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**Innovation policies and innovation systems:
The case of Information Technologies in South Africa**

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0. Abstract

The alignment of innovation policies with the needs of the innovation system remains a great challenge, particularly for developing countries. In relation to this challenge there are several factors associated to problems with measuring innovation, the recognised different dynamics of innovation processes in developing countries, and the 'distance' between relatively new innovation policies and the dynamics of the local industry. These problems can sometimes lead to 'disconnections' between innovation policies and innovation processes in developing countries. These aspects will be examined in this paper, illustrated through the case of the Information Technologies (IT) industry in South Africa, in particular software. Based on a few existing studies, this paper highlights the urgency to collect continuous and comprehensive data on the dynamics and innovation processes of the South African software industry. In South Africa, dearth of data is clearly inhibiting the chance to develop a much needed software strategy to compete with other countries with more coordinated efforts.

1. Business dynamics and innovation policy: theoretical framework

The alignment of business dynamics to national and regional innovation policies is considered in this paper to take place within the context of national systems of innovation. According to Freeman a national system of innovation can be defined as "the network of institutions in the public and private sectors whose activities and interactions initiate, import, modify and diffuse new technologies" (Freeman 1987).

This definition represents the interaction between business firms and the multiple actors that influence their dynamics and innovation processes, including the public sector through innovation

policies. The importance of innovation for development has since then been widely acknowledged (Nelson, 1993; Lundval, Kim and Nelson, 2000- among many others). However, this acknowledgement usually stresses the final form of innovation, embodied in inputs and outputs, new products and new technologies. Without denying the importance of this side of innovation, it has been recently accepted that in developing countries, innovation tends to be of a different nature than that observed in more developed economies (Bell and Albu, 1999; Romijn, 1998; Lastres and Cassiolatto, 2002; Sutz, 2006). In developing countries innovation has been described as incremental rather than radical; more focused on learning than invention. In this line, innovation as learning refers to the development of capabilities to solve problems (Lall, 1992).

Understanding innovation in such a way is crucial to effectively feed this information into the policy-making process, especially for those countries where innovation policy has a relatively short history, like South Africa. Measuring this particular type of innovations, where the differentiation between inputs and outputs is yet more unclear requires an additional effort. 'Especially in the context of developing countries one needs to collect information on the learning process that underlies innovation. This is not an easy task, as learning and competence building are qualitative and multidimensional processes' (Goedhuys and Mytelka, 2005).

Innovation dynamics do not only differ for the case of developing countries but also for emerging, fast-growing sectors, such as Information and Communication technologies (ICTs). The fast-moving nature of the industry and the continuous state of flux and development of the activities that fall into this category make Information technologies move faster than its measures. Innovation in those sectors does not respond to conventional methods, which can underestimate the efforts and needs of these growing niches of production in developing economies.

This paper will tackle with these issues by presenting the case of the Information and Communication Technologies (ICTs) sector in South Africa. South Africa has gone through a major process of transformation and reformulation of its innovation and technology policy. The end of the Apartheid in the mid 1990s and the new economic and social imperatives re-focused attention on the innovation system. This resulted in the recent emergence of numerous policies and institutions designed to accelerate domestic technology development and improve the absorption of imported technologies. As part of this overall strategy, the Government of South Africa with the support from the Canadian International Development Agency (CIDA) has recently targeted the ICT sector, under its Country Development program for South Africa. These

efforts resulted in the release of the South African ICT Sector Development framework in November 2000 with the intention to promote South Africa to be a key player in the global ICT market.

Strategic intervention in specific sectors of the economy has been largely debated for more than a decade. Picking up winners and promoting certain industries through incentives and subsidies has been pointed as authors such as Wade (1990), Lall (1996) and Timmer (2000) as key factors for their ‘success’. In particular Lall’s approach (1987, 1992) places great importance on the role of incentives and the coherence of policies to supplement and improve markets:

“[...] Interventions in product or factor markets separately [...] in isolation from each other are unlikely to be effective because of the systemic nature of learning and market deficiencies” (Lall and Teubal, 1998). Lall and Teubal assert that the effectiveness of the innovation system depends on the effectiveness of market- stimulating technology policies.

The evidence on which policies related to the ICT sector have been informed for their design, implementation and re-formulation is considered in this paper. The ‘youth’ of innovation policy in South Africa makes of it an ongoing process that is still shaping and evolving with the time, experience and new available research.

