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TOWARDS A BETTER UNDERSTANDING OF THE ICT SECTOR IN SOUTH AFRICA: PROBLEMS AND OPPORTUNITIES FOR STRENGTHENING THE EXISTING KNOWLEDGE BASE

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1. Introduction

The purpose of this paper is to present a broad overview of the information and communications technology (ICT) industry in South Africa, based on available secondary sources. Because of the nature of the information economy and the requirements for high-level human resources in this sector, the paper also presents an overview of the status quo of skills required to ensure that the ICT industry will flourish and grow. The paper does not present detailed analyses of the sector but rather a bird's eye view that will enable those not involved directly in the sector to have a better understanding of the structure and boundaries that define it. The paper also raises issues and concerns that require further research and investigation, and that will hopefully stimulate interest in areas that to date have not received much attention.

The paper covers the following topics:

- Status of the ICT industry in South Africa, including policy and regulatory aspects, the industry itself and the diffusion of ICTs into other sectors
- Supply and Demand of ICT skills in South Africa
- (Re)defining the ICT industry
- Future directions in the ICT sector
- Research challenges in the ICT industry.

2. State of the ICT Industry

2.1 Overview

There is little reliable and publicly available information on the state of the ICT industry in South Africa. An early attempt to fill the gap commenced in 1996 and led to an international publication in 1997[1]. Building on and extending that work was a 1998 report to inform the deliberations of the ICT Working Group on the National Research and Technology Foresight Study[2]. Thereafter the SAITIS project commissioned so-called "Baseline Studies," that were published early in

[1] Hodge, J. & Miller J., July 1997: *Information Technology in South Africa: The State of the Art and Implications for National IT Policy*, *www.uct.ac.za/depts/dpru;* in press, UN University.
[2] Day, R.S. (Compiler), May 1998: *The State of the Information and Communications Technologies Sector in South Africa, www.dacst.gov.za/foresight*

2000[3]. There have been no further reports, other than high-priced studies of particular segments of the ICT market by private sector organisations such as BMI TechKnowledge and the Gartner Group. Still today, therefore, the classification and general availability of information to inform public policy and industry decision makers in the dynamic, rapidly changing and converging ICT sector leaves a lot to be desired.

The following paragraphs summarise some of the information from the previously mentioned reports, supplemented where indicated by more recent information.

2.2 The Policy and Regulatory Environment

This paper will not go into detail on the policy and regulatory environment that directly affects the ICT industry[4], many of which apply to industry sectors in general e.g. the Competitions Act and the Skills Development Act (1998). There are however a number of recent developments that influence the future growth of the ICT industry and these are mentioned below.

Despite debates in the mid-90s on the wisdom of developing an integrated ICT policy, this did not materialise and to our knowledge, there is no intention of developing any such policy in the near future.

2.2.1 The Regulator

The telecommunications and broadcasting sectors are regulated by a single body that arose from the merger of the telecommunications regulator (SATRA) and the Independent Broadcasting Authority (IBA). This new body, the Independent Communications Authority of South Africa (ICASA) came into being in July 2000. The thinking behind the merger coincides with increasing awareness that convergence within the ICT industry is a reality and that a joint regulator would be required. Whether the merger will result in a truly merged operation, or two entities residing within a single regulator still has to be seen.

According to the Telecommunications Act of 1996, the regulator assumes responsibility for the following tasks, amongst others:

- *Interconnect agreements*, which the quality and levels of service, time periods, and fees and tariffs to be paid between parties;

- *Re-issuing of new licences* - in practice this means that the regulator hashad to develop new regulatory frameworks for value-added network data services (VANs) and

[3] James, T. (Project Leader), January 2000: A Survey of the IT Industry and Related Jobs and Skills in South Africa, www.saitis.co.za

[4] See also James, T (Editor) (2001, in press*). An Information Policy Handbook for Southern Africa: A Knowledge Base for Decision-makers,* which provides an in-depth analysis of the South African policy environment in three areas – e-commerce, education and ICT (including telecommunications and broadcasting).

for private telecommunications networks (PTNs)[5], regulate the contributions to the Universal Service Fund (USF) and the Human Resources Fund (HRF); define *needy persons* in terms of who would benefit from the Universal Service Fund; conduct a study on feasibility of introducing further cellular licences; and monitor the licence conditions of the incumbent PSTN, Telkom;

- A *numbering plan* to ensure that all services in this fast-growing sector can make provision for a number.

South Africa has an independent regulator, funded through a Parliamentary appropriation and partially self-funded from a variety of sources such as licence application and service fees. As in many developing countries, concerns have been raised about the capacity (financial and human resources) within the regulator to ensure that a level playing field is maintained in the telecommunications sector. With the phased liberalisation of the telecommunications sector commencing in May 2002, the necessity for a strong regulator becomes of paramount importance.

