute to and benefit from being a fully-fledged participant in the global knowledge creation processes in its industry. Sasol used its existing intellectual property to mitigate that threat, a strategy that is discussed in detail in Section 5.2.

4.1.4 The Fourth (SPDTM) Era: Diversification (± 1991-2000)

After Nelson Mandela's release from prison in 1990, economic sanctions and the academic boycott were lifted, and South African firms were free to resume international contact. Sasol was able to draw on a depth of expertise to successfully carry through a long-standing project when it commissioned the commercial Slurry Phase Distillate (SPDTM) reactor in 1993. The process was first developed during the mid-1980s at small bench scale in R&D, by 1998 scaled up to pilot plant size (Sasol, 1998), and a one-meter demonstration unit was developed in 1990.

In its first (Synthol) era, Sasol focused its technology development fairly narrowly on addressing the problem of the poorly performing Kellogg reactor, and the Synthol plant embodies almost the entire in-house technological capacity of Sasol at the time. In contrast, the SPDTM process was developed over the second, third and fourth periods, and also reflects only part of Sasol's technological capabilities: in addition to its deepening expertise in the high and low temperature FT processes, Sasol was by now also active in the manufacturing of a wide range of other chemicals. Sometimes the spur for their development was a desire to take advantage of by-products of the FT process, but in other cases Sasol exploited its increasing understanding of chemicals to serve local markets, e.g. develop explosives for the mining industry in South Africa. It has long been known that the evolution of firms is characterized by technological diversification (Cantwell, 1989; Granstrand and Sjölander, 1990) and Sasol's trajectory from a single product, single technology firm to one with a wider range of products and technologies is therefore typical.

Mainly as a result of the success of its technological development, the 1990s also heralded a change in strategy, with the announcement of diversification into higher value chemicals (Annual Report, 1990). These included an n-butanol plant, anode coke plant and ethylene recovery plant expansion at Secunda, as well as full commissioning of propylene and polypropylene plants in the town of Secunda. The migration into higher value products (Kim and Nelson, 2000; Lall, 2001a; Sachwald, 2001) is also associated with technologically maturing companies.

However, the disruption and sometimes severing of international relationships had a lingering negative effect, for example in the difficulties in (re-)establishing collaborative research relationships. Recognizing the urgency of re-establishing formal international contact, Sasol put a high priority on international joint ventures. These included a joint venture with the German firm Schumann in 1995 (now Sasol Wax), and the merger of Sasol Phenolics with the US-based Merichem to form Merisol in 1997. In 1997, a Memorandum of Understanding was signed between Sasol, Qatar General Petroleum Corp. and Phillips Petroleum Company for the proposed construction of an SPD facility in the Escravos Delta in Nigeria with a capacity of 20,000 bbl of fuel per day and, in 1999, Sasol and Chevron agreed to form a joint venture for the identification, development and implementation of gas-to-liquids ventures worldwide based on Sasol's FT technology. Sasol's actions suggest that it recognized the importance of international linkages to support its increasingly diverse undertakings.

4.1.5 The Fifth (Globalization) Era: Internationalization (± 2001-2005)

In 2001, Sasol announced a new corporate vision statement, articulating a desire "to be a respected global enterprise". In 2005 Sasol CFO, Trevor Munday set a goal to generate 50 per cent of Sasol's receipts from operations from non-SA operations by 2010 (Annual Report, 2005). The importance of foreign linkages in terms of technological accumulation became even more marked in this era of globalization.

A number of interventions to upgrade capabilities were initiated at Sasol. Recognizing its limited awareness of the global research landscape, Sasol constituted the Homogeneous Catalysis Advisory Board in 2000, following the appointment of a senior scientist from BP, who accessed his network of international experts in order to obtain advice and guidance on setting up a research group focused on the selective formation of high-value chemicals. No such competency existed in South Africa at the time, and Sasol did not feel confident that it had the ability to independently establish a world-class research group in this field. The Homogeneous Catalysis Advisory Board met four times annually, and assisted in knowledge transfer, competency development, recruitment and training, as well as in the technical auditing of research programs. The Board was formally dissolved in 2003, having achieved its objective to establish a research group that could support and develop technologies for the production of high-value chemicals that are integrated with the FT feedstocks. A number of research groups have been established at local South African universities as a result of the interaction with members of the Homogeneous Advisory Board. Despite the fact that the Board no longer exists in its initial form, many of the Board members continue to collaborate with Sasol and a number of joint publications have followed as a result.

A second panel of experts, the Heterogeneous Catalysis Advisory Board was also constituted in 2000. The objective differed from the Homogeneous Catalysis Advisory Board in that the competencies for developing catalysts for the FT process were well established at Sasol. Only one South African was represented on the Advisory Board, as its purpose was to provide access to international groups with specialized skills or techniques, as well as to

technically review research programs. As a result of their extensive experience and knowledge, the Board members also perform a consultative role on catalyst and process development. The Heterogeneous Catalysis Advisory Board remains active and meets annually at Sasol R&D to interact with local researchers.

In 2001 Sasol also concluded a 1.3 billion euro asset and share purchase agreement with the German firm RWE-DEA for that company's entire chemical business, Condea (renamed Sasol Chemie). The Condea acquisition not only had an immediate effect on Sasol's turnover, but also allowed Sasol to gain access to its R&D laboratories and patent portfolio

Table 2. Geographical Location and Technological Specialization of R&D Laboratories

Corporate R&D	Sasolburg (South Africa)
	Twente (Netherlands)
	St Andrews (UK)
Sasol Oil	Sasolburg (South Africa)
	Cape Town (South Africa)
Merisol	Sasolburg (South Africa)
Sasol Olefin and Surfactants	Sasolburg (South Africa)
	Lake Charles (USA)
	Moers (Germany)
	Brunsbuttel (Germany)
	Marl (Germany)
	Paderno (Italy)
	St Andrews (UK)
Sasol Solvents	Sasolburg (South Africa)
	Moers (Germany)
Sasol Nitro	Sasolburg (South Africa)
Sasol Polymers	Modderfontein (South Africa)
Sasol Wax	Sasolburg (South Africa)
	Hamburg (Germany)

Table 2 highlights the eventual broad geographical location and technological specialization of Sasol's various R&D laboratories. Sasol strengthened research partnerships with universities, both at the University of Cape Town and the University of Johannesburg in South Africa, and in 2002 also in the Netherlands and the UK. The focus of the group in the Netherlands, based at the University of Twente, is reactor engineering. The second satellite laboratory is a joint venture with the School of Chemistry at the University of St Andrews in the UK, and was established primarily to support research into homogeneous catalysis. The willingness of especially the foreign universities to enter into research partnerships with Sasol is a testament to Sasol's technological capabilities. A central goal of public research institutions is to enhance their status by doing meaningful research. Universities or public research institutions are more likely to collaborate with firms that they perceive as competent enough to potentially contribute to their own research standing. For this reason, only firms that have established their credibility in the knowledge networks in their field are likely to enter into collaborations with prestigious public research institutions.

4.2. Learning to Manage Intellectual Property

From its founding, Sasol focused on advancing its technological competence, but formal IP management was either not done at all, or done haphazardly. Only after more than three decades of technological accumulation, did Sasol finally start to manage its intellectual property in a strategic way. This section focuses on Sasol's increasingly more sophisticated IP management processes and how they are reflected in its patenting and scientific publication portfolio.

4.2.1. The First (Synthol) Era: First Forays into Intellectual Property Disclosure

In Sasol's early days, no attempts were made to publish peer-reviewed research. It was the only firm using FT technology in South Africa, and there was no need to develop mechanisms to share knowledge within the country. Its market was domestic, and in spite of the important role of foreign consultants, Sasol at this point was fundamentally nationalist in its orientation. To the extent that Sasol considered the need to safeguard, it relied on secrecy for protection. For example, the early Synthol technology was never patented or licensed, and remains unique to Sasol. Most internal documents, including research reports (except when written by or for foreigners) were written in Afrikaans, and Sasol was clearly also not concerned about participating in extra-national research networks.

The fact that Sasol's reactors were operational, and, by 1960 profitable, provides concrete evidence of the quality of its work, and when a greater awareness developed about the value of participating in global knowledge networks, research results from this period still proved to be publishable in scientific journals. For example, a number of peer-reviewed papers on the development of Sasol's FT technology (drawing on findings from the early years) were published from 1982 onwards.

The first patent on the Sasol FT process was filed in South Africa only in 1968 and reflects the type of experimentation documented in other developing country contexts (Da Motta and Albuquerque, 2000) rather than a response to a business need. Inexperienced patentees do not operate with a clear understanding of the goals and purposes of patenting, and patenting often results from a "me-too" mindset. Patents in South Africa are granted without substantive examination – they are not examined for novelty and inventiveness. Compared to examined patent regimes in places like Australia, Europe, Japan and the US, South African patents are easier to obtain, but also weaker and generally considered less valuable. At this stage in the evolution of Sasol, the distinction between examined and non-examined patent regimes clearly did not matter. In the period 1971-1975, 15 patent re-filings took place in less developed neighboring countries like Botswana and Lesotho and the so-called "independent homelands", the subsections of South Africa that had been designated "black" areas (Figure 1). Sasol represents a typical developing country firm, experimenting with patenting in a low risk (mainly domestic) environment with only a limited sense of its goals with patenting.

4.2.2 The Second (Secunda) Era: Local Experimentation

The pattern of local experimentation continued to dominate when Sasol started to formally publicize its newly developed knowledge around the mid-1970s. It is noteworthy that the milestones during this era are not technological – Sasol was replicating existing technology in its two new plants. However, with privatization, ownership no longer lay with the isolationist government, thus making disclosure easier. The choice between secrecy and disclosure is one of the fundamental IP management decisions firms have to make, and the Sasol case demonstrates vividly that this decision reflects the strategic goals of management rather than the firm's technology. For the privatized Sasol, the influence of its secretive government was reduced.

The example of foreigners played an important role in Sasol's initial IP disclosure. One of Sasol's first journal publications was written in 1976 by German researchers Dressler and Uhde and appeared (in German) in *Fette, Seifen, Anstrichm*. Collaboration with foreign partners, mainly firms from Germany and the US, generated 10 of the 53 journal papers that were published over the 10-year period (see Table 3), and research was published equally in local and international outlets. Thirty-one patents were filed, about half of which were also filed abroad (mainly in Europe, although in certain cases also North America and Australia).

However, there was still no underlying business strategy for its IP disclosure process. For example, the location of patenting activities cannot be ascribed to a specific strategy, either in terms of markets or blocking competitors. There is coal in North America, but no real reason for the Australian filings in the early years. Close association with German firm Lurgi that developed gasification technology together with Sasol (in the Sasol-Lurgi Joint Venture) accounts for some of the focus on Europe. Although the growing awareness of IP disclosure seems to have been triggered in part through the example and participation of foreigners, it mainly reflected local experimentation by Sasol.

Table 3. Sasol Publications in Peer-Reviewed Journals

	1966-1970	1971-1975	1976-1980	1981-1985	1986-1990	1991-1995	1996-2000	2001-2005
	(Final Stage of) Synthol Era		Secunda Era		SAS™ Era	SPD™ Era		Globalization Era
Total peer-reviewed papers published	0	2	16	37	25	31	65	172
Total papers published in ISI database journals	0	0	10	19	17	14	30	124
Average impact factor of journals*	0	0	0.43	0.44	0.78	0.30	0.49	1.30

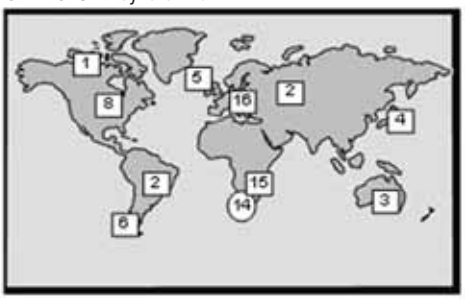
* Non-ISI journals are coded as having an impact factor of 0.

Source: CAS Database (2005)

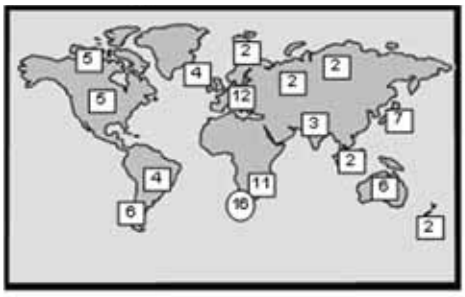
Figure 1. Global Distribution of Sasol-Filed Patent Specifications

1966-1970 Symbol Era

1971-1975 Synthol Era

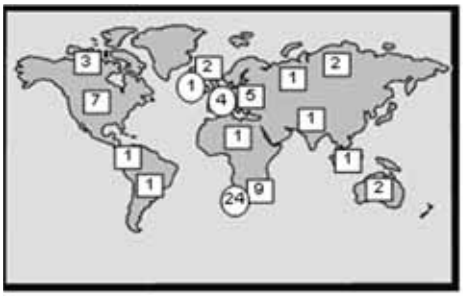


1976-1980 Secunda Era

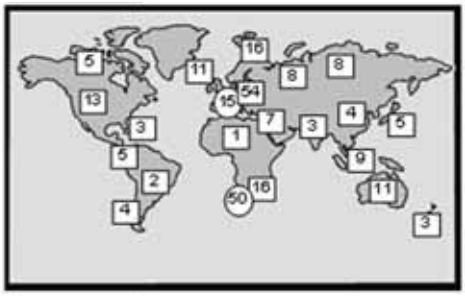


1981-1985 Secunda Era

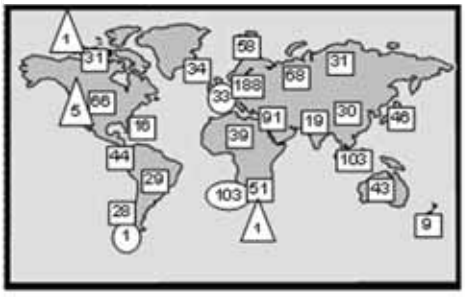
1986-1990 SAS™ Era



1991-1995 SPD™ Era



1996-2000 SPD™ Era



2000-2005 Condea Era

O Original filing
□ Re-filing of original patent in another country
△ Original not filed in country of invention

Source: Sasol Patent database

4.2.3 The Third (SAS™) Era: Foreign Experimentation

Sasol's engagement with formal IP management processes and its IP disclosure accelerated tremendously during the turbulent late 1980s, to a significant extent as a response to the increasing global resistance to the government's apartheid policies. Technologically, Sasol was at a critical point where its own learning could not be sustained without inputs from more advanced and foreign sources of expertise. However, as a South African firm with close ties to the government, the global anti-apartheid movement directly affected its political legitimacy. The political context made it virtually impossible to enter into new academic international collaborations and even longstanding collaborators, such as the US firm Raytheon, retreated from the relationship with Sasol. Concerned about exclusion from critical knowledge-creation networks, Sasol started using publications to retain a presence – albeit a marginal one – in the knowledge-creation networks it valued.

Virtually overnight, the average impact factor of journals in which Sasol published rose from 0.44 to 0.73 (see Table 2). Sasol was harvesting all publishable papers, including publishing findings dating from its founding. The increase was not sustainable, and in the next era, the average impact factor of journals dropped noticeably to 0.3, suggesting that Sasol might have also been rushing the publication of new insights. The publication strategy reflects an attempt by Sasol to increase its perceived technological legitimacy in the networks of knowledge creation. Sasol's response highlights the importance of scientific publications as a signaling device: by disclosing some of its most interesting research results to the research community, Sasol was able to maintain an informal presence in that community, even though the number of formal collaborations sharply reduced.

Patenting can serve a similar signaling purpose, but it seems that Sasol at that time associated patenting primarily with the potential to appropriate direct financial benefits from new technology. Sasol did not accelerate its international patenting, and, in fact, changes in its patenting behavior were triggered by domestic developments.

In 1987, the increasingly defensive government had decided to further expand the fuel self-sufficiency of South Africa by developing Mossgas, a natural gas exploration and conversion project, also based on FT technology. Although the project siphoned off some of the scarce petrochemical research skills in South Africa, Mossgas did provide a local market for Sasol's know-how – for example, Sasol's Synthol technology was licensed to Mossgas. Sasol accelerated local patent filings at the time that Mossgas was created (Figure 1, 1986-1990).