2. South Africa and the thriving IT industry

2.1. Background of South African economy

South African economy is at the forefront of African economies in a number of economic indicators. The table below shows that GDP growth has been positive and steady in the last years- although slow- confirming that the domestic economic environment is characterised by significant levels of economic activity. Increasing consumer demand is considered as the main driver of economic activity¹. However, unemployment still remains a great challenge at an alarming value of nearly 30%. Foreign investment has experienced a large growth in the last years, partly as a response to an image of political and market stability, as well as the sophisticated financial structure of South African economy in comparison to other developing countries².

¹ For more information see www.dti.gov.za

² For more information see www.dti.gov.za

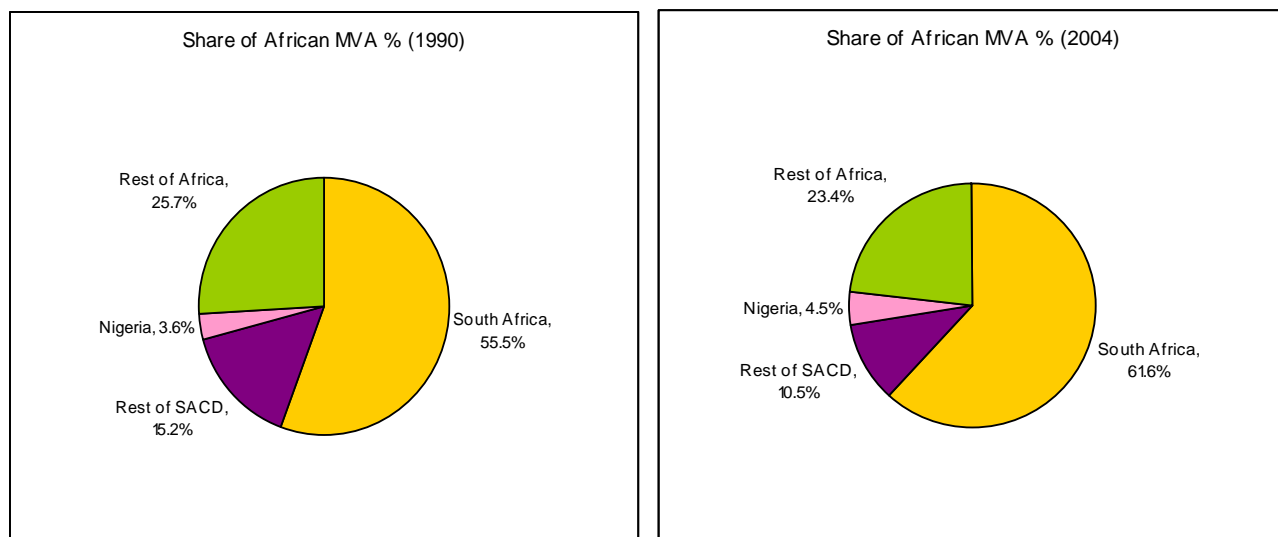
Table 1: Some economic indicators for South Africa

	2001	2003	2005
GDP (real % change)	2.2	2.7	3.7
GDP pc (constant prices 2000)	21,269	21,967	23,414
Unemployment (%)	29.5	28.3	27.6
Merchandise Exports (mill Rand)	251,329	314,101	331,405
Merchandise Imports (mill Rand)	216,032	275,427	351,664
Foreign Direct Investment (bill Rand)	0.8	1.5	40.2

Sources: South African Reserve Bank and ABSA Bank

South Africa is not only the largest economy in Africa (representing over 40% of African total GDP), but also the most industrialised. The improvement of South Africa’s industrial competitiveness is captured below by its outstanding performance in manufacturing value added in comparison to the rest of the continent, especially to those economies based on oil production/export.

Figure 1: Share of African MVA (1990 and 2004)



Source: Calculated by authors from World Development Indicators (2005): Kraemer-Mbula and Maharajh (upcoming) chapter on the case of South Africa in “Neighbourhood System of Innovation: Regional Poles as Dynamios for Economic Development” Muchie and Baskaran (2006)

In relation to exports, South African economy represents nearly one third of the African total. Moreover, when we look at the ‘technological content’ of these exports it can be observed that South African economy represents even a much larger proportion of African manufactured exports and most of the technology intensive exports (over 83% in 2004).