However, Sasol did not yet know how to manage the patenting process. Where patents were filed internationally, this was done with a limited understanding of the purpose of such patenting. Thus a clutch of patents was filed in an inordinate number of countries (30 or more) during this period. One patent – that has to date only received four citations and two self-citations and is clearly not a core patent – was filed in 46 countries. It is questionable whether the broad country filing strategy was justified. In addition, the nature of the patenting regime in a country was hardly considered. Obtaining a patent in countries where patents are substantively examined provides a strong signal that it is a real inven-

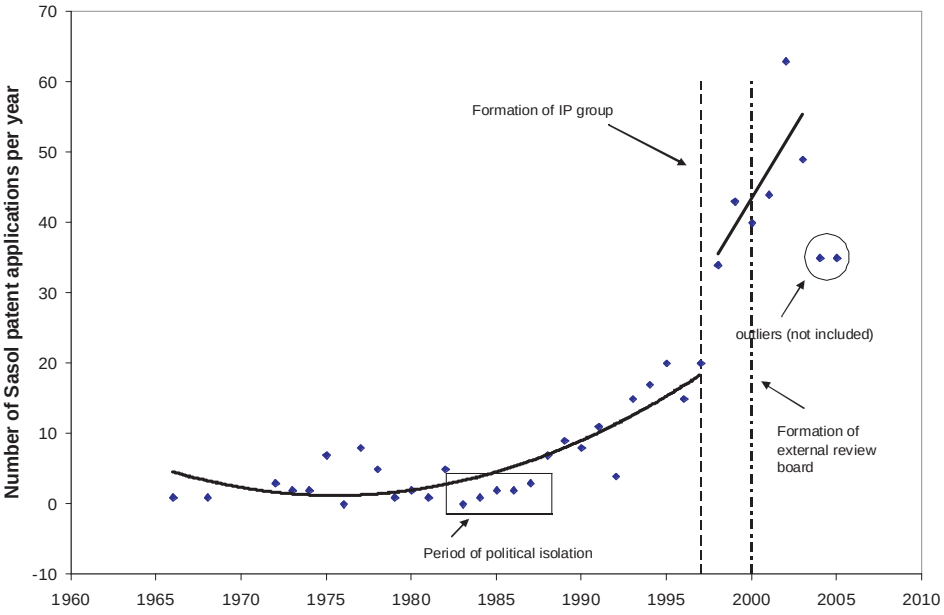
tion, supports more secure rights and is important for signaling purposes. Sasol did not evidence a real awareness of these issues in its early international patenting. In short, although Sasol was clearly realizing that there was value to disclosing its intellectual property, both through patents and scientific publications, disclosure was still a relatively *ad hoc* rather than a managed process.

During Sasol's first and second eras, the process of experimentation with intellectual property took place mostly locally: during this third era, experimentation took place internationally. Although international experimentation achieved Sasol's goal of retaining an international footprint, even given the pervasive anti apartheid sentiment, the costs of this strategy were high. In addition to the direct costs associated especially with patent filings (and as a result of Sasol's expansive filing, some patents were very expensive), the disclosure of a core technology must be carefully managed to ensure that it does not detract from the competitiveness of a firm. Recognizing the need to manage intellectual property more strategically, Sasol developed a number of internal governance mechanisms.

4.2.4 The Fourth (SPD™) Era: Local Governance

In 1996, Sasol introduced a formal IP function, starting the process of actively managing the disclosure of its technology. Until then, patent applications were handled on an *ad hoc* basis by the Company Secretary and an external patent attorney. Sasol adopted a strategy of encouraging Sasol scientists and engineers to pursue careers as patent attorneys, enabling them to be familiar with the technology as well as having the required legal qualifications.

Figure 2. Variation in Number of Patent Applications Filed by Sasol Employees During 1966-2005

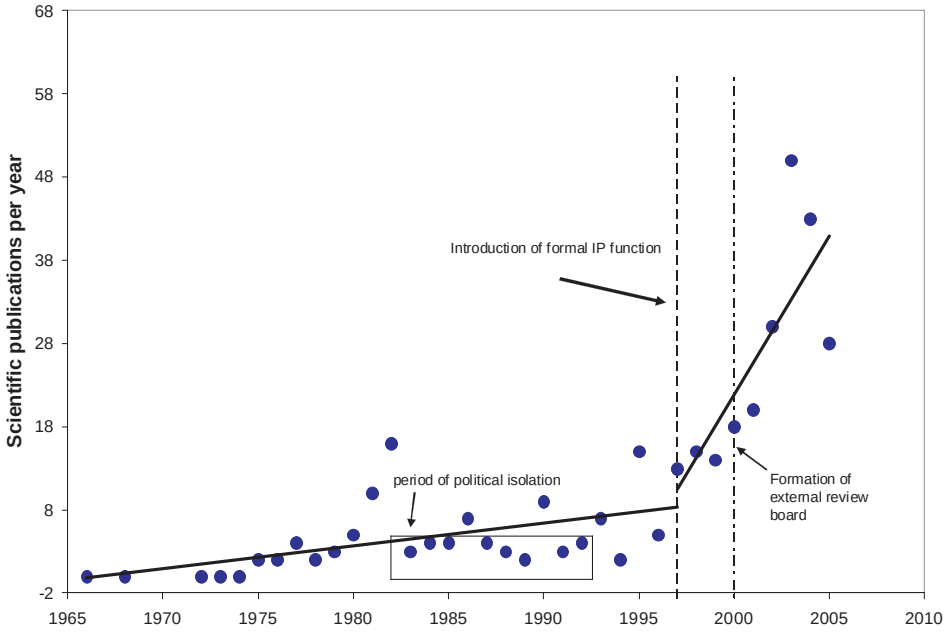


Source: Sasol Patent Database

Apart from the negative effect of political isolation on patenting, a review of overall trends (Figure 2) shows a gradual upward trend in the number of patent applications filed by Sasol up to 1997. After 1997 and the formation of the IP group, a positive step-change in the propensity to patent is evident. (The patent applications which were listed as pending final filing during 2004 or 2005 are not included in the data set, resulting in a lower number of patents for the years 2004 and 2005.) Although there was a more strategic approach to (and thus reduction in) the number of countries in which patents were filed, the number of inventions patented continued to increase. Figure 3 demonstrates a similar change in the propensity to publish in scientific journals with the formation of the IP function in 1997.

However, as the number of patent filings increased, costs also increased dramatically. The discovery of how expensive this process can be led Sasol to more rigorously assess the reasons for patenting. Sasol realized that it lacked the deep pockets of its US counterparts (e.g. ExxonMobil and ConocoPhillips) and through the creation of various IP management bodies in its fourth era, adopted a more focused patenting strategy. This resulted in strict governance on patents, and strong justification was required before an invention was patented. A number of patents were abandoned because they did not form part of the core technology of the company.

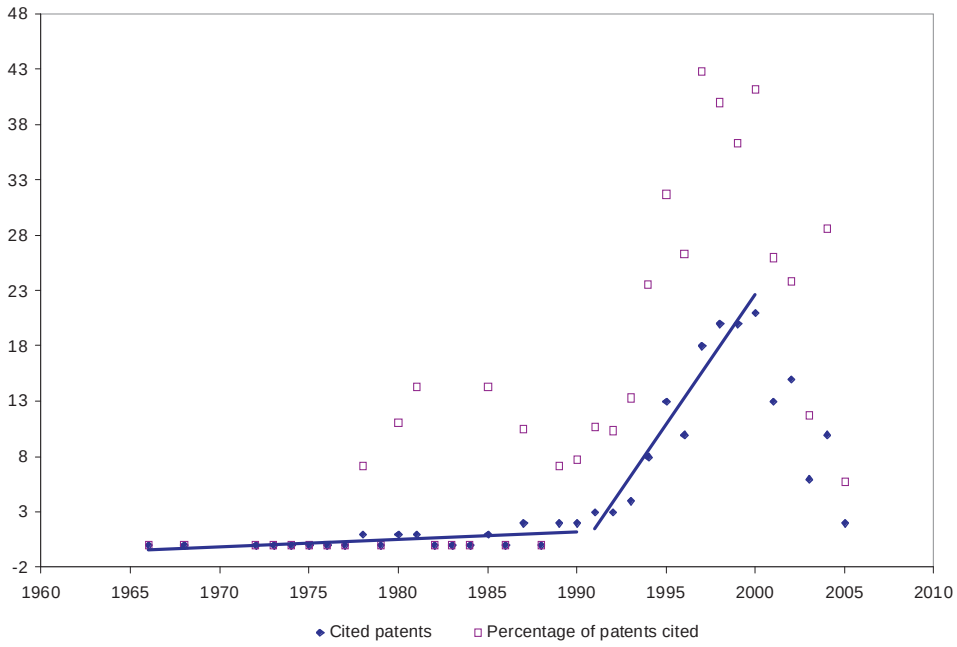
Figure 3. Variation in Number of Scientific Publications by Sasol from 1966 to 2005



Source: CAS Database 2005

In assessing the formalizing of intellectual property it is important to examine its effect not only on the quantity but also the quality of disclosure (i.e. the value that is captured by the firm in exchange for dissemination of knowledge). Forward citations of Sasol-filed patents were counted as a measure of their value, following the methodology of Mowery *et al*. (2002). Figure 4 shows all the Sasol patent applications that had received at least one forward citation prior to 2005. There is a clear change in the curve after the introduction of a formal IP function. The lower count for 2004 and 2005 can be ascribed to a truncation bias as a result of which later patents will have fewer citations. Figure 4 shows that, although the number of patents cited does increase with a greater propensity to patent, the increase in citations was not merely due to an increase in patenting; there is also an increase in the percentage of patents cited post-1990.

Figure 4. Forward Citations of Sasol-Filed Patents (1966-2005)

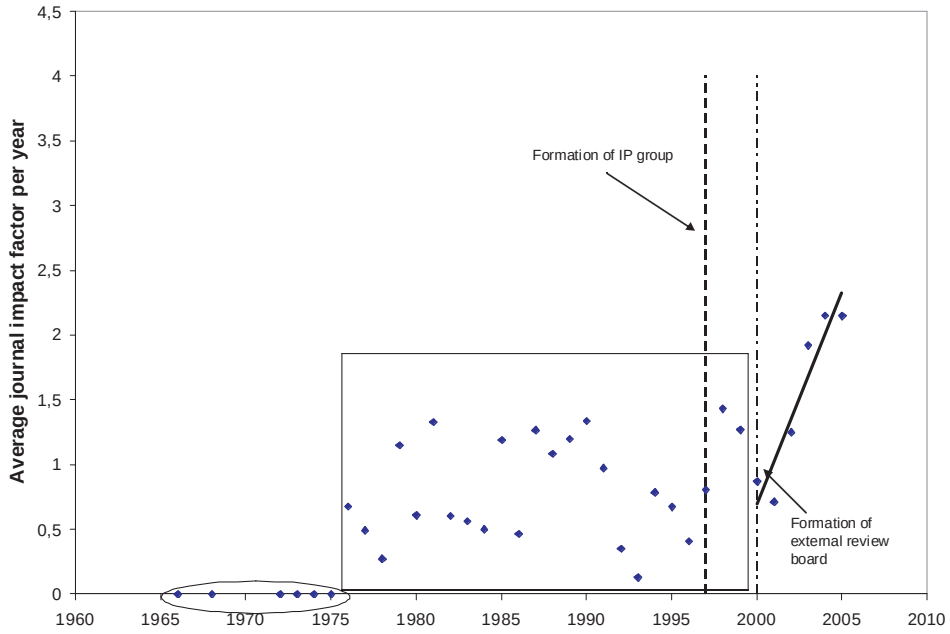


Source: Delphion database of Sasol related US, EP, DE (Germany) and PCT (WO applications) patents and applications.

In assessing the change in value of scientific publications following the formalization of intellectual property at Sasol, an average Journal Impact Factor was used. The data (Figure 5) appear fairly scattered and there is no clear evidence of benefits from the introduction of the IP group, although there is a steady annual rise. To the extent that an understanding of formal intellectual property is a separate process from technology accumulation, this is not surprising. The formalization of the IP function would have created an awareness of the value of disclosure and the appropriateness of patents, but would not have

been able to influence the scientific quality of the research. Quality was instead positively affected by the Homogenous and Heterogeneous Catalysis Advisory Boards that were subsequently established, as discussed in the previous section.

Figure 5. Variation in Average Journal Impact Factor



Source: ISI Journal Database

4.2.5 The Fifth (Globalization) Era: Global Governance

The decision to patent or keep secret is highly strategic and depends on the technology area. Because FT is core to Sasol's sustainable advantage, patenting is an important aspect of developing a licensed technology offering. Having established (mainly through trial and error) local governance principles, in 2000 Sasol refined its IP management process by introducing governance principles gleaned from foreign partners.

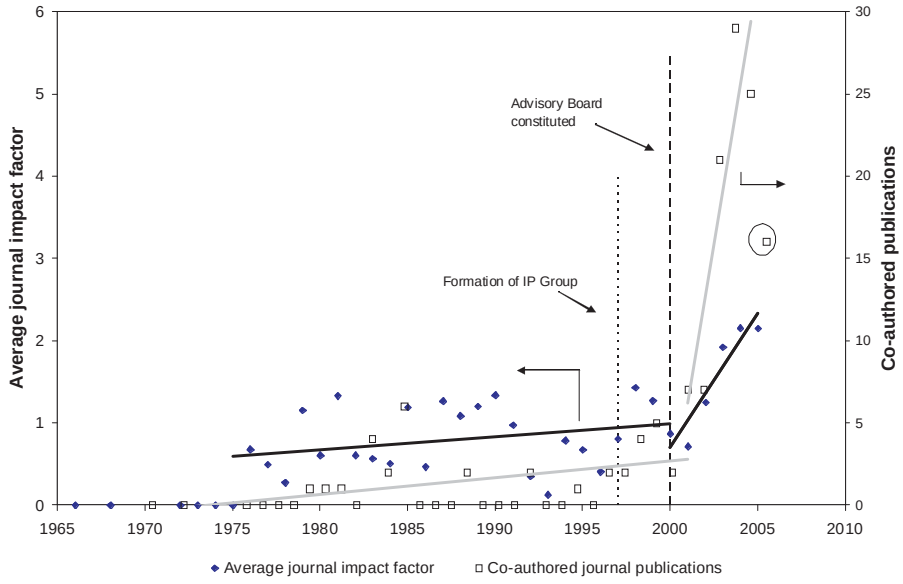
The Sasol/Chevron joint venture that was concluded in 2000 provided Sasol with insight into the IP management process of another leading petrochemical country, and Sasol modeled a number of refinements on Chevron practices. For example, Chevron served as a model for the development of IP review teams to formally decide, per technology area, on the most appropriate vehicle for IP protection (trade secret, patent or scientific publication) in order to manage the business and technological risks associated with disclosure.

The advent of the IP review teams in 2000 heralded a more rigorous approach to patenting. Specific country filing strategies were developed for different technology areas, chosen from a pre-selected list of markets, sources of feedstock or location of synthetic fuel plants. The review teams have proven to be successful in competitor analysis and technology landscaping, increasing the agility of responses in terms of in-house filing strategies and opposition proceedings.

In order to ensure alignment with the corporate strategy, an IP governance committee ratifies decisions taken by the review team. In addition, the organization structure is intended to ensure integration of IP management with wider corporate (rather than narrower R&D) goals. Originating in the R&D department, the IP department now reports to the Chief Technical Officer at the corporate level, although many of the IP technical advisors are based in the R&D function, close to the innovation hub of Sasol. Similarly, patent attorneys are located within many of the business units. So-called "deep dive specialists" and "value chain coordinators" have been appointed to ensure that the patent portfolio has the desired balance between focused specialization and technology integration across process units. Costs are now managed within a budget, which also includes provision for litigation proceedings.

As mentioned earlier, the introduction of the internal IP group had no noticeable effect on the average journal impact factor. However, the establishment of the review team (facilitating more strategic thinking about research) and advisory boards (facilitating better research) was followed by a significant increase in the quality of research, as measured through publications in high-impact journals.

Figure 6. Effect of International Linkages on the Quality of Scientific Publications in Journals



Although there is a close relationship between greater scientific and technological understanding and greater external recognition of intellectual property (as evidenced in Figure 6), it is important to note that Chevron's model was the only external source of knowledge in a process that was developed and refined largely in-house. Throughout its history, Sasol relied on international connections to support its technological upgrading. Indications – e.g. Sasol's large number of foreign R&D laboratories and its research partnerships with foreign universities – are that foreign inputs will only increase in number and importance in its technological advancement. Given the critical role of foreigners in the creation of intellectual property, Sasol's predominantly internal focus in the development of its IP management capacity is striking.

5. DISCUSSION

Technologically, Sasol evolved from a firm with a single enabling technology (the Synthol processor) and a single, commodity product (fuel) to a firm with multiple enabling technologies and numerous products, including higher value-added chemicals. It evolved from a firm with a purely domestic focus to a firm with a strong international focus, operating in multiple geographic regions. Sasol evolved through periods of incubation to consolidation and harvesting, and finally through processes of diversification and internationalization.

At the same time, its IP management strategy also evolved. Experimentation initially played an important role, as did governance later on when the costs of experimentation became clear. In each case, the process started with a local and evolved into a global orientation. Table 4 summarizes the co-evolution of Sasol's technological and IP management strategies.

When comparing the evolution of its technological and IP management trajectories, it is clear that Sasol took much longer to develop an effective IP management strategy than a profitable technological capability base. This could to a certain extent be explained by the fact that firms may need a threshold level of technologies before they stand to benefit from IP management. However, Sasol was experimenting with IP disclosure for at least 30 years before it developed a capacity for strategically managing intellectual property. Part of the reason for this may have been Sasol’s original orientation to the domestic market, in which it did not face competition, thus having felt less of a need to protect its IP. However, Sasol could have still leveraged its IP internationally even if it did not intend to enter those markets directly. In addition, even once it began to venture into foreign markets, its IP management capabilities and structures appeared weak and unsystematic.

It is therefore argued that in order to understand why it took so long for Sasol to develop its IP management capacity, it is necessary to consider the role of foreign expertise. The Sasol case reconfirms the important role of foreign inputs in the evolution of technological capabilities. However, in the case of its IP management capabilities, the role of foreigners is far more ambiguous. The evolution of its IP management function was, with the important exception of the Chevron joint venture, essentially through in house trial-and-error. Thus Sasol first made use of legal firms and then developed an in-house capacity for

Table 4. Co-Evolution of Technological and IP Management Capabilities

	1st (Synthol) Era	2nd (Secunda) Era	3rd (SAS™) Era	4th (SPD™) Era	5th (Globalization) Era
	± 1950–1975	± 1976–1985	± 1986–1990	± 1991–2000	± 2001–2005
Characteristic Process	Incubation	Consolidation	Harvesting	Diversification	Internationalization
Technological capabilities	Initial adoption and local integration of foreign technology.	Large-scale replication of technology and consolidation of capabilities.	Increased efficiencies of existing technologies achieved and desire to extend into new technologies for which foreign inputs critical.	Diversification into higher value added products, supported by increasingly diverse underlying technologies.	Corporate goal to generate substantial international sales, supported by joint ventures, acquisition of leading firms, foreign- dominated advisory boards, and establishment of international research laboratories.
IP Management Capabilities					
Characteristic Process	Local Experimentation		Foreign Experimentation	Local Governance	Global Governance
Patenting	Limited domestic patenting toward end of era, not strategically planned.	Accelerated domestic patenting, some foreign filings, mainly in immediate region.	Domestic patenting in order to facilitate licensing to local competitors, complemented by extensive but ad hoc foreign filings.	Development of decision criteria for patenting, based on a focused disclosure strategy.	Importing of foreign practices (e.g. review teams) supplemented with local innovations (e.g. deep dive specialists and value chain coordinators).
Scientific publications	None – although findings from this era proved publishable in 3rd era.	Mainly domestic publishing, following example of foreigners.	Extensive publishing and potentially over-recovery of knowledge in order to establish a credible global presence.	Increase in quantity but not quality of publications.	Sustained publishing in high impact journals.

managing patenting. It first made the mistake of filing some patents in too many countries, and then developed criteria for deciding in which countries to file. It looked to Chevron as a model for its IP review team, but the specialist committees to ensure balance in its patent portfolio again represented an internal innovation.

The nature and the motives of interaction between Sasol and its foreign technology partners differ for technological versus IP management goals. Sasol's foreign technology partners – whether firms or universities – stand to benefit directly to the extent that Sasol can expand its technological capacity: Sasol is potentially a more competent research partner, has a stronger offering as a potential partner in an alliance or merger, and can further advance general understanding of the niche technology in which it is a leader. Where a firm's contribution to a technology partnership is small, there may be little to gain for the foreign partner in becoming involved in not only the technology, but also the IP management of the smaller firm.

Alternatively, if the firm's technology poses a major threat to the partner, the partner may also be less inclined to want the firm to develop expertise at managing its intellectual property. IP management regimes aim at finding a balance between rewarding the inventor and allowing the new knowledge to be used for the greater good. To the extent that an individual firm is more skilled at the "game" of IP management, it is better able to appropriate for itself the benefits of its inventions. This suggests that greater competence in the management of intellectual property will result in Sasol (rather than its foreign partners) appropriating more of the benefits.

Because arm's length partners tend not to reap greater benefit if Sasol becomes more competent at managing (rather than creating) its intellectual property, the alignment of motives that spur the mutually beneficial interactions between Sasol and its foreign connections around technological and scientific capability creation is critical. Most foreign technology partners can be expected to be neutral or even somewhat opposed to Sasol becoming better at negotiating its way around an IP regime. The exception in Sasol's case involves a joint venture. In the case of joint ventures, the interdependencies between the two partners are usually significant, and strict IP governance and a high level of capacity in its management are required from both parties. Within the Sasol/Chevron joint venture, the need for common governance of their IP created a strong enough alignment of motives for Sasol to gain privileged access to the IP management processes of its partner.

The implications of the more common case of the non-alignment of motives of the large developing country firm and its partners are substantial. First, large developing country firms have to go through an extensive and sometimes costly learning process to learn how to gain benefits from participating in a global IP regime. Second, the partners who can probably contribute most to the technological upgrading of the large developing country firms – capable partners, typically from the developed world, in the same or a closely related industry – are unlikely to have the incentive to help the large developing country firm become more capable of managing its intellectual property. Unless motives are very explicitly aligned, for example in a joint venture, the issues of rivalry and appropriation inhibit those partners from sharing their knowledge: indeed, they may even stand to benefit directly if new intellectual property is not appropriated by the developing country firm.

Third, the case reconfirms the potential value of learning from more experienced firms also in the IP arena. The Chevron example was of tremendous benefit to Sasol and dramatically accelerated the refinement of their IP management processes. In order to avoid costly learning through trial-and-error, firms can benefit from advice on aspects like the strategic role of intellectual property, the complementary roles of patenting and publishing in scientific journals, and the need to think strategically about the purpose of a given patent before deciding where to patent. In sum, the case analysis points to the value of a platform where firms which are grappling with the issues raised by the introduction of formal intellectual property can share their knowledge and experience.

6. CONCLUSION

By the end of 2005, Sasol had matured into a fairly typical although small multinational. Much as the first era in Sasol's history had served as an incubation period allowing the firm to transfer assimilated technology and evolve into a truly South African company, the fifth era concluded an incubation period that heralded the start of Sasol's identity as a multinational firm.

Having a coherent IP strategy is one of the characteristics of MNCs, especially in chemical and related industries. Some of the most concrete and direct benefits of a well-executed IP strategy are the direct financial benefits that firms can realize through the licensing of patents. For this study, we were unable to obtain data on licensing costs and revenues, and subsequent research will hopefully be able to tease out the role of licensing in an IP strategy. But the study does provide evidence of how patents and scientific publications act as signals of technical competence and legitimacy in the field. For developing country MNCs – coming from economically less successful regions – such "currency" is especially important to gain access to the relevant international knowledge networks.

This chapter demonstrates the evolution of Sasol's IP strategy. This strategy has lagged behind the development of intellectual property *per se*, and much more than in the case of Sasol's technological capacity base – where the role of foreign connections has been and continues to be critical – IP capacity management has developed through internal trial and error. This is because a stronger IP management capacity at Sasol does not particularly serve the purposes of its foreign partners, and again highlights that the beneficial interaction between partners from more- and less-developed contexts that is most successful is when there is goal convergence between the parties.

Note

1 For the purposes of this study, every patent filed in every jurisdiction has been counted separately. There has been no attempt to group patents into patent families.

References

Acs, Z.J. and D.B. Audretsch, 'Patents as a Measure of Innovative Activity', KYKLOS, 42(2):171-180, 1989.

Acs, Z. J. and D.B. Audretsch, 'R&D, Firm Size and Innovative Activity', in *Innovation and Technological Change: An International Comparison,* Z.J. Acs and D.B. Audretsch (eds.), 39-59, Harvester Wheatsheaf, London, 1991.

Almeida, P., 'Knowledge Sourcing by Foreign Multinationals: Patent Citation Analysis in the U.S. Semiconductor Industry', *Strategic Management Journal*, 17 (Special Issue: Knowledge and the Firm):155-165, 1996.

Almeida, P. and A. Phene, 'Subsidiaries and Knowledge Creation: The Influence of the MNC and Host Country on Innovation', *Strategic Management Journal*, 25:847864, 2004.

Arora, A., A. Fosfuri and A. Gambardella, *Markets for Technology*, MIT Press, Cambridge, US, 2004.

Bell, M. and K. Pavitt, 'Accumulating Technological Capability in Developing Countries', *The World Bank Research Observer,* 257-282, 1992.

Blomström, M., A. Kokko and S. Globerman, 'The Determinants of Host Country Spillovers from Foreign Direct Investment: A Review and Synthesis of the Literature', in *Inward Investment, Technological Change and Growth,* N. Pain (ed.), 34-65, Palgrave, Houndmills, UK, and New York, US, 2001.

Borokhovich, K. A., R.J. Bricker and B.J. Simkins, 'An Analysis of Finance Journal Impact Factors', *Journal of Finance,* 55(3):1457-1469, 2000.

Cantwell, J., *Technological Innovation and Multinational Corporations*, Basil Blackwell, Oxford, 1989.

Cantwell, J., 'The Globalisation of Technology: What Remains of the Product Cycle Model?' *Cambridge Journal of Economics*, 19:155-174, 1995.

Cohen, W.M. and D.A. Levinthal, 'Absorptive Capacity: A New Perspective on Learning and Innovation', *Administrative Science Quarterly*, 35(1):128-152, 1990.

Cohen, W.M., R.R. Nelson and J.P. Walsh,. 'Protecting their Intellectual Assets: Appropriability Conditions and Why US Manufacturing Firms Patent (or not)', NBER *Working Papers*, Number 7552:1-31, 2000.

Collings, J., *Mind over Matter: The Sasol Story: Half a Century of Technological Innovation*, Sasol, Johannesburg, 2002.

Da Motta and F. Albuquerque, 'Domestic Patents and Developing Countries: Arguments for their Study and Data from Brazil (1980 - 1995)', *Research Policy*, 29:1047-1060, 2000.

Dancuart, L.P. and A.P. Steynberg, 'Fischer-Tropsch Based GTL Technology: A New Process?' Paper presented at the ACS National Meeting, Anaheim, US, 2004.

Dunning, J.H., American Investment in *British Manufacturing Industry*, George Allen & Unwin, London, 1958.

Fok, D. and P.H. Franses, 'Modelling the Diffusion of Scientific Publications', *Journal of Econometrics*, 139:376-390, 2007.

Granstrand, O. and S. Sjölander, 'Managing Innovation in Multi-Technology Corporations', *Research Policy*, 19(1):35-60, 1990.

Granstrand, O., 'Innovation and Intellectual Property Rights', in *The Oxford Handbook of Innovation*, J. Fagerberg, D.C. Mowery and R.R. Nelson (eds.), 266-290, Oxford University Press, Oxford and New York, 2004.

Griliches, Z., 'R&D and Innovation: Some Empirical Findings', in R&D, *Patents, and Productivity*, Z. Griliches (ed.), 127-148, University of Chicago Press, Chicago and London, 1984.

Haddad, M. and A. Harrison, 'Are there Positive Spillovers from Direct Foreign Investment?', *Journal of Development Economics*, 42:51-74, 1993.

Hagedoorn, J. and M. Cloodt, 'Measuring Innovative Performance: Is there an Advantage in Using Multiple Indicators?' *Research Policy*, 32(8):1365-1379, 2003.

Hall, B.H. and R.H. Ziedonis, 'The Patent Paradox Revisited: An Empirical Study of Patenting in the U.S. Semiconductor Industry, 1979–1995', *The Rand Journal of Economics*, 32(1):101-128, 2001.

Harhoff, D., F.M. Scherer and K. Vopel, 'Citations, Family Size, Opposition and the Value of Patents', *Research Policy,* 32:1343-1363, 2003.

Kim, L., 'Crisis Construction and Organizational Learning: Capability Building in Catching-Up at Hyundai Motor Corporation', *Organization Science*, 9(4):506-521, 1998.

Kim, L., *Imitation to Innovation*, Harvard Business School Press, Harvard, US, 1999.

Kim, L. and R.R. Nelson, *Technology, Learning & Innovation*, Cambridge University Press, Cambridge, 2000.

Kumar, N., 'Foreign Direct Investment and Technology Transfers in an Era of Globalization and Prospects for Developing Countries', *Globalization, Foreign Direct Investment and Technology Transfers* in N. Kumar (ed.), 197-215, Routledge, London, 1998.

Lall, S., 'Technology Development Policies: Lessons from Asia', in S. Lall (ed.), *Learning from the Asian Tigers*, 59-106, Macmillan, London, 1996.

Lall, S., 'What "Competitiveness" is and Why it is Important', in *Competitiveness, Technology and Skills*, S. Lall (ed.), 1-30, Edward Elgar Publishing, Cheltenham, UK, 2001a.

Lall, S., 'MNCs, Technology and Export Competitiveness', in *Competitiveness, Technology and Skills*, S. Lall (ed.), 188-259, Edward Elgar Publishing, Cheltenham, UK, 2001b.

Lerner, J., '150 Years of Patent Protection', *American Economic Review*, 92(2):221-225, 2002.

Levin, R.C., A.K. Klevorick, R.R. Nelson and S.G. Winter, 'Appropriating the Returns from Industrial Research and Development', *Brookings Papers on Economic Activity*, 3:783-820, 1987.

Lhuillery, S., 'Voluntary Technological Disclosure as an Efficient Knowledge Management Device: An Empirical Study', *Economics of Innovation & New Technology*, 15(4/5):465-491, 2006.

Machlup, F. and E. Penrose, 'The Patent Controversy in the Nineteenth Century', *The Journal of Economic History*, 10(1):1-29, 1950.

Mairesse, J. and P. Mohnen, 'The Importance of R&D for Innovation: A Reassessment Using French Survey Data', *Journal of Technology Transfer*, 30(1/2):183-197, 2005.

Mansfield, E., 'Patents and Innovation: An Empirical Study', *Management Science*, 32(2):173-181, 1986.

Marin, A. and M. Bell, 'Technology Spillovers from Foreign Direct Investment (FDI): The Active Role of MNC Subsidiaries in Argentina in the 1990s', *Journal of Development Studies*, 42(4):678-697, 2006.

Mazzoleni, R. and R.R. Nelson, 'The Benefits and Costs of Strong Patent Protection: A Contribution to the Current Debate', *Research Policy*, 27:273-284, 1998.

Miotti, L. and F. Sachwald, 'Korean Multinationals' Strategies and International Learning', in F. Sachwald (ed.), Going Multinational: *The Korean Experience of Direct Investment*, Vol. 9:127-166. Routledge, London, 2001.

Mowery, D.C., J.E. Oxley and B.S. Silverman, 'The Two Faces of Partner-Specific Absorptive Capacity: Learning and Cospecialization in Strategic Alliances', in *Cooperative Strategies and Alliances*, F.J. Contractor and P. Lorange (eds.), 291-319, Elsevier Science Ltd., Oxford, 2002.