Table 2: Share of African exports

	<i>South Africa</i>		<i>Rest of Africa</i>	
	1998	2004	1998	2004
Exports of goods and services	37.4%	31.6%	62.6%	68.4%
Manufactured Exports	56.2%	52.4%	43.8%	47.6%
High-tech exports	89.3%	83.7%	10.7%	16.3%

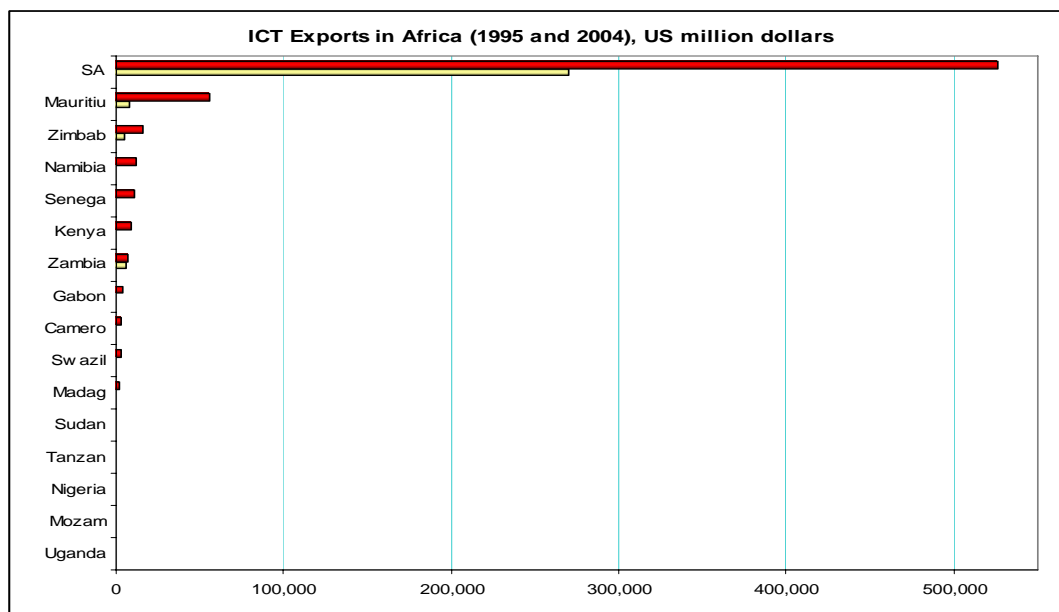
Source: Figures on exports of goods and services calculated by authors from the World Development Indicators (2005), manufactured exports and high-tech exports calculated from COMTRADE database. Extracted from Kraemer and Maharajh (upcoming) chapter on the case of South Africa in “Neighbourhood System of Innovation: Regional Poles as Dynamios for Economic Development” Muchie and Baskaran (2006)

2.2. South African IT industry

The relative strength of the so-called “knowledge economy” of South Africa is often attributed to the historical economic development of the country and close links to European markets.

The distance of South Africa with the rest of Africa in knowledge-intensive sectors is significantly high, as indicated by the level of IT exports in comparison to other African countries.

Figure 2: IT exports in South Africa and other African countries (1995-2004)



Source: Calculated from COMTRADE database.

The IT business in South Africa is thriving. According to the latest reports from market analysts³ the IT sector has evolved from a relatively unsophisticated and immature market to the biggest growth opportunity, not only in South Africa but also for the rest of Africa (ICT World, 2006⁴).

Despite the relatively high level of exports in comparison to other African economies, the IT sector is still mainly considered to be driven by domestic consumption rather exports and by telecommunications and IT services more than by software development and hardware supply (Moleke & al., 2003). The table below shows that South Africa is mainly a consumer rather than a producer/exporter of knowledge intensive products. Imports of technology intensive products grew nearly 50% between 2001 and 2005 whereas exports did at a 36%.

Table 3: South African high-tech and IT trade

	2001	2003	2005	<i>Growth</i>
High-tech exports (million Rand)	10,329	9,506	14,006	36%
High-tech imports (million Rand)	53,912	60,926	80,567	49%

Source: DTI, South Africa, Trade database

Therefore, coming mostly from domestic sales, the revenue has been growing at a stable rate of around 10% from 2001 to 2005.

Table 4: Value of Sales in South Africa IT industry (Million Rand)

	2001	2002	2003	2004	2005
Total vendor revenue	34,300	37,793	41,991	46,484	51,487
Growth (Nominal)	10.5%	10.2%	11.1%	10.7%	10.8%

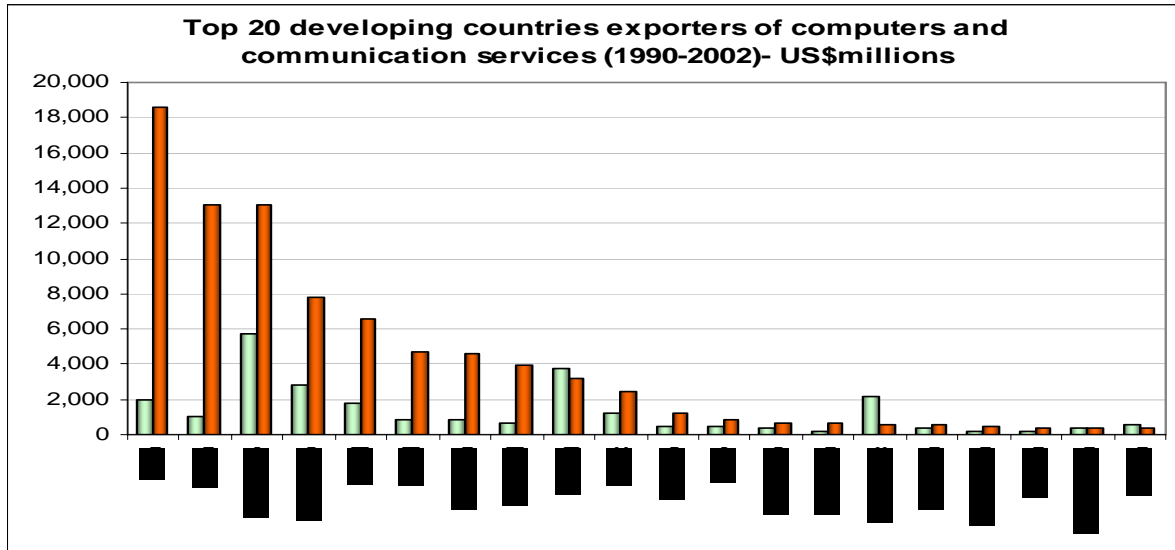
Source: BMI-Techknowledge

South Africa is the major IT player in Sub-Saharan Africa although still small in relation to the rest of the world. Despite its potential, South Africa lags developing nations such as India, Brazil and China in establishing a viable entrepreneurial base in the IT sector.

³ The major market research in South Africa's IT industry is conducted by BMI-Techknowledge

⁴ See <http://www.ictworld.co.za/>. Local news, September 2006.

Figure 3



Source: World Development Indicators (2005)

As noted below, this is largely due to the lack of a coordinated strategy to promote the industry and also the fact that South Africa is a consumer, rather than a developer or manufacturer, of IT products and services. As a result, South Africa enjoys still a relatively small share of the global opportunities in the sector.

3. Business dynamics in the software industry

Business dynamics in the IT industry are largely under-researched in South Africa. Rapid changes in IT products and services create global opportunities and new competition on a daily basis. Countries that have realised these opportunities, have developed targeted strategies to facilitate international competition, such as China, India and Korea. IT-related activities require deep and continuous data collection for strategy development, currently lacking in South Africa. The challenges and opportunities for the software industry shown below are based in two studies:

(1) Conducted by Africa Analysis in 2004 at a national level- undertaken by the Department of Trade and Industry (DTI). This study was aimed at analysing and sizing the South African software market as well as benchmark it against other leading global markets, such as the USA, UK, Ireland, China and India.

(2) Conducted by CITI⁵ (Cape IT Initiative), for the Western Cape region. CITI was born in 1998 to stimulate and support the growth and development of the ICT cluster in the Western Cape. Since then it has conducted two sector scans (in 2000 and 2001) and the first ICT Census 2003 to identify the total population of IT firms and characterise the sector, only for the Western Cape region.

3.1. Challenges of the software industry

For the particular case of software industry, Africa Analysis (2004) estimated a total number of firms in South Africa of 1,000 of which the majority were small companies. Using the Census of Western Cape ICT Companies 2003 as a guideline, companies with less than 10 staff members constitute 60% of entities active in the IT sector. Within the ICT sector, the Africa Analysis (2004) observed that software companies tend to be on the small end of the scale in comparison to other IT and telecommunications companies.