Muller, P. and J. Pénin, 'Why do Firms Disclose Knowledge and How does it Matter?' *Journal of Evolutionary Economics*, 16(1/2):85-108, 2006.

Murmann, J. P., *Knowledge and Competitive Advantage: The Coevolution of Firms, Technology, and Institutions*, Cambridge University Press, Cambridge, 2003.

Narula, R. and J.H. Dunning, 'Industrial Development, Globalization and Multinational Enterprises: New Realities for Developing Countries', *Oxford Development Studies*, 28(2):141-167, 2000.

Oddi, A.S., 'The International Patent System and Third World Development: Reality or Myth?' Du*ke Law Review,* 5:831-878, 1987.

Pack, H., 'Research and Development in the Industrial Development Process', in *Technology, learning, and innovation*, L. Kim and R.R. Nelson (eds.), 69-94, Cambridge University Press, Cambridge, 2000.

Reitzig, M., 'The Private Values of 'Thickets" and "Fences": Towards an Updated Picture of the Use of Patents across Industries', *Economics of Innovation and New Technology*, 13(5):457-476, 2004.

Report, S.A., South African Coal, Oil and Gas Corporation, Ltd., Sasolburg, 1957.

Sachwald, F., *Going Multinational: The Korean Experience of Direct Investment*, Routledge, London, 2001.

Sasol, The Slurry Phase Distillate Process, Sasol Synfuels International, Johannesburg, 1998.

Sasol, A.R., South African Coal, Oil and Gas Corporation, Ltd., Sasolburg, 1979.

Sasol, A.R., South African Coal, Oil and Gas Corporation, Ltd., Sasolburg, 1990.

Sasol, A.R., South African Coal, Oil and Gas Corporation, Ltd., Sasolburg, 2005.

Saxenian, A., 'Transnational Communities and the Evolution of Global Production Networks: the Cases of Taiwan, China and India', *Industry and Innovation*, 9(3):183-202, 2002.

Schmookler, J., 'The Utility of Patent Statistics', *Journal of the Patent Office Society*, XXXV(6):407-412, 1953.

Sell, S.K., 'Intellectual Property Protection and Antitrust in the Developing World: Crisis, Coercion, and Choice', *International Organization*, 49(2):315-349, 1995.

UNCTAD, *World Investment Report: Transnational Corporations and the Internationalization of R&D*, 332, United Nations, UN Conference for Trade and Development, New York and Geneva, 2005.

Vang, J. and M.L. Overby, 'Transnational Communities, Offshore Outsourcing and Offshore Subsidiaries: The Case of the Indian IT Industry', in *Asia's Innovation Systems in Transition* B.-Å. Lundvall, P. Intarakumnerd and J. Vang (eds.), 54-74, Edward Elgar Publishing, Cheltenham, UK, 2006.

CHAPTER 5
INTELLECTUAL PROPERTY, COMMERCIALIZATION AND INSTITUTIONAL ARRANGEMENTS AT SOUTH AFRICAN PUBLICLY FINANCED RESEARCH INSTITUTIONS

MCLEAN SIBANDA*

Abstract

Publicly financed research institutions form the largest concentration of skills and personnel in the area of science and technology in South Africa. They are composed of 23 higher-education institutions and five science councils. In 2002, the South African Research and Development Strategy identified disparate practices in respect of ownership, management and commercialization of intellectual property emanating from publicly financed research at these institutions (DST, 2002). Furthermore, the R&D strategy proposed a need for harmonization of IP practices and establishment of a dedicated fund to finance the securing of intellectual property from publicly financed research. This paper explores the state of IP generation and protection at South African publicly funded research institutions from 2001 to 2007, with a view to understanding the current state of patenting by such institutions, the possible constraints that are faced and the institutional arrangements that are currently in place.

The paper, therefore, analyzes the extent of patenting by the institutions both locally (at CIPRO) and internationally (EPO, USPTO and international applications via the PCT). It provides insights into the areas of technology in which South African institutions are patenting, and relies on patent citations to understand the possible economic and technological importance of such patents. The paper also explores the extent of commercialization of the institutions' patents and relies on a survey of the institutions to understand the factors that may be affecting the commercialization of patents and the amounts the institutions have spent on patenting and earned from patent licensing. In addition, a comparative analysis of patenting activity to publication output in respect of the most prolific academic inventors provides some useful insights on the extent to which patenting may affect publication.

Finally, the paper reviews the institutional arrangements for the management of intellectual property and technology transfer at the institutions and various policy initiatives by the Department of Science and Technology (DST). Although it may be too early to judge the exact impact of these initiatives, the study suggests that they are already contributing to changing the culture at these institutions. The paper proposes some goals in order to transform the manner in which research results are handled, and shows an alignment between these goals and the DST's Ten-Year Plan for Science and Technology, aimed at progressing South Africa to a knowledge-based economy.

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The views expressed in this paper are those of the author and do not necessarily represent those of WIPO.

1. INTRODUCTION

South African publicly-financed research institutions (institutions) comprise higher-education institutions and statutory science councils or research institutes. In December 2002, a merger of a number of higher-education institutions was initiated resulting in 23[1] higher-education institutions[2] (see also Table 1). There are five science councils that undertake technological research and development in South Africa, namely the Council for Scientific and Industrial Research (CSIR), Mintek (which specializes in mineral and metallurgical technology), the South African Medical Research Council (MRC), the Water Research Commission (WRC) and the Agricultural Research Council (ARC). Both the MRC and the WRC fund research on a competitive basis, largely at higher-education institutions, with the MRC also undertaking its own research internally.

In 2002, the South African Research and Development Strategy identified disparate practices in respect of ownership, management and commercialization of intellectual property emanating from publicly financed research at these institutions (DST, 2002). Furthermore, the R&D strategy proposed a need for harmonization of IP practices and establishment of a dedicated fund to finance the securing of intellectual property from publicly financed research. Since then, some of the institutions have proceeded to develop and implement IP policies aimed at ensuring certainty in respect of ownership, commercialization and technology transfer of intellectual property developed there.

Since the institutions collectively form the biggest concentration of skills and personnel in the area of knowledge generation, they are likely to be the sources of new knowledge, inventive ideas and inventions and, possibly, patents. It is thus important to get a good understanding of the state of IP generation and protection and the extent to which such intellectual property is converted to useful products and services, so as to determine its potential impact on South Africa's system of innovation and economy.

This paper presents the results of research undertaken on the state of protection, management and commercialization of IP by the institutions over a seven-year review period covering 2001 to 2007. The paper also analyzes the extent of institutional arrangements, including government support for IP management and commercialization. The research was carried out in order to address the following questions in an empirical manner: What is the extent of patenting by the institutions both at local and international IP offices? Are there any specific technology areas which receive the most attention in respect of patenting by the institutions and could these be proxies for technology and research strengths? What is the extent of citation of patents from the institutions? To what extent are they commercializing their patents? What is their mode of commercialization of the patents? What are the factors seen as affecting commercialization of intellectual property, particularly patents, by the institutions? Is patenting hindering scientific development by reducing publication rates? To what extent is the existence of technology transfer offices and IP policies influencing patenting and commercialization of research results at the institutions? What has been the impact of government policy interventions on the IP landscape? What strategic interventions are required to maximize technology transfer of research results from the institutions to industry and society?

This paper is organized as follows. The research methodology is contained in Section 2. Section 3 is divided into four parts. The first part presents the patenting activity by the institutions at the South African Patent Office (CIPRO); the second part looks at patenting activity by the institutions in respect of patent applications filed under the auspices of the PCT and patents granted by the EPO and the USPTO. Particular emphasis was placed on the distribution of patenting activity in terms of the areas of technology as indicated by the IPC system and citation analysis; the third part analyzes the state of commercialization of intellectual property at the institutions with a focus on revenues generated against patent expenditure and also the extent to which start-up[3] companies are used as vehicles for commercialization; and the fourth part reviews the institutional arrangements for technology transfer and institutional policies. Section 4 is a discussion of the various aspects of Section 3 within the context of broader policy perspectives, including research funding and research output as indicated by publication rates of the institutions. Section 4 also presents some lessons and arguments arising from the research and discusses some policy interventions by the DST, aimed at transforming the way in which the institutions handle research. The paper concludes with Section 5, which summarizes the conclusions from the research, with particular emphasis on answers to the specific questions set out above.

2. RESEARCH METHODOLOGY

2.1 Patenting at the Local Level at CIPRO

CIPRO operates on a deposit or non-examining system, which means that as long as formalities have been complied with, a patent will be granted from a complete patent application. Thus, unless an applicant decides not to proceed, a complete patent application that complies with formalities always proceeds to grant.

A provisional patent application is a first filing application which provides a priority date for an invention, i.e. the earliest possible date from which to claim protection for an invention, according to the Paris Convention. In South Africa, a provisional patent application comprises a specification which broadly describes the invention, as opposed to a complete specification which is expected to more clearly define the invention through a set of claims. Following the filing of a provisional patent application, an applicant has a period of 12 (twelve) months to secure final patent protection in Paris Convention member states through the filing of a complete patent application accompanied by a complete specification claiming priority from the provisional patent application, or to file a PCT application claiming priority from the provisional patent application.

Patent abstracts are published in the Patent Journal on a monthly basis by the government printers in the month in which the patent is granted. Manual name-index searches were conducted through the records at CIPRO, using the names of the various South African higher-education institutions and science councils. These searches were supplemented by manual review of the various issues of the Patent Journal published in the review period.

2.2 International Patent Applications and Patents Granted at the EPO and the USPTO

Searches were conducted through the databases of the EPO, USPTO and WIPO[4] for patent applications filed under the auspices of the PCT, and also through the commercial database Micropatent[5] for patents granted at the EPO and USPTO. The searches were conducted using the names of the institutions in the review period, with South Africa as a priority. In respect of the PCT, the results are for patent applications published in the review period, whereas in respect of patents, they are for patents granted during the review period.

The results were analyzed to determine various aspects, including the trend of filing and the areas of technology where the institutions were securing patent protection for their research results. Further, citation analysis was carried out on PCT applications, EPO patents and USPTO patents. Since patent citations can be used as a proxy for the importance and significance of the patents in the area of technology in which they belong (Jaffe and Trajtenberg, 2002), the highly cited patents would generally be expected to have a higher economic and technological importance (Montobbio, 2006).[6] Commercialization details, if any, of the most-cited patents were requested from institutions, to assess the extent, if any, of the economic and technological relevance of the cited patents and also the institutions' efforts to commercialize these patents. Furthermore, inventor analysis was undertaken to determine the most prolific researchers at the institutions, in addition to relating their patent outputs to publication outputs. Interviews were carried out with some of the inventors to understand how patenting had affected their publication outputs.

2.3. Institutional Arrangements and State of Commercialization

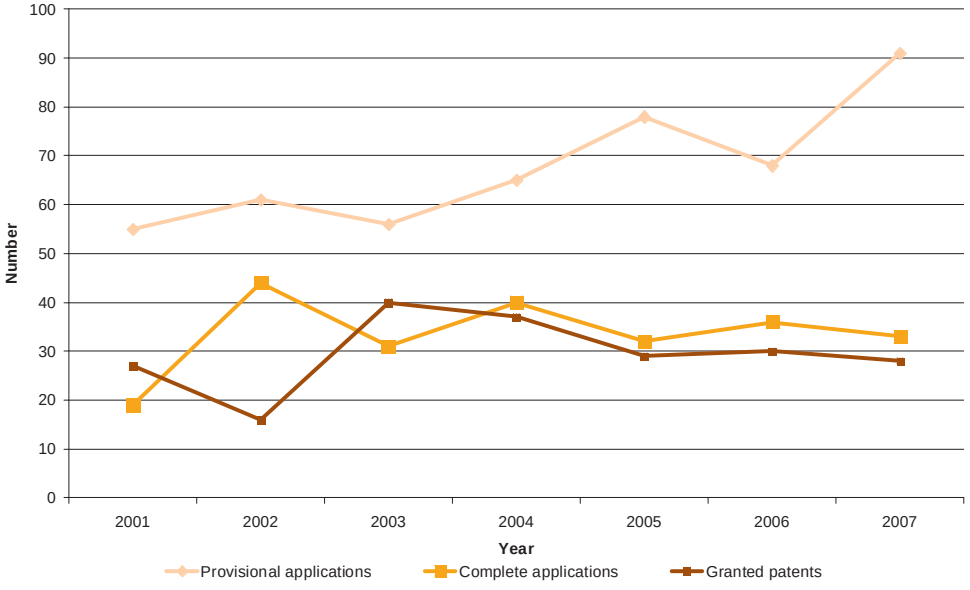
A questionnaire was developed and sent out to all the institutions which either had a technology transfer office or had filed at least one patent application during the review period. The questionnaire was adapted from that used in the Australian study of patenting and commercialization by Australian universities (Singhe *et al*., 2005). The institutions were asked to score the relevance of certain factors in respect of patenting and commercialization at their institutions. Of the 20 institutions to which the questionnaire was sent, responses were received from 14, comprising 11 of the 23 higher-education institutions and three of the five science councils. The mean scores of the various factors listed in the questionnaire were used to measure the relevance of the factors affecting both patenting and commercialization by institutions. In order to better understand the issues that affect institutions' ability to protect and to successfully commercialize such new knowledge, they were requested to provide the following details: year of establishment of the technology transfer office, patenting costs incurred and revenues generated in the review period, number of start-up companies established and whether or not the establishment was associated with a patent.

3. STATE OF PATENTING AND COMMERCIALIZATION BY SOUTH AFRICAN INSTITUTIONS

3.1 Patenting at the Local Level at CIPRO

In an analysis of the CIPRO patent register entries which cite the institutions as applicants, Figure 1 shows that although there has been an increase in the filing of provisional patent applications over the review period, the number of complete patent applications filed at CIPRO by the institutions remained fairly static, as did the number of patents granted to them. The grant of a patent normally takes about six to 12 months from the filing of the complete patent application. Thus, the patents granted in Figure 1 for any given year should be interpreted in relation to the complete patent applications filed in the preceding year.

Figure 1. Patent Applications Filed and Patents Granted to the Institutions at CIPRO in the Review Period



A further analysis of the actual entries indicated that only 20 institutions out of a total of 28 had filed a patent application in the review period. Table 1 summarizes the provisional patent applications, complete patent applications and granted patents filed by them for each year of the review period.