The distribution of revenue by size of the firm is highly uneven. In the software industry is highly fragmented, and the top five software houses in South Africa generate around 40% of the revenue in this market while the top 10 companies generate 55% of the revenue (Africa Analysis, 2004). The pattern of innovation and adoption of technology differ between these two types of companies. Recent analysis performed by the BMI-T (June 2006)⁶ detected that big businesses have progressed in the adoption of technologies that enhance functionality of current IT infrastructure rather than replacing them, opposite to the small businesses.

In South Africa it has been widely recognised that the software industry suffers from a skills shortage of high level, experienced individuals. Lack of appropriate skills has been linked to a disconnection between the national educational policy and software industry skills requirements. This is caused by lack of investment in the right type of training and educational programmes. However, a study by Moleke, Paterson and Roodt (2003) asserts that the shortage of skills in the South African software industry is frequently exaggerated and should be understood in the context of specific time-based shortages of specific skills. Also the effect of in-house training largely predominant in smaller companies should be taken into consideration.

For the case of smaller companies, the predominant strategy seems to be based on finding very specific niche markets directed to the domestic market. In this context there are still many

⁵ For more information see www.citi.org.za

⁶ Quoted in <http://www.ictworld.co.za/>. Local news, September 2006.

companies that are developing products which have some client support, but are not innovative enough and do not have the capacity to scale into a globally competitive product. At the same time, global players continue to spend on R&D and extend their market reach proving to be a direct threat to local software development companies that are not inherently innovative enough and have strong enough IP protection mechanisms (Africa Analysis, 2004).

Despite the lack of official published records of software exports DTI research established that South African software export market revenue constitutes less than 6% of the total software market. However, according to the Western Cape ICT Census part of the actual export activity goes unrecorded as some companies do not consider intangible products as export. The results from the CITI census in the Western Cape in 2003 showed that one third of the surveyed ICT companies claimed to be engaged in export activities. The main export markets for this sample of companies is Africa (76%) and Europe (32%), (CITI, 2003). This may prove to be an opportunity for increased exports in the future.

The high fragmentation of the sector has contributed to a lack of a comprehensive, medium to long-term marketing strategy for the South African software industry. African Analysis (2004) states that this has resulted in a lack of awareness of the South African software industry in the biggest import markets of US and Western Europe and the lack of strategic partnerships with foreign software vendors, which would match local skills with foreign skills to create a competitive solution for the global market.

In addition to this, there is no software association active in developing the South African software industry. The lack of industry cohesion through a focussed software association puts South Africa in disadvantage to other countries with a strong software global orientation and active associations.

Therefore, South Africa counts with a relatively large base of small and medium software South African companies that are oriented to niche domestic markets with the potential to grow in Africa and also Europe and the USA. Their constraints and challenges for innovation should thus constitute a central point of the innovation policy in South Africa.

3.2. Opportunities in the software industry

These studies have also derived some potential areas for growth of the various subsectors for the different segments of the IT industry, including software.

At a national level, DTI⁷ points at different types of software as major potential opportunities for the development of the IT industry in South Africa. Experience in related industries such as the defence industry and mobile telephony are often considered in this study as major arguments for competitiveness.

Table 5: Major opportunities for the South African IT industry

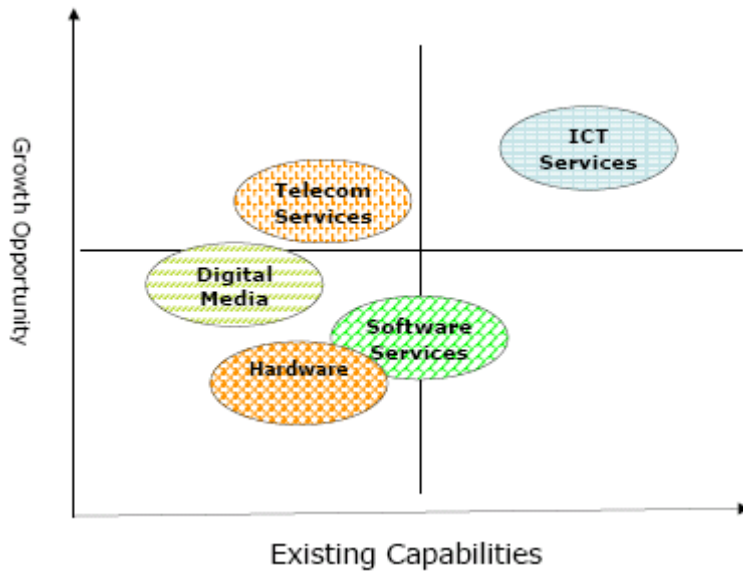
Sector	Major Markets	Rationale
Wireless Software	Solutions Worldwide	Experience in areas such as financial transactions over mobile phones, systems integration, wireless LAN solution and WAP services. (Global Technologies, Siemens SA)
Embedded Software	North America and Europe	Experience in demanding industries such as the defence sector.
Systems Integration	Africa	A wide range experience
Wireless security systems	Worldwide	A demanding and innovative security environment