Table 1. Patent Applications and Grants at CIPRO by Institution (2001-2007)

Institution	Patent Type	2001	2002	2003	2004	2005	2006	2007	Total
CSIR	Provisional	16	13	8	14	18	8	11	88
	Complete	6	9	8	6	3	7	7	46
	Grant	3	4	12	12	8	5	2	46
MRC	Provisional	1	1	0	0	0	0	4	6
	Complete	3	2	1	1	0	2	1	10
	Grant	0	2	4	1	3	0	3	13
Mintek	Provisional	8	4	3	2	3	1	0	21
	Complete	2	6	3	3	1	0	2	17
	Grant	4	3	5	4	1	1	1	19
Agricultural Research	Provisional	2	2	0	2	0	0	1	7
Couoncil (ARC)	Complete	1	2	0	1	3	0	0	7
	Grant	1	2	0	1	2	1	0	7
Water Research	Provisional	2	3	1	0	0	5	1	12
Commission	Complete	1	2	0	3	0	0	3	9
(WRC)	Grant	4	1	0	0	1	2	0	8
University of the	Provisional	1	2	1	10	22	14	19	69
Witwatersrand (WITS)	Complete	0	0	0	2	5	2	2	11
	Grant	0	0	0	0	1	0	2	3
University of Pretoria	Provisional	8	7	2	6	3	9	6	41
	Complete	2	5	4	2	1	5	3	22
	Grant	10	2	6	5	1	1	3	28
University of	Provisional	0	0	4	3	0	0	2	9
Johannesburg (UJ)	Complete	0	1	1	0	7	3	2	14
	Grant	0	0	2	1	1	2	7	13
University of	Provisional	10	7	7	6	12	3	4	49
Cape Town (UCT)	Complete	0	2	3	7	4	5	1	22
	Grant	1	0	3	0	4	3	3	14
Nelson Mandela	Provisional	0	1	1	2	0	2	0	6
Metropolitan University	Complete	0	2	2	2	0	1	0	7
(NMMU)	Grant	2	0	1	2	1	0	0	6
Tswane University of	Provisional	0	0	0	1	0	3	6	10
Technology (TUT)	Complete	0	0	0	0	1	0	4	5
	Grant	0	0	1	0	0	1	0	2
University of	Provisional	0	0	0	0	0	1	1	2
KwaZulu-Natal (UKZN)	Complete	0	0	0	0	0	0	0	0
	Grant	0	0	0	0	0	0	0	0
Durban University of	Provisional	0	0	0	0	3	1	1	5
Technology (DUT)	Complete	0	0	0	0	2	4	3	9
	Grant	0	0	0	0	0	0	0	0
Rhodes University	Provisional	0	0	1	1	1	0	0	3
	Complete	0	0	0	0	0	1	0	1
	Grant	0	0	0	0	0	0	0	0
University of Stellenbosch	Provisional	5	14	17	14	9	10	16	85
	Complete	1	5	2	7	2	2	4	23
	Grant	1	1	3	5	2	5	2	19
North West University	Provisional	2	6	10	3	4	4	3	32
	Complete	3	8	6	5	4	4	1	31
	Grant	1	1	3	4	4	3	4	20
University of	Provisional	0	0	0	1	0	0	1	2
Western Cape (UWC)	Complete	0	0	0	0	0	0	0	0
	Grant	0	0	0	0	0	0	0	0
Vaal University of	Provisional	0	0	0	0	0	1	0	1
Technology	Complete	0	0	0	0	0	0	0	0
	Grant	0	0	0	0	0	0	0	0
University of the Free State	Provisional	0	1	0	0	1	0	0	2
	Complete	0	0	1	1	0	1	0	3
	Grant	0	0	0	2	0	3	1	6
Total	Provisional	55	61	55	65	76	62	91	465
	Complete	19	44	31	40	33	37	33	237
	Grant	27	16	40	37	29	30	28	207

Source: CIPRO

From Table 1, it is evident that there is a big variation in patenting activity among the institutions. In the review period, 20 of them filed at least one provisional patent application, with 16 institutions having patents granted by CIPRO.

The CSIR has the highest patenting rate as measured not only by the number of patent applications filed (both provisional and complete applications), but also in terms of patents granted in the review period. The CSIR[7] is a research institution that undertakes research in a variety of disciplines as its main business. The other research institutions that were among the 20 institutions were the MRC which has a mandate for promoting health; the ARC[8] which has a mandate to "conduct research, development & technology transfer in order to promote agriculture and industry, contribute to better quality of life, and facilitate or ensure natural resource conservation"; the WRC with a mandate "to support water research and development as well as the building of a sustainable water research capacity in South Africa":[9] and Mintek[10] which specializes in mineral processing and extractive metallurgy. Mintek had the highest patenting rate after the CSIR, as far as research institutions are concerned.

An analysis of the data for the higher-education institutions showed that the Universities of Cape Town, Pretoria, North West, Stellenbosch and the Witwatersrand have the most important patenting activity among the higher-education institutions. The two latter, while having the highest numbers of provisional patent applications, have a lower conversion rate into complete patent applications. In addition, the table reveals that some of the higher-education institutions that were not patenting at the beginning of the period had began to file patent applications toward the end of the period.

Patent abstracts as published in the *Patent Journal* were analyzed for their classification in terms of the IPC system. A summary of the classification of the South African patents granted to the top 12 institutions is set out in Table 4.

Table 2. Summary of IPC Codes of Patents granted by CIPRO to the Top 12 Institutions in the Review Period

Assignee	A Human necessities	B Performing operations, transporting	C Chemistry and metallurgy	D Textiles paper	E Fixed constructions	F Mechanical engineering, lighting,heating, weapons, blasting	G Physics	H Electricity
CSIR	A23L;A23P; A61B (2); *A61K (3); A62B (2); A45C A71F	B01D (3); B01J (3); B22D; B60P; B62B (2); B65D (3); B67D	C01B(2); C01G; C07B;*C02F (2); *C12P; *C12N; *C12M; C10L; C11B; C07C; C23C; C08F; C22C		E21C; E21D (3); E21B (3); E21F; E05G	F01N; F02G; F25B; F16H; F01B; F41H	*G01N (2)**G01P; **G01B; **G01D; **G01J; **G08B; G01V; **G08C; G02B	**H01L (2); **H04B; **H04N (2); H04G
MRC	A61B (2); A61D; A61P; *A61K (6)A61L		*C07K (4)C07C; *C12N(4); C12Q (2); C22B		E21D		*G01N (3); **G08C	
Mintek		B01J (5); B22D; B22F; B60R	C01G (3); C04B (2); C08J; C22B (8); C22			F15D; F32B	G06K	
ARC	A01N; A23B; A23F	B65B	*C07K; *C12N (4); *C12M					
WRC		B01D	C02F (7)				**G01B	
University of the Witwatersrand	A61B; *A61K (2)				E04B			
University of Pretoria	A01G; A61B (3); *A61K (4); A61N; A61P (2); A61Q; A62C (2); A62D	B01J; B06B	C01B (2); C01F; C08L; C23F; C09K (2); C07C (3); C09D; C22B; C01G (3); C06B; C07F; *C12N		E04B; E04C; E04H	F02M; F16SF16F; F21V; F23Q; F42B	**G02B; **G04B; **G06F; **G09B; **G06F; G21F	**H01L(3); **H01P **H01S; **H04M
University of Johannesburg		B23B; B25F	C07C; C07D; C08G	D21B; D21F	E04B		G01N (2); G01L; **G06K	H04B; H01L (2)
University of Cape Town	A61F (2); A01N; A23L	B03B (2); B03D (2)	C02F; C22B; C07C; *C07K; *C07K; *C07 *C07K; *C07K; *C12N; *C12N				G01D; G22B; **G01N	
NMTU		B23K; B29C	C07B (2); C07C (3)				**G01L; **G01B	H01M
University of Stellenbosch	A01C (2); A01G; A01H (2); A23B; A23F; A23L (2); A61B; A61D; *A61K (2)	B01D; B01L; B65D	C01F; C05F; *C07K (2); *C12N (6); C08F *C12P (3); C07H; C12G; *C12Q; C13K; C22B				G01J; *G01N (2); G01R; G06F	**H01J; *H04B; H02J; H02H; H02B; H02G; **H03C;**H03K
University of North West	A01G; A61C	B01D (3); B02C; B32B; B64B	C01B; C05F;C07B; C08L; C08K; C23F; *C12N; C22B; C09K		E05B	F03D	**G01F;**G01R; **G01V; G06F	**H03F; **H03K

1 The numbers in brackets represent the number of patent documents with the same classification. Where a document had more than one classification, all the classifications are included in the Table.
2 The summary of IPC codes is based on classification of the patents as per patent abstracts. Where an abstract did not have a classification, we have not attempted to classify the patent.
3 Biotechnology*; Information Communication Technology (ICT) **, as per classification in OECD (2007).

As can be seen from Table 2, the patents granted to the institutions were in the following areas of technology (as per the IPC), in decreasing order of quantity: C (chemistry and metallurgy), A (human necessities); B (performing operations, transport); G (physics) and H (electricity); E (fixed constructions); F (mechanical engineering, lighting, heating, weapons, blasting); and D (textiles, paper). A more in-depth analysis further revealed that a large number of the patents were in life sciences/biotechnology and ICT (see Table 2).

The CSIR has the broadest patent portfolio, consistent with the fact that it "undertakes directed and multidisciplinary research, technological innovation as well as industrial and scientific development" in eight broad research focus areas covering biosciences, information technology, material science and engineering, laser technology, space technology, natural resources and environment, defense and built environment. The patents in the name of the MRC are predominantly in the life sciences/biotechnology sector, as would be expected in line with its mandate of health research.[11] Mintek's portfolio of patents is in C22B (production or refining of metals; pre-treatment of raw materials), which is consistent with Mintek's mandate "to serve the national interest through research, development and technology transfer, to promote mineral technology and to foster the establishment and expansion of industries in the field of minerals and products derived therefrom". The WRC's patent portfolio is primarily in C02F (treatment of water, waste water, sewage or sludge), in line with its mandate of funding and promoting water research.

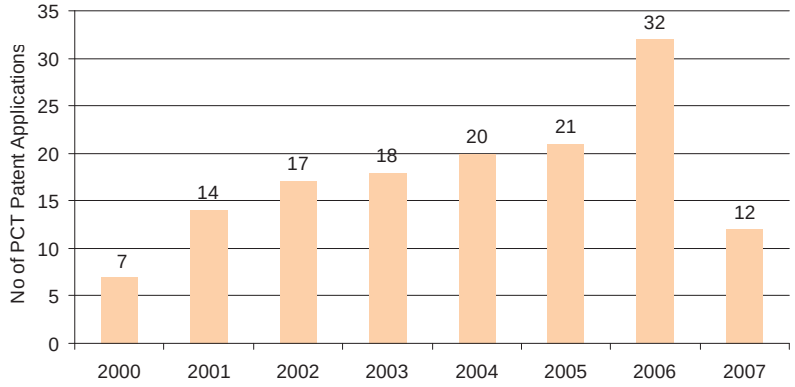
Most of the patents from the University of Stellenbosch were in the life sciences/biotechnology sector (OECD, 2007), with the next highest number of patents in ICT. The patents from the University of Pretoria and the North West University were predominantly in ICT. Similar to the University of Stellenbosch, the University of Cape Town's patents were predominantly in the area of life sciences/biotechnology. Owing to the fact that no classification data could be obtained for provisional applications (there is no requirement to classify provisional applications in South Africa) and complete patent applications filed at CIPRO, we were unable to determine whether there was a difference between areas of technology of patent applications and granted patents.

3.2. Patenting by the Institutions at the EPO, USPTO and WIPO

3.2.1 PCT Applications

In the review period, 141 PCT patent applications claiming priority from at least one South African application were published in the names of the institutions. Figure 2 shows the pace of filing of the published applications.[12]

Figure 2. Pace of Filing of PCT Applications by the Institutions



Source: PatentScope®, WIPO

Table 3 shows the distribution of the 141 PCT applications among the institutions. The top three higher-education institutions, namely the Universities of Cape Town, North West and Pretoria had a publication rate ranging from 1.7 to 3.29 applications a year, respectively, compared with the CSIR's 5.71 applications a year.

Table 3. Top Institutions by PCT Patent Applications with a South African Priority

Assignee	Document Count
CSIR	40
University of Cape Town	23
North West University	18
University of Pretoria	12
Mintek	10
South African Medical Research Council (MRC)	10
University of Johannesburg	9
University of the Witwatersrand	9
Agricultural Research Council (ARC)	5
University of Stellenbosch	5
Nelson Mandela Metropolitan University	3
Total PCT applications	141

Table 4 summarizes the top 10 IPC subclasses in respect of the 141 PCT applications. An analysis of the top five IPC subclasses indicates that 25.5 per cent of the applications were in medicinal or veterinary sciences and hygiene (A61K and A61P), micro-organisms or enzymes (C12N) and organic chemistry (C07K).

Table 4. Summary of the Fields Covered by the PCT Patent Applications with a South African Priority in the Names of the Institutions

IPC Subclass	Description of IPC Subclass	Document Count
A61K	Preparations for medical, dental or toilet purposes.	25
C12N	Micro-organisms or enzymes.	21
C07K	Peptides.	17
A61P	Therapeutic activity of chemical compounds or medicinal preparations.	11
G01N	Investigating or analyzing materials by determining their chemical or physical properties.	10
C12P	Fermentation or enzyme-using processes to synthesize a desired chemical compound or composition or to separate optical isomers from a racemic mixture.	7
B01J	Chemical or physical processes (e.g. catalysis, colloid chemistry); their relevant apparatus.	6
C22B	Production or refining of metals; pre-treatment of raw materials.	6
C08L	Composition of macromolecular compounds.	5
C09D	Coating compositions (e.g. paints, varnishes, lacquers); filling pastes; inks; woodstains; pastes or solids for colouring or printing; use of materials therefor.	5
Number of occurrences in top 10 patent classes		113
Total number of IP subclasses		237
Total number of documents in group		141

Citation Analysis

Forward citation analysis was carried out on the 141 PCT applications to determine the extent to which any of them were cited by other patent applications and/or patents, and hence a proxy for their economic and technological importance.[13]

According to Table 5, nine of the 141 PCT applications were cited at least three times, with the leading document cited seven times. Of the top 10 most-cited PCT applications from the institutions, six were from higher-education institutions. According to enquiries at the institutions concerned, the most-cited patent (WO2002096393) is the only one that has been licensed so far, namely to Sportron International (Pty) of South Africa.

Table 5. Most-Cited PCT Applications with a South African Priority, in the Names of the Institutions

Document ID	Assignee	Title	Year Issued	Cited by
WO2002096393	North West University	Anorexic composition comprising calcium acetate	2002	7
WO2002016272	CSIR	Water treatment method	2002	5
WO2002004494	MRC	Process for the selection of HIV-1 subtype C isolates, selected HIV-1 subtype isolates, their genes and modifications and derivatives thereof	2003	4
WO2002092162	University of Stellenbosch	Radiation application method and device	2004	4
WO2001080550	CSIR	A panoramic camera.	2001	3
WO2003059507	Mintek	Gold catalysts and methods for their preparation	2003	3
WO2003006956	University of the Witwatersrand	Cell enumeration	2003	3
WO2001000554	University of Pretoria	Naphthoquinone derivatives and their use in the treatment and control of tuberculosis	2001	3
WO2003002126	University of Pretoria	Anti-retroviral agent in combination with tea polyphenol for the treatment of viral infections	2003	3
WO2003104675	University of Pretoria	Vibration isolator	2003	2
Number of citations in top 10 documents				37
Total number of documents in the group				141

3.2.2 EPO Patents

Twenty-three EPO patents were granted to South African institutions during the review period. The distribution of the EPO patents among the institutions is set out in Table 6. The CSIR leads the table with 11 granted EPO patents, with North West University leading the higher-education institutions with four granted patents.

Table 6. Top Institutions in Terms of EPO Patents Granted to the Institutions

Assignee	Document Count
CSIR	11
Mintek	4
North West University	4
University of Pretoria	2
University of Stellenbosch	1
University of Johannesburg	1
University of Free State	1
South African Medical Research Council (MRC)	1
Total EPO patents	23[14]

IPC Codes and Citation Analysis

The analysis of the IPC subclasses of the 23 EPO patents indicated a lack of significant portfolios, in that no single IPC subclass had more than two documents. However, a review of the most-cited IPC subclasses reveals that at least 25 per cent of the patents were in the area of life sciences/biotechnology (A61K, A61P and C02F). From Tables 4 and 6, it is apparent that A61K, A61P and C22B are the only IPC subclasses that are common to the PCT applications and the EPO patents.

Table 7. Summary of the Most-Cited IPC Subclasses in Terms of EPO Patents in the Names of the Institutions

IPC Subclass	Description of IPC Subclass	Document Count
A61K	Preparations for medical, dental or toilet purposes.	2
A61P	Therapeutic activity of chemical compounds or medicinal preparations.	2
C02F	Treatment of water, waste water, sewage, or sludge.	2
C21C	Processing of pig-iron (e.g. refining, manufacture of wrought-iron or steel); treatment in molten state of ferrous alloys.	2
C22B	Production or refining of metals; pre-treatment of raw materials.	2
Total number of documents in group		23

None of the 23 EPO patents received forward citations. This could be due to a number of factors such as a somewhat more protracted prosecution process at the EPO, and also differences in examination procedures and prior-art disclosure requirements between the EPO and, for example, the USPTO, which appears to result in lower citations in EPO patents as compared with USPTO patents (Montobbio, 2006). Other reasons could be that these patents are of very little economic and/or technological relevance within their fields, or that they are too recent and their full technological value is as yet unclear.

3.2.3 USPTO Patents

In the review period, 29 patents were granted by the USPTO to the South African institutions. Similar to the EPO patents, both the CSIR and North West University had the most patents in respect of science councils and higher-education institutions, respectively (see Table 8). As can also be seen from Table 8, only two other higher-education institutions, namely the Universities of Pretoria and Stellenbosch were granted patents by the USPTO during the review period, each with two patents. The Water Research Commission has also been very active in patenting in the US, with four patents in the review period.

Table 8. Top Institutions by USPTO Patents in the Names of the Institutions

Assignee	Document Count
CSIR	15
North West University	4
Water Research Commission	4
University of Pretoria	2
University of Stellenbosch	2
Mintek	2
South African Medical Research Council (MRC)	1
Total USPTO patents	29

IPC Codes over a Period of Time

The most-cited IPC subclasses in respect of the USPTO patents are summarized in Table 9. Other than A61K and C02F (biotechnology) which featured in the top list of IPC subclasses in respect of the EPO patents, C01B and G01N were cited on at least three and two patents respectively.

Table 9. Summary of the Most-Cited IPC Subclasses on USPTO Patents in the Names of the Institutions

IPC Subclass	Description of IPC Subclass	Document Count
C02F	Treatment of water, waste water, sewage or sludge.	7
A61K	Preparations for medical, dental or toilet purposes.	3
C01B	Non-metallic elements; compounds thereof.	3
G01N	Investigating or analyzing materials by determining their chemical or physical properties.	2
Total number of documents in group		29

Citations Analysis

Citation analysis of the USPTO patents indicated higher citations compared with both the PCT applications and EPO patents (which had no citations) (see Table 10). This could be due to patent prosecution requirements in the US in respect of information disclosure (Montobbio, 2006). No higher-education institutions have cited patents. Other than having the most-cited USPTO patent, the CSIR has a total of six patents in the top 10 most-cited USPTO patents in the names of the institutions, followed by Mintek and the Water Research Commission, each with two patents. Of the 10 patents included in Table 10, three have been licensed.

The most-cited patent (US6376657) of the CSIR, was the object of a license agreement to Phytopharm,[15] while patents US6228263 and US6197196, owned by the Water Research Council, have been licensed to East Rand Water Care Company. The other patents have not yet been the object of a license. Interestingly, both inventors cited on the WRC patents were full-time researchers at Rhodes University (which did not have a policy on IP ownership – see Table 11 below) undertaking research funded by the WRC at the time of filing of the patent applications.

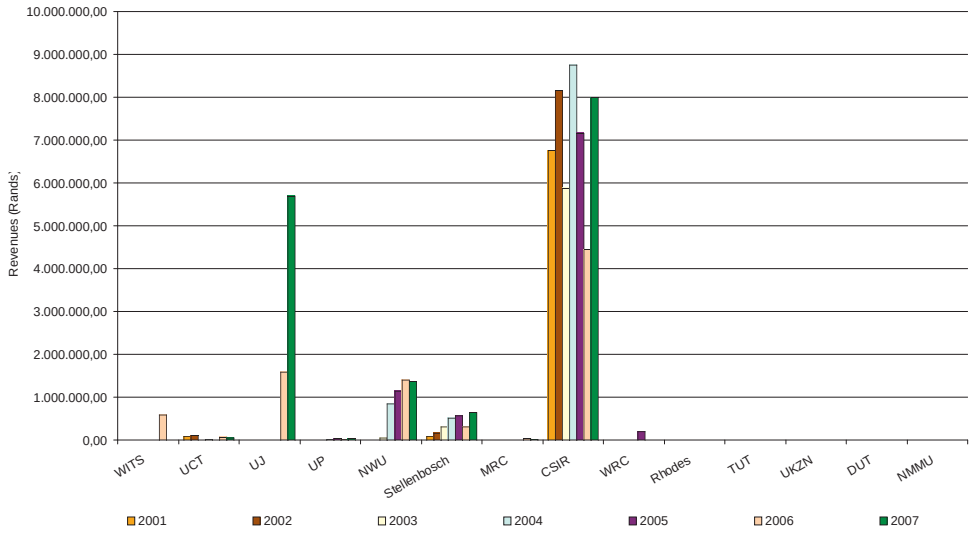
Table 10. Top 10 Most-Cited USPTO Patents in the Names of the Institutions

Document ID	Assignee	Title	Year Issued	Cited By
US6376657	CSIR	Pharmaceutical compositions having appetite-suppressant activity	2002	12
US6221399	CSIR	Method of making controlled release particles of complexed polymers	2001	10
US6306302	CSIR	Process for treatment of sulphate-containing water	2001	6
US6490881	CSIR	Generating displacement and thermoacoustic refrigerator	2002	5
US6419834	CSIR	Treatment of acidic water containing dissolved ferrous cations	2002	4
US6228263	WRC	Treatment of sulphate-and metal-containing water	2001	4
US6592246	CSIR	Method and installation for forming and maintaining a slurry	2003	2
US6197196	WRC	Treatment of water	2001	2
US6699302	Mintek	Treatment of metal sulphide concentrates by roasting and electrically stabilized open-arc furnace smelt reduction	2004	1
US6287362	Mintek	Production of metal lumps and apparatus therefor	2001	1
Number of citations in top 10 documents				47
Total number of documents in the group				29

3.3. Commercialization of Intellectual Property by the Institutions

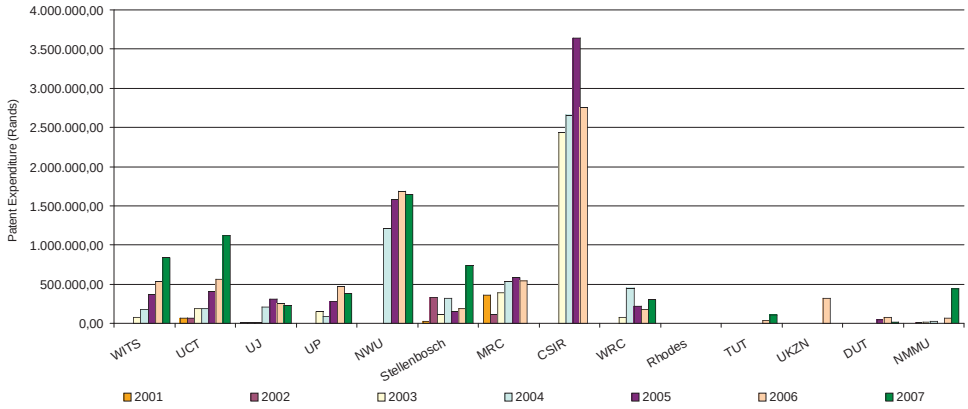
As explained in Section 2.3, a survey questionnaire was sent to the 20 institutions, which either had a technology transfer office or had filed at least one patent application during the review period, to enquire further about their commercialization and technology transfer activities, for which 14 replies were received. Based on that survey, only a few institutions generate revenues from commercialization of their intellectual property, particularly patents. Figure 3 summarizes revenues generated by the institutions in the review period. Other than the CSIR and the Universities of Johannesburg and North West, none of the other institutions generated revenues in excess of one million rand[16] in any of the years in the review period. Most higher-education institutions received no revenues from their patents. Figure 4 summarizes the patent expenditure by the institutions in the review period. A comparison of patent expenditure and commercialization revenues generated shows that for most institutions, there has been little success in commercialization of their patent portfolios, if success is to be measured by commercialization revenues.[17]

Figure 3. Commercialization Revenues Generated by Institutions



Source: Survey of institutions

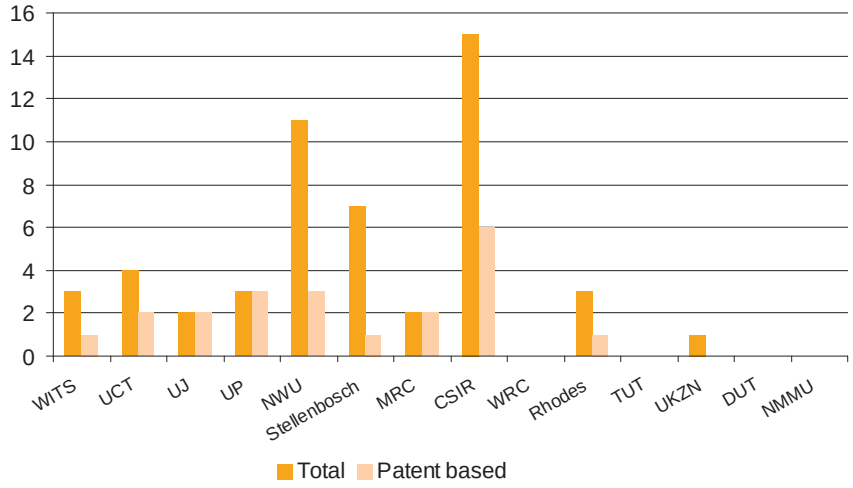
Figure 4. Patent Expenditure by the Institutions



Source: Survey of institutions

Figure 5 shows the number of start-up companies established from institutional intellectual property during the review period. It is evident from this that there is a low rate of establishment of start-up companies. Generally, less than half of the start-up companies are based on patents, with know-how and technology packages playing a more significant role in their establishment. For most of the institutions, start-up companies are not viewed as being a practical mechanism for commercializing patents, with most of the institutions preferring licensing instead. Those, particularly the higher-education institutions, regard technology transfer through the establishment of start-up companies as being very risky as they would often be expected to contribute to further funding needs. The institutions are also increasingly under pressure to generate revenues from their intellectual property, and the establishment of a start-up company would amount to "deferred revenues". The lack of strong patent portfolios that could form the basis for strong and potentially high growth start-up companies, if they are able to attract substantial investments required to further develop the patent portfolio, has, in our view, contributed to the low rate of start-up companies based on patents. The dearth of entrepreneurial researchers who have an appetite for following through on their inventions via a start-up company has also contributed to the low number of start-up companies based on intellectual property from the institutions. This is also related to the differing views on their role, particularly the higher-education institutions. The sentiment among researchers at the latter suggests that their researchers are still grappling with the tension between the universities' primary role of knowledge generation and graduate training and the increasing role of technology transfer to ensure that knowledge generation is within a socio-economic context.

Figure 5. Start-Up Companies Established in the Review Period



Source: Survey of institutions

3.4. Institutional Arrangements

Table 11 summarizes the institutional arrangements for IP management at the institutions at the end of 2007. It is evident that most of them do not have the required infrastructure to manage the process of invention disclosures, filing of patent applications and technology transfer. Of particular concern is the lack of relevant policies in respect of IP issues at most of them, particularly at the higher-education institutions.

A subjective assessment has been made in respect of the skills and capacity at the institutions. In some cases, we have concluded that there is limited capacity, based on the skills and experience of their personnel at those with technology transfer offices. For example, where there is only one person with an IP background but with little or no commercialization experience, we have concluded that there is limited capacity. Similarly, the same conclusion has been reached where there is one person with commercialization experience but no one with an IP background.

Table 11. Summary of Institutional Policies and Arrangements for IP Management, Commercialization and Technology Transfer

Institution	IP Policy	Tech. Transfer Capacity (Year Established)	Institution	IP Policy	Tech. Transfer Capacity (Year Established)
University of Cape Town	Yes	Limited (2002)	University of Pretoria	Yes	Limited (1996)
University of Stellenbosch	Yes	Yes (1999)	North West University	Yes	Yes (2003)
Nelson Mandela Metropolitan University	Yes	Limited (2007)	University of the Witwatersrand	Yes	Limited (2003)
Rhodes University	Yes	No	University of Limpopo	No	No
Walter Sisulu Metropolitan	Yes	No	Tshwane University of Technologie	Yes	Limited (2005)
Durban University of Technology	No	No	University of KwaZulu-Natal	No	In process of establishment
University of Fort Hare	No	No	UNISA	No	No
Cape Peninsula University of Technology	No	No	University of Western Cape	No	No
Vaal University of Technology	No	No	CSIR	Yes	Yes (2001)
University of Johannesburg	Yes	Limited (2004)	Water Research Commission (WRC)	Yes	Limited (2003)
Central University of Technology	No	No	University of Forthare	No	No
Mangosuthu University of Technology	No	No	University of Zululand	No	No
Vaal University of Technology	No	No	Agricultural Research Council (ARC)	Yes	No
Medical Research Council (MRC)	Yes	Yes (2004)	Mintek	Yes	Limited

Source: Survey of institutions

In general, technology transfer offices in South Africa are relatively new, having been functioning on average for approximately three years. The more established offices at the Universities of Cape Town, Stellenbosch and Pretoria have seen a turnover of staff, thus significantly impairing their ability to consolidate the experience and lessons learnt to strengthen their activities. What we have observed is that the more successful technology transfer offices are those in which trust has been established between the technology transfer professionals and the researchers. This is often under-estimated, and our discussions with some of the top academic inventors indicated that trust is based on the ability of the technology transfer professionals to demonstrate empathy with the researchers' challenges and on being able to proactively assist the researchers extract maximum value from their research. A high staff turnover has a negative effect on the establishment of this trust.

On average, the technology transfer offices in South Africa have around two professional staff members compared with 8.7 in Europe (Arundel and Bordoy, 2007). Most of these offices operate as stand-alone cost centers within the institutions. At the University of Cape Town, the technology transfer office forms part of the research office whereas at the University of the Witwatersrand it forms part of Wits Enterprise (Pty) Ltd., which has as its mandate, the generation of "third stream income" for the uni-

versity. Whereas there may be some merit in respect of having the technology transfer office as part of an office with a broader mandate, these activities could receive less attention, as more focus will invariably be placed on activities that bring in money in the short to medium term, i.e. contract research in the case of the University of Cape Town and short courses in the case of the University of the Witwatersrand, with the result that technology transfer activities, which require more effort and time, receive less attention.

4. DISCUSSION

4.1. Patenting Activity

In general, there is a low rate of patenting by South African institutions at both local and international levels. Science councils, particularly the CSIR, have significantly higher patenting rates than higher-education institutions. This is consistent with findings in Europe where it was established that public research organizations have a relatively higher number of patents than universities (Montobbio, 2008).

By international standards, South African higher-education institutions generally have very low patenting activity which appears to mirror a stagnant research output from these institutions as indicated in publications by the available data on scientific publications. (See Chapter 1 by Kaplan for an analysis of this issue.)

A review of patenting activity by institutions at CIPRO revealed a concentration of patents in classes that may be linked to the life sciences/biotechnology and ICT. This is consistent with the findings of Geuna and Nesta (2006) that "broadly defined the research area of biotechnology and pharmaceuticals tends to be an area of extremely high university patenting activity across countries". This, as pointed out by Montobbio (2009) could be due to growing opportunities in the biomedical and ICT sectors or to the fact that the results of university research in the area of pharmaceuticals, communications and electronics are conducive to R&D projects which require clearly defined intellectual property (Montobbio, 2009). The other reason for a relatively high patenting rate in the life sciences/biotechnology sector could be attributed to significant funding by the government pursuant to the formulation of the biotechnology strategy (DST, 2001) which allocated a total amount of 450 million rand over a three-year period for establishment and funding of biotechnology regional innovation centers (BRICS). This funding was in addition to over 100 million rand which, according to its various annual reports, the Innovation Fund[18] provided for life sciences/biotechnology-related projects during the review period. According to Gastrow (2008), of the 454 million rand spent on biotechnology R&D in South Africa in the 2005/2006 financial year, the higher-education spend was the greatest (approximately 39 per cent of the total), with science councils spending approximately 28 per cent.

The extent of patenting appears to be dependent on the type of research being undertaken by each institution, which is often influenced by the mandate of the funding agency.