Source: extracted from DTI sector analysis (2005)

A report by Naidoo, Neville and Dingley (2004) for the Western Cape shows that IT Services have the highest possible growth opportunities and a solid base of skills to support it. Following this category software services holds the second highest level of existing capabilities to support the growth of the industry, contrasting with the previous argument of skills shortage. This is further confirmed by the information gathered in the First Census of ICT firms in the Western Cape in 2003.

⁷ For more information see <http://www.dti.gov.za>, sector analysis, based on African Analysis (2004) findings

Figure 5: ICT Sector growth opportunities versus existing capability in the Western Cape
(Radian diagram):



Source: Extracted from Naidoo, Neville and Dingley (2004).

Some additional competitive advantages pointed by the African Analysis (2004) are: (1) English language as a business medium as well as a westernised culture, work ethic and the legal environment (2) same time zone with respect to Europe (3) links with the UK via UK ex-pats in South Africa and many South African ex-pats in the UK US, Australia, New Zealand and Canada (3) small cost advantage compared to the developed markets and (4) portal to Africa for global vendors, even if South African firms themselves do not export software to the sub-Saharan region.

Therefore, according to existing studies South Africa has a competitive advantage in software and IT activities. Experience and skills base are commonly pointed as central arguments for competition. However, software activities are subject to rapid change and strong competition. Benefiting from these opportunities largely depends on the formulation and effective implementation of an adequate strategy and policy support mechanisms that allow South African software firms (particularly the vast majority of small firms), to compete with emerging markets in other developing regions, such as India and China.

4. Some policies affecting software development

Lack of coordination to promote the software industry characterises the sectoral intervention scheme in South Africa. However, a number of existing initiatives are intended to have a positive impact on small software producers⁸. Some of them are presented below. Their actual impact and effective results on the promotion of the industry are still under-researched.

The South African Information Technology Industry Strategy (SAITIS) project was conceived in 1995 in this new era by the Minister of Posts and Telecommunications (later Minister of Communications), and sponsored by Thabo Mbeki, then Deputy President (now President). Initial stakeholder meetings were conducted on the SAITIS project. These resulted in the nomination of a group of 37 stakeholders as an Advisory Group to the SAITIS Project. The group of 37 represented key organizations and agencies with interests in the ICT Sector in South Africa. The outcome was a Project Design Document (PDD) to guide the direction of the project and the establishment of a Project Steering Committee (PSC).

The Government of South Africa was greatly supported in the development of the ICT Sector Development Framework by the Canadian International Development Agency (CIDA), under its Country Development program for South Africa. This resulted in the release of the *South African ICT Sector Development framework in November 2000*.

Among the numerous goals in this framework, are to (1) accelerate growth of the base of ICT SMMEs and support their continued success and (2) leverage South Africa's strong local market for ICTs and its presence in the South African regional market into global markets, particularly the expanding developing country market.

Although there is a policy framework for the overall IT industry, there is no specific strategy for the software industry. However, since 2000 policies related to the IT sector have evolved and have certain influence on the software industry. Some of the most relevant are:

- The *Small Enterprise Development Agency (SEDA)*⁹, established in December 2004 in terms of the National Small Business Amendment Act. This law merged previous small

⁸ It is important to note that these policies only represent a sample of the most related policies at national level. However, there are also some initiatives at the provincial level and a few private and public incubators for software activities not included in this compilation.