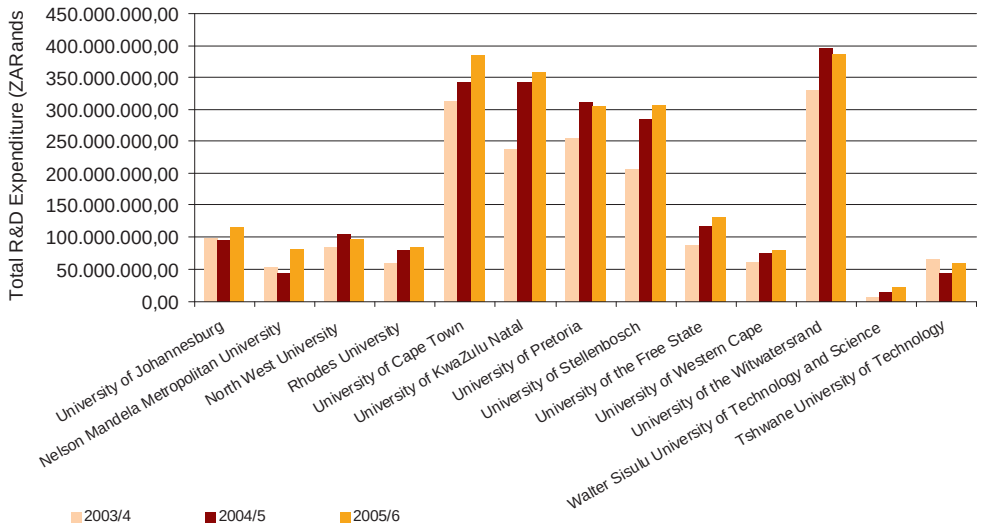
4.2. Patenting Activity as a Function of Institutional Arrangements, Research Expenditure and Publication Rate

There appears to be a correlation between patenting activity and the existence at the institutions of IP policies and institutional arrangements for the management and commercialization of intellectual property, with institutions having arrangements and policies in place recording higher proportions of PCT patent applications, EPO and USPTO patents. This finding is consistent with the findings in Garduno (2004) on South African institutions and also with the review carried out by Nicola (2006), that a supportive environment inside a university is important to stimulate patenting and licensing activities. Interviews revealed that patent data in the names of the institutions may not necessarily reflect the full complement of intellectual property emanating from them, particularly the higher-education institutions, as some of the patent applications could have been filed in the names of the individual researchers, particularly where there were no policies regarding IP ownership (see Table 11). This would be an interesting area for further research.

Generally, the technology transfer offices at the institutions are under-resourced, thus explaining not only the low disclosure rates which result in the low patenting rates, but also the low conversion of patents to commercial products and/or licenses. One of the challenges faced by technology transfer offices, particularly at the higher-education institutions is the increasing pressure to generate "third stream" income in the wake of reduced government subsidies. This may adversely impact on the focus of the technology transfer offices. Instead of focusing on getting institutional intellectual property out into the market place, these offices may increasingly find themselves under pressure to generate income, with the result that relationships with industry may be affected, as the institutions may adopt more aggressive approaches to negotiating licenses and technology transfer. The fact that technology transfer is at a fairly nascent stage in South Africa means that there will also be differences among the institutions as to why they need to embark on it. The lack of institutional policies in respect of IP ownership and commercialization, including benefit-sharing, appears to have contributed to low patenting and commercialization activities at the institutions.

Cloete *et al.* (2006) are of the view that one of the reasons for the low patenting activity by South African scientists is that "research has not been carried out with commercialization in mind and has, therefore, lacked market focus". Although we were unable to verify this assertion, the low rate of commercialization of the patents arising from higher-education institutions appears to support it. Another reason can be the low research capacity of the South African higher-education institutions.[19] This is supported by the fact that patenting activity at most of the major established higher-education institutions (Jacobs and Pichappan, 2006), with reasonable research capacity and substantial funding for research and development (see Figure 6), substantively mirrors that of publication outputs (see Figure 7), with the University of the Witwatersrand, the University of KwaZulu-Natal and the Free State University being anomalies.

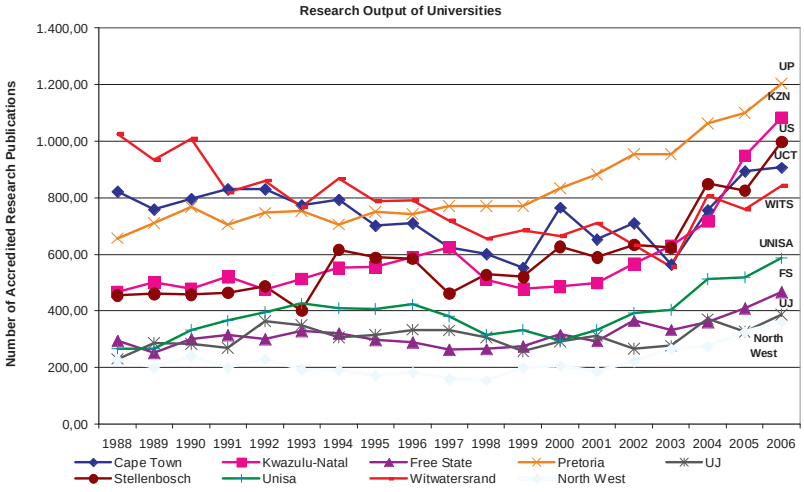
Figure 6. Research and Development (R&D) Expenditure for Selected Higher-Education Institutions



Source: Human Sciences Research Council

The anomaly in respect of the Universities of Kwa-Zulu Natal and the Witwatersrand can be attributed to a lack of a policies in respect of IP ownership, which could explain the high publication output and almost negligible patenting activity, as the individual researchers may have retained ownership of intellectual property generated from their research or simply not applied for IP protection at all.

Figure 7. Research Output by Publication, of Selected South African Higher-Education Institutions



Source: Pouris, 2008

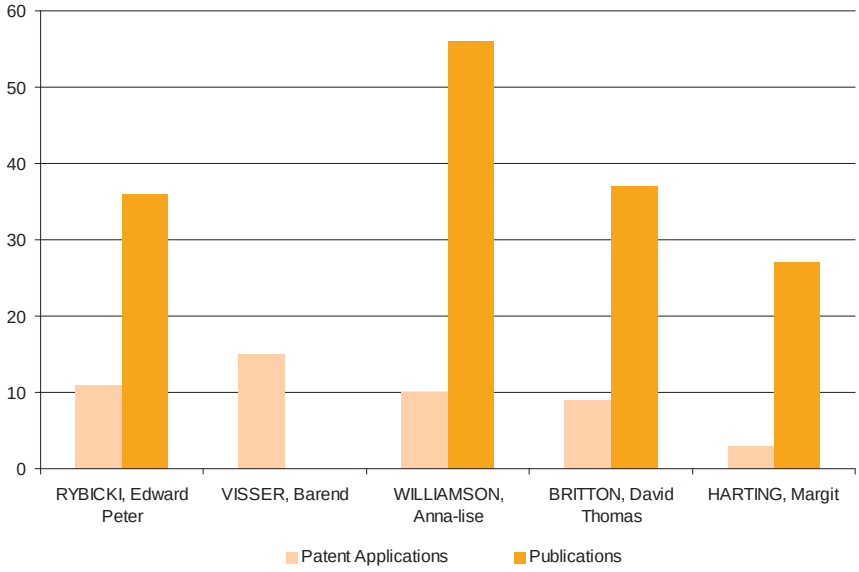
Figure 7 suggests increasing research output by publications since 2003 for the major higher-education institutions. Overall, the number of publications per higher-education institution is greater than the patent applications filed and/or granted. One possible explanation for this misalignment is the fact that publications, as opposed to patents, form the core of subsidy determinations at higher-education institutions by the Department of Education and also promotion of academics at these institutions.

As stated by one of the respondent higher-education institutions: "There is a disjuncture between the policy approaches of the Department of Education (DoE) and the Department of Science and Technology (DST), with the DoE supporting and promoting the traditional outputs i.e. publication in peer-reviewed journals while the DST's main emphasis is on the impact of scientific endeavor in the lives of South Africans. (...) not sure if there is acceptance of the emerging role of higher-education institutions as significant contributors to economic growth and development over and above the traditional role of producing qualified graduates and publications."

Interviews were undertaken with the top five academic PCT inventors who indicated that the adverse effect that patenting has on publication is in respect of publication delays necessitated by a need to comply with novelty requirements of patentability. In some cases, where there were protracted delays, some of the publications had to be abandoned as the results had either become obsolete or there was better data. It does appear that whether to prioritize publication or patenting is wholly dependent on a variety of factors, including the type of research being undertaken, and also the area of technology, with more commercial or market-focused research being more prone to patenting, and possibilities of publication depending on whether the research results can be suitably packaged for a publication.

Figure 8 shows a comparison of patent applications (PCT, EPO, and USPTO) filed by the top five academic inventors with their publication outputs in the review period. Most of the academic inventors had a three-fold publication rate compared with patenting rates, which suggests, particularly in light of the low patenting rate, that it may not be possible to categorically conclude that patenting adversely affects publication, although the issue would need to be studied further using more rigorous techniques. We support the view expressed by one of the top academic inventors that "it is not clear if, in the long term, there will be a negative impact on publication record, but in the short term there are inevitable delays in preparing papers for submission as well as pressures against publishing" as researchers and their technology transfer professionals get to grips with IP management, and in particular, patenting strategies. According to North West University,[20] the reason that Visser had no publications in the review period is not surprising as most of his research work has been on applied research or product development and less on basic research which as indicated above, generally appears to be more suited for publication.

Figure 8. Patent Applications (PCT, EPO, USPTO) and Publications for Selected Inventors from Higher-Education Institutions



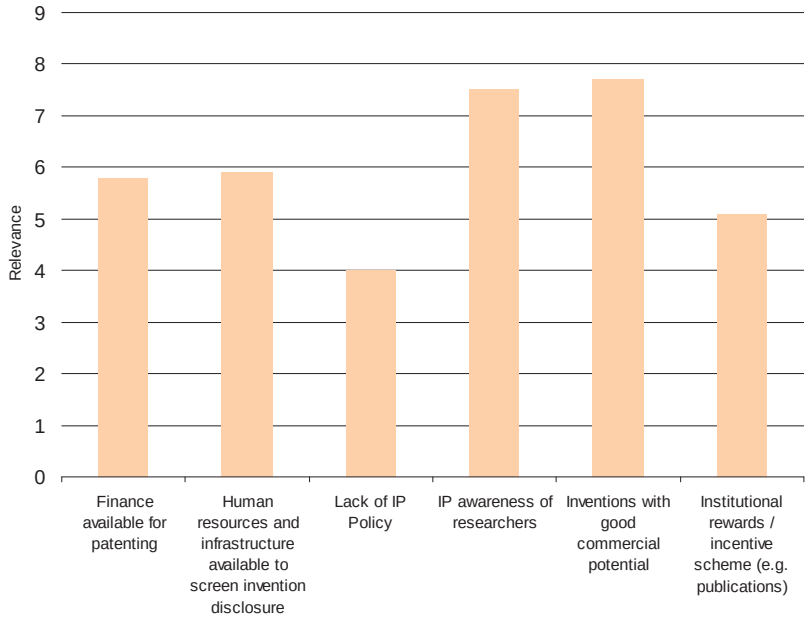
Source: Searches and survey of top inventors

By understanding the patenting time-lines, we are of the view that the perceived delays to publication caused by patenting could either be avoided or at least minimized (Sibanda, 2007). A recent study of patenting by academics (Lubango and Pouris, 2007), which found that those with prior industry experience had a higher propensity to patent, suggests that it is possible to successfully manage the tension between patenting and publication, such that both objectives are attained. It is likely that academics with some prior industry experience, or who can rely on an experienced technology transfer office, would be better able to manage this process.

4.3. Factors Affecting Patenting and Commercialization According to Institutions

According to the institutions, the three most important factors that affect patenting were: (i) commercial potential of inventions; (ii) IP awareness of researchers; and (iii) availability of human resources and infrastructure to screen invention disclosures (see Figure 9). It is worth noting that in the institutions where technology transfer offices were embedded within research offices, one of the issues raised was the financing of patenting, as they still have to bear part of these costs (see discussion of government interventions below).

Figure 9. Factors Affecting Patenting at Institutions



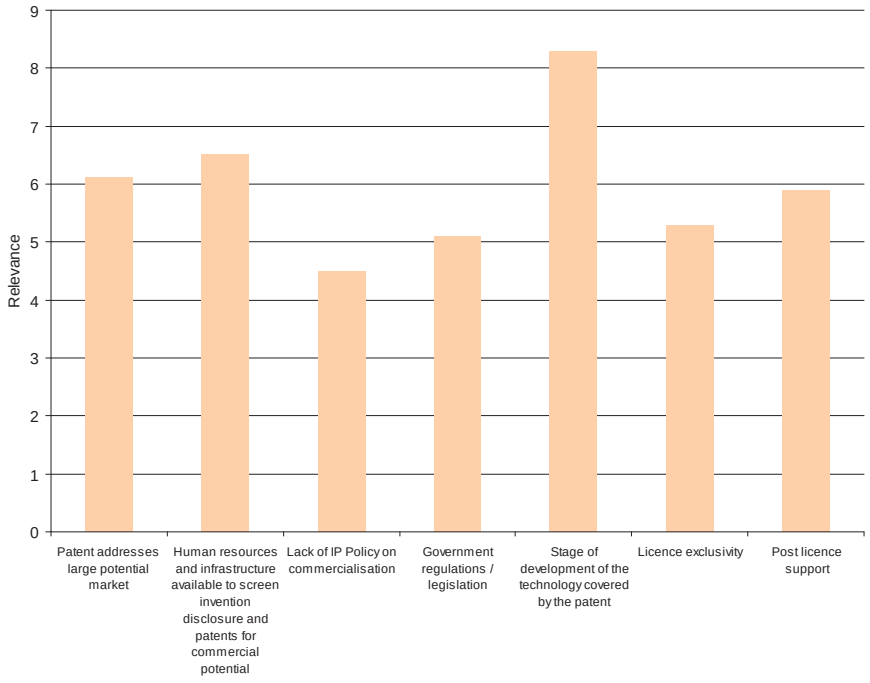
Source: Survey of institutions

Regarding commercialization or technology transfer, the institutions generally exhibit low conversion of patents to licenses and/or start-up companies. If one takes the definition of technology transfer as being the process of transferring knowledge and technologies developed at research institutions to the private sector (Garduno, 2004), within the institutions this process is varied and perceived as being complex. From the interviews, it was also evident that not all revenues were generated from patent-based technologies. In some cases, as illustrated in Figure 9, revenues were generated from non-patented technologies. Other mechanisms of transferring research results to industry, which did not form the subject of this research, but which we believe occur at the institutions, include training of graduates and students, publications, consulting and contract research.

According to the institutions, the three most important factors affecting commercialization of patents were: (i) stage of development of the technology; (ii) availability of human resources and infrastructure to screen invention disclosures for commercial potential; and (iii) the extent to which the patent addresses a large potential market (see Figure 10). Other than the factors set out in Figure 10, the institutions believe that the following factors have also impacted on their success in converting patents to licenses and/or commercial products: (i) "a lack of a system that supports venture creation where technologies are disruptive technologies or fill a space where there are no current licensees available; (ii) dearth of venture capital investors who really understand the technology offering; (iii) lack of entrepreneurial skills to take a new technology to market

through a start up; (iv) a small home market that is available to support a new start up; and (v) lack of seed funding for preliminary proof-of-concept work to increase success of licensing/technology transfer."

Figure 10. Factors Affecting Commercialization of Patents at Institutions



Source: Survey of institutions

4.4. Technology Transfer Activities at the Institutions

In recent years, however, the South African public has started asking what the benefits are of funding research at the institutions. There are increased expectations on the institutions not only to be knowledge generators but also to protect that knowledge and ensure that it contributes to economic development and solving various social challenges relating to health, food, energy and poverty alleviation. Institutions in responding to these expectations are faced with: (i) different views in respect of their role in society, particularly the higher-education institutions; (ii) lack of understanding of IP issues; (iii) where there is some understanding there are different, often untested approaches to IP protection and management; (iv) dearth of entrepreneurial skills and human resources to facilitate technology transfer; and (v) different views as well as expectations about technology transfer.

A comparative study of technology transfer activities in Europe and the US (De Juan, 2002) suggests that successful technology transfer requires a regulatory and institutional support framework which must include policies regarding: (i) the ownership of new technology; (ii) protection of new technology; (iii) the transfer of new technology. Hurlin (1985) in his study of management of technology developed at South African universities observed that: (i) proper use of the patent system could result in additional publications for the researcher; (ii) patents could facilitate transfer of new technology to industry; (iii) although publications could be delayed by a year or so to obtain patent protection, the patent system has the benefit of securing the researcher a far earlier date for his/her work; and (iv) the transfer of technology to industry is a complex function requiring diverse skills, some of which may have to be sourced from outside the university. This paper has indeed demonstrated how complex the institutions are finding this function and also the need to develop the diverse skills required for technology transfer.