⁹ For more information see www.seda.org.za/

enterprise development agencies¹⁰ into a single small enterprise support agency. The objective of SEDA is to design and implement a standard national delivery network to support and promote small enterprises. In line with the Department of Trade and Industry's Integrated Small Enterprise Development Strategy, SEDA aims to: facilitate SMMEs access to finance, create an enabling regulatory environment and expand market opportunities for specific categories of small enterprises, including software companies.

- *Strategic Industrial Project¹¹*: implemented in 2001 and managed by the DTI, this incentive provides 50-100% tax allowance to encourage investments into South African operations from local and foreign investors. Its aim is to contribute to the competitiveness of specific industry sectors. The programme is set to benefit computer and computer-related activities. However, as software development does not fall into the category of manufacturing, most companies are not eligible for this incentive. The definition and categorisation of software activities should thus be taken into account.
- *Skill Support Programme*: providing 50% of training costs for small and medium enterprises of any sector. One of the requirements of this programme is that only covers certified training. However, according to DTI research, most of the training in small software companies occurs in-house.
- SAVANT, established in 2000, it is a public-private partnership between government and industry with the aim of marketing the South African IT industry locally and internationally. The initiative also aims to strengthen the South African IT sector in order to add dimension to its global competitiveness.
- *Open Source*: The South African government has gone further than other African governments in the promotion of Free Open Source Software (FOSS). In 2003, the Government Information Technology Officers Council (GITOC) presented a draft FOSS policy to the Government. The document was finally adopted as an official policy, recommending the use of open standards and procurement of free/open source software in Government.

¹⁰ Ntsika Enterprise Promotion Agency, NAMAC Trust and the Community Public Private Partnerships (CPPP).

¹¹ For more information see www.dti.gov.za

- *Duties:* Import duties on IT hardware and software were abolished on 2003. Companies importing into South Africa only pay a Value Added Tax (VAT) to the South African Customs. This scheme is a practical benefit for software companies as most South African IT companies import the hardware from abroad. Release from import duties highly benefits South African small companies, which consume most of their technology from abroad.
- *Telecommunications liberalisation:* Another significant factor affecting the software industry in South Africa is the monopoly on telecommunications by Telkom, a previous parastatal in which the government still holds a large stake. Telkom's monopoly has raised many voices of discontent from the public interest, as a result of very high prices affecting households and the competitiveness of the growing software business. Telkom is currently the largest provider of broadband in the country. The cost of ADSL services are separated into a line rental fee, a connection fee and an Internet Service Provider (ISP) fee. Telkom has monopoly on the first two services, but the company allows local ISPs to repackage the third item. Telkom also has a monopoly of all international calls originating within South Africa excluding VoIP (the ban against VoIP was lifted by Telkom only in 2005). Efforts are under way to liberalise the telecommunications sector, including the passing of the Telecommunications Act Amendment Act of 2001, which legislated the end of the Telkom monopoly in South Africa. Nevertheless the effective end of this monopoly is still on its way and its effect of the monopoly on small local software producers is devastating. Recent legislation has lowered many restrictions on companies entering the telecommunications market. Competitors to the land-line monopoly are slowly emerging, especially providers of wireless broadband. Examples of these providers include Sentech, an extension of the state-owned South African Broadcasting Corporation, and WBS Co., a black owned enterprise. The push for competition is now on its way, and in August 2006, Neotel announced the launch of its services as the second national operator.

5. Conclusions

This paper has presented the status of the software industry in South Africa based on a few recent studies. South Africa is a major player in the IT industry in Africa and a potential gateway for IT products into the continent. The opportunities and challenges of the growing base of software firms need to be considered from an innovation policy perspective. South African software small producers constitute the majority of the industry's population, although most of the revenues are concentrated in a few large software producers. South Africa's relative advantage in terms of skills and experience offers a great chance to improve its presence in global software markets. However, this requires a specific and defined strategy in relation to its specialisation and niche markets to compete with other developing countries that have already developed very concrete and dynamic strategies.

The global software industry is moving rapidly and bringing significant benefits to those countries that have managed to harness the "IT revolution". South Africa software producers still have many barriers and challenges, some related to the nature of the industry itself but some are policy generated, such as the Telkom monopoly. These policy barriers contrast with the national recognition of the need to promote the IT (and particularly software) industry in South Africa; proving again the lack of a consistent sectoral strategy. The design of such strategy requires continuous and detailed evidence on the dynamics and rapidly changing innovation processes of software companies.

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