Garduno (2004), in a study of South African universities, concluded that in addition to having policies in respect of ownership of intellectual property, universities had to set up an institutional framework appropriate to technology transfer. The Bill that is currently under consideration (IPR-PFRD Bill, 2008) requires institutions to establish a designated office of technology transfer[21]. Whereas there is merit in advocating the establishment of offices of technology transfer at the institutions, the impending legislation also acknowledges the fact that not all of them will necessarily have fully fledged offices "unless determined otherwise by the Minister in consultation with the Minister responsible for higher-education, or any other Cabinet Minister to which an institution reports, any institution must, within 12 months of the coming into effect of this Act: (a) establish and maintain an office of technology transfer; or (b) designate persons or an existing structure within the institution to undertake the responsibilities of the office of technology transfer". The Bill also proposes a concept of "regional technology transfer offices", which could be based at an institution with high research activity and output. Such an office could thus have pooled tools and/or scarce skilled professionals that can be accessed by other institutions with low research activity and output, through a dedicated innovation champion at such institutions. This role would initially be to regularly interact with researchers and be a central point of contact at such institutions; and in the medium to long term, such innovation champions could then help establish dedicated offices at their institutions. Based on the present research outputs as measured by publications and patents, we are of the view that for at least a few years, there appears to be no compelling reason for establishing fully fledged offices of technology transfer at each and every institution. At present, there may not be justification for more than 10 of these offices to service all the higher-education institutions. We recommend that the initial focus should be to strengthen the capacity of the existing offices to enhance their current skills, expertise and outputs and increase their relevance in the eyes of the researchers and also to establish at least three regional offices to provide pooled resources and skills for the fledgling institutions.

Technology transfer requires patience. It is a particularly new field for most South African higher-education institutions that by and large have tended to focus on other technology transfer mechanisms such as publications and contract research. The process can take anything from three years from the filing of a provisional patent application for the patent to be developed into a commercial product or service which can provide tangible value and benefits before an income stream can be generated. Tamai asserts that technology transfer is similar to the whiskey business, in that it does not yield profits at the early stages - "[whiskey] manufacturer must wait for a long period of time from distillation until introducing properly-aged whiskey into the market". This is the message that should be communicated not only to policy makers but also senior administrators at the institutions, so that undue pressure is not placed on the technology transfer professionals, based on unrealistic monetary expectations, resulting in the latter focusing only on low hanging fruit. As set out in Wolson (2007), technology transfer should be acknowledged as a public good which facilitates the transfer of useful technologies to the marketplace, thereby contributing to economic growth.

Needless to say, a review of the costs incurred by institutions in obtaining patent protection and the revenues generated from commercialization of the patents (see Figures 4 and 5), clearly shows that in general, whereas costs of patenting have increased, the revenues have not followed. What has to be determined beyond the monetary benefits of technology transfer are the secondary benefits of patenting and technology transfer, such as training and human resource development, skills transfer to the industry, development and support of local industries, institutional infrastructure development, improved institution-industry relations and development of technologies that have local and national benefit or contribute toward poverty alleviation. This paper has not examined or measured those secondary benefits, which could be the object of further studies.

The R&D strategy identified a need to prioritize the IP agenda and in particular, a need for: (i) a dedicated fund to finance the securing of IPRs resulting from publicly funded research and development, when this is in the national interest and (ii) a more effective regime for intellectual property derived from publicly funded research.

As this paper has demonstrated, the low rate of protection of research outputs at the institutions, particularly those of higher education, which form a single unit of dedicated workers employed to generate knowledge, has persisted.

4.5. Policy Initiatives and Impact on IP Management and Commercialization

In order to incentivize institutions to protect their knowledge, in 2004, the DST, through its instrument the Innovation Fund,[22] set up a Patent Support Fund to provide wholesale subsidies for patenting costs incurred by the institutions and also a Patent Incentive Fund to provide monetary incentives to researchers at the institutions to protect their knowledge which has the potential for commercialization. In order to benefit from this Fund, the institutions must have an IP policy which includes benefit-sharing arrangements for inventors.

In light of the requirements of the Patent Support Fund for institutions together with the IPR Framework Policy (DST, 2006) and the impending legislation (IPR-PFRD Bill, 2008), institutions without IP policies have started to develop policies consistent with the provisions of the IPR Framework Policy and impending legislation. This legislation requires institutions to establish a designated office of technology transfer to undertake institutional obligations.

In recognition of the lack of capacity in the area of IP management in the publicly financed institutions, the Innovation Fund has set up a patent attorney development program aimed at addressing the racial imbalance within the South African IP system whilst at the same time contributing to human resource development for enhanced IP management and commercialization. There are currently four candidates in the program, with a further 10 expected to be recruited before the end of 2009. In 2005, a program to enhance commercialization skills within the public sector, run by the Innovation Fund together with Deloitte Innovations, a private-sector consulting firm, delivered seven candidates out of the 10 participants. The Innovation Fund will, during the course of 2008, launch a new commercialization manager-development program (CHUMA) to develop commercialization skills for public sector institutions.

The various policy initiatives, largely driven by the DST and its instruments, have played and will continue to play an important role in the institutions' contribution to South Africa's economic growth.

5. CONCLUSIONS

Although South African publicly financed institutions are generally characterized by low patenting activity coupled with low conversion of these patents to licenses and/or products, a majority of the major higher-education institutions and at least two of the science councils have made significant progress toward laying a sound foundation for IP management and technology transfer. As patenting activity is dependent on research activity and research output, not all higher-education institutions will have high patenting activity as, according to the DoE, not all higher-education institutions are meant to be research intensive, with some geared toward teaching. This is also explicit in R&D expenditure per higher-education institution. There is a need, as set out in the Ten-Year Plan for Science and Technology (DST, 2007), to increase the development of research capacity at the institutions if South Africa is to progress to a knowledge economy.

This paper has also shown that although there are low patenting rates, most patenting activity at the institutions has a bias toward biomedical/biotechnology and ICT with some important exceptions (e.g. patents by Mintek). There is some noticeable citation of patents emanating from the institutions, with a few of them forming part of licensed patent portfolios, indicating their relevance and importance within the sectors in which they are filed.

We could not find evidence of patenting affecting publication rates in respect of the most prolific inventors. Instead, they indicated that a focus on patenting tended initially to impose delays in publication as they became acquainted with the patenting process.

In general, preliminary evidence was found of a relationship between research expenditure and output as measured by publication and patenting activity, with a few anomalies which have been attributed to policy inadequacies and also institutional focus.

The institutions have had variable success in commercializing their patents. Spin-off formation is not a significant activity or preferred mode of commercialization by most of them. At least half of the spin-off companies and also revenues generated by most of the institutions were not based on patents but other forms of intellectual property.

The institutional arrangements in respect of managing and commercialization of intellectual property are at an early stage, with a shortage of skilled professionals posing a challenge to the protection and commercialization of research results. The lack of harmonized IP policies with clear benefit-sharing arrangements for inventors has also contributed to the low rate of patenting by the institutions. Technology transfer activities should be viewed as a public good aimed at ensuring that publicly financed intellectual property or technologies developed at the institutions reach the marketplace where they can be utilized for the greater benefit of society.

The various initiatives by the DST and the Innovation Fund to support IP management and commercialization, which require institutions to develop clear institutional policies, are consistent with the impending legislation (IPR-PFRD Bill, 2008). This legislation provides clear guidelines on the development of such institutional policies and required institutional arrangements for IP management and commercialization. These initiatives are indicative of the support of the South African government in the establishment of a knowledge-driven economy that can contribute to the country's growth, poverty alleviation and competitiveness. The ultimate goal of these initiatives should be: (i) the promotion of intellectual property; (ii) greater protection for intellectual property by the institutions; (iii) increased commercialization of intellectual property by the institutions; (iv) improvement in general awareness of IP issues by researchers; and (v) promotion of IP management and commercialization-related human resources for the benefit of South Africa's National System of Innovation. The support and cooperation of the various stakeholders, namely the researchers, the institutions, the government and industry, is vital to the realization of these goals, which should ultimately result in more technologies developed at the institutions making their way to the market place. We are of the view that the promotion of intellectual property together with the improvement of public awareness of IP issues should result in researchers paying more attention to protecting their research results thereby increasing patenting activity. The development of appropriate human resources for IP management and commercialization coupled with the increased focus on commercialization of intellectual property, whether for economic or public good, should result in improved quality of patenting and higher conversion of patents to licenses and/or products and services.

As the present work has shown, it is important that there is a balanced approach to IP management, not just patenting, and to effect such a balanced approach requires skilled professionals to provide the required advice. The South African government's Ten-Year Plan for Science and Technology (DST, 2007) acknowledges that, in order to progress toward a knowledge-based economy, South Africa needs to "increase the number of patents and products, and in order to do that, some investment should be made in increasing the number and type of skills in engineering, technology and economic interface (the innovation skills)". The Plan further states that focus should be on four elements: (i) human capital development; (ii) knowledge generation and exploitation; (iii) knowledge infrastructure; and (iv) enablers to address the innovation chasm between research results and socio-economic outcomes. These elements are consistent with the goals articulated above. In order to achieve them, there should be increased targeted funding for the institutions, aimed not only at research in high priority technology areas that will contribute to economic growth, poverty alleviation and ensuring that South Africa competes globally with its peers, but also for the development of critical human resources to undertake such research and optimally manage and commercialize the intellectual property emanating from such research.

Notes

1 Available at *http://en.wikipedia.org/wiki/List_of_universities_in_South_Africa#Current_Official_South_African_Universities*

2 Available at *http://www.wes.org.wenr/04 May/feature.html*

3 As used in this paper, start-up refers both to spin-off companies on which an institution has an equity position and also those companies established on the basis of the institution's intellectual property by its researchers and/or other parties where the institution has no equity position.

4 Available at *http://www.wipo.int/patentscope/en/*

5 Available at *http://www.micropatent.com*

6 On the possible limitations of patent citations as an indicator of economic and technological relevance see: Hall *et al*. (2005)

7 Available at *http://www.csir.co.za*

8 Available at *http://www.arc.agric.za*

9 Available at *http://www.wrc.org.za*

10 Available at *http://www.mintek.co.za*

11 Available at *http://www.mrc.co.za*

12 The 2007 data is incomplete and is not representative of all the applications filed during 2007, as the 141 patent applications are based on publication and the patent applications filed toward the end of 2007 would not have been published by December 31, 2007 (the cut-off date for the review period).

13 It is important to note that the most recent applications have a lower likelihood of being cited by subsequent applications. In particular, applications made in 2007 and part of 2006, would not have received any citations, as any applications that may have cited them would not have been published by December 2007.

14 While the document count adds up to 25, the total number of patents is 23 due to more than one applicant cited in certain documents.

15 See Chapter 2 by Wynberg *et al*. for more information on this patent and other CSIR patents relating to this product.

16 At the time of writing, 1 rand was equivalent to approximately US$0.12.

17 As will be discussed below, revenues from licensing may not be the primary reason for institutions to engage in patenting and licensing, and, as a result, may also have limitations as a measure of success. However, the figures provide interesting information on the economics of technology transfer at South African research institutions.

18 Available at *http://www.innovationfund.ac.za*. The Innovation Fund is an instrument of the Department of Science and Technology managed by the National Research Foundation. It was established to promote cross-sectorial collaborative research and fund end-stage research and commercialization of South African intellectual property.

19 Available at *http://www.universityworldnews.com/article.php?story=20071108145540742* (South Africa: universities set priorities for research), November 11, 2007.

20 Telephonic interview with Rudi van der Walt, Director of Innovation and Head of TTO (North West University) on July 11, 2008.

21 The Department of Science and Technology announced on January 14, 2009, that the Intellectual Property Rights Bill had been signed into law

22 The Innovation Fund is an instrument of the DST managed by the National Research Foundation. It was established to promote cross-sectorial collaborative research and fund end-stage research and commercialization of South African intellectual property.

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References

Cloete, T.E., L.H. Nel and J. Theron, 'Biotechnology in South Africa', *openUP*, 2006.

De Juan, V., 'Comparative Study of Technology Transfer Practices in Europe and the United States', *Journal of the Association of University Technology Managers*, volume XIV, 2002.

Department of Science and Technology, 'A National Biotechnology Strategy for South Africa', available at *http://www.pub.ac.za/resources/docs/biotechstrategy_2002.pdf*, 2001.

Department of Science and Technology, 'South African R&D Strategy', available at *http://www.dst.gov.za*, 2002.

Department of Science and Technology, 'Framework for Intellectual Property from Publicly Financed Research', available at *http://www.dst.gov.za*, 2006.

Department of Science and Technology, 'Innovation Towards a Knowledge-Based Economy: Ten-Year Plan for Science and Technology', available at *http://www.dst.gov.za*, 2007.

Department of Science and Technology, 'Intellectual Property Rights from Publicly Financed Research and Development Bill', IPR-PFRD Bill, B46-2008, available at *http://www.pmg.org.za*, May 2008.

Garduno, E., 'South African University Technology Transfer, A Comparative Analysis', *International Intellectual Property Institute Report*, January 2004.

Gastrow, M., 'Great Expectations: 'The State of Biotechnology Research and Development in South Africa', *African Journal of Biotechnology*, Vol. 7 (4), 342-348, available at *http://www.academicjournals.org/AJB*, February 19, 2008.

Geuna, A. and L. Nesta, 'University Patenting and its Effects on Academic Research. The Emerging European Evidence', *Research Policy*, 35(6), 790-807, 2006.

Hall, B. H., A. B. Jaffe, and M. Trajtenberg, 'Market Value and Patent Citations'. *The RAND Journal of Economics*. 36, 16-38, 2005.

Hurlin, D.C.R., 'The Management of Technology Developed at South African Universities', *PhD Thesis*, 1985.

Intellectual Asset Management Magazine, 'Japan's Lessons for the Wider IP World', Issue 16, February/March 2006.

Jacobs, D. and P. Pichappan, 'Research Collaborations and Scientific Productivity among the Research Universities in South Africa', International Workshop on Webometrics, Informetrics and Scientometrics, COLLNET meeting No7, pp. 433-440, Nancy, France, 2006.

Jaffe, A.B. and M. Trajtenberg, 'Patents, Citations and Innovations', *The MIT Press*, 2002

Lubango, L.M. and A. Pouris, 'Industry Work Experience and Inventive Capacity of South African Academic Researchers', *Technovation*, 2007.

Montobbio, F., 'Intellectual Property Rights and Knowledge Transfer from Public Research to Industry in the US and Europe: Which Lessons for Innovation Systems in Developing Countries?' in WIPO, The Economics Of Intellectual Property (2009).

Montobbio, F., 'Patenting Activity in Latin American and Caribbean Countries in WIPO - Economic Commission for Latin America and the Caribbean (ECLAC) - Study on Intellectual Property Management in Open Economies: A Strategic Vision for Latin America', available at *http://eco.uninsubria.it/webdocenti/fmontobbio/cv/Montobbio2007wipo_draft.pdf*, 2006.

Nicola, B., 'The Patenting Universities: Problems and Perils', available at *http://mpra.ub.uni-muenchen.de/7370*, March 27, 2006.

OECD Country Review of SA NSI-NACI 2006, National Science Indicators - *Institute for Scientific Information* (ISI), available at *http://www.naci.org.za/OECD/OECD%20Report%2021Aug.pdf*, 2006.

OECD *Compendium of Patent Statistics*, 2007.

Pouris, A., 'The International Performance of the South African Academic Institutions: A Citation Assessment', *Higher Education*, vol. 54, no. 4, 501-509, 2006.

Sibanda, M, 'The State of Patenting in South Africa', Special Report published by the Innovation Fund, 2007.

Singhe, K., S. Playford and R. Quader; 'Survey of Patenting and Commercialization Activities of Australian Universities, Canberra', available at *http://www.innovation.gov.au/Documents/Unipatentandcommercilaisation20070810102636.pdf*, April 2005.

Tamai, K., 'The University Office of Technology Transfer: Japan', *Streamlining International Intellectual Property No 5,* available at *http://www.law.washington.edu/CASRIP/Symposium/Number5/pub5atcl13.pdf*.

Wolson, R., 'The Role of Technology Transfer Offices in Building the South African Biotechnology Sector: An Assessment of Policies, Practices and Impact', *Journal of Technology Transfer*, vol 32, 343-365, 2007.

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