2.2.2 The 2001 Telecommunications Policy and the Proposed Amendment of the Telecommunications Act

The telecommunications sector is in a considerable state of flux as the results of the 1996 Telecommunications Act play out—and especially as the period of exclusivity accorded to the state telecommunications company, Telkom, comes to an end in May 2002. The recent government about-face on fundamental policy directions for telecommunications and the delays in tabling electronic commerce legislation have not helped. While licences have now been granted to a third cellular operator and apparently only a single additional fixed line operator will be licensed to compete with Telkom until 2005, uncertainty will remain in this sector until the relevant amendments to existing legal and regulatory arrangements and new proposals are tabled in parliament and passed into law[6].

Some important aspects that underpin the final telecommunications policy[7] are:

- Black economic empowerment;
- Domestic and foreign direct investment – the previous inclusion of a cap on foreign investment (at 49%) has been removed;
- Stable predictable regulation;
- Universal service and access;
- Human resource development; and

[5] The still-to-be resolved conflicts between Telkom on the one hand, and the ISPs and VANs on the other, illustrate some of the key economic issues that have arisen over the vague definition in the 1996 Telecommunications Act (1996) on what constitutes basic telecommunication, and what can be regarded as value-addition.

[6] See also a previous paper by James Hodge, 'The State of the Telecommunications Industry in South Africa and the Potential Costs/Benefits of Further Liberalisation', TIPS Annual Forum, Sept 19-22, Johannesburg. *http://www.tips.org.za/papers/showpaper.asp?ID=284*

[7] Refer to the Department of Communications Website, *http://docweb.pwv.gov.za/docs/pr/2001/prpoldir.html for* a statement on the proposed changes to the Telecommunications Act.

- A reduced digital divide.

Some points worth highlighting are:

- A second fixed-line network operator (SNO) will be appointed by May 2002, a possible third operator by 2005,depending on a feasibility study. Either Transtel or Esi-Tel will be allowed to participate in the winning consortium;

- Voice over IP (Internet Protocol) is prohibited except in areas where teledensity is 5% or less – in these areas community-based operators will be allowed to operate as telecommunications cooperatives;

- VANs will only be allowed to deal in data services;

- The Universal Service Agency (USA) will be restructured to facilitate and offer guidance in the evaluation, monitoring and implementation of universal access targets;

- Public schools will be entitled to an e-rate of 50% discount on Internet access;

- All telecommunications operators will contribute up to 0,5% of their turnover to a Universal Service Fund;

- The Sentech licence will be extended to offer international telephone services and other multi-media products;

- All new operators will be required to set aside 30% for black empowerment;

- Number portability, and carrier pre-selection in 2005

- Public Emergency Communications Centres (PECCs) designated as 112 emergency centre (s) will be established and will include the rollout of services to rural areas; and

- No broadband licences will be issued.

2.3 The Supply of ICT Products and Services

BMI-T estimated that in 1998 the country spent R10.7 billion on computer hardware. The main purchasers were the Finance/ Insurance/ Real Estate, Manufacturing, Retail, Transportation/ Communications/ Electricity, Public Administration, and Consumer sectors, in that order. At that time the installed base of computers was of the order of 100 mainframes, 20 000 midrange computers and 2 million PCs (not including household PCs). Data for 2000 suggests a market of R14.6 billion implying a growth of about 16% a year and some 2.85 million PCs (including household units). Built into that growth will have been a spike due to the Y2K phenomenon.

Thus 2001 is likely to be a very poor year for growth, given the Y2K spike and the current worldwide downturn in the high-tech arena.

While there is some PC assembly in South Africa, almost all hardware is imported from Europe, North America and the Far East and marketed and distributed here.

2.3.1 IT Software

1998 software revenues were estimated as R3.8 billion. Half of that amount derived from packaged applications software and the rest from operating systems, networking software and software development tools. The amount included an estimated R253 million in *consumer* software purchases, with 90% of the rest spread across the major user sectors noted in the hardware section above. The total value for software purchases in 2000 was estimated as R5.7 billion.

As in the case of hardware, South Africa imports almost all generic software, which is then marketed and distributed here. It is estimated that in 1998 about R175 million worth of financial and supply chain management software was developed and exported. Most bespoke software development is limited to reworking or local integration of international products, but there are some exceptions (notably the Internet security and verification software developed by Thawte Consulting and software servicing the banking industry developed by Mosaic).

2.3.2 Telecommunications[8]

99% of the estimated R48 billion in revenues accruing to this sector in 2000 came from fixed line (R25 million), mobile connections (R18 million) and data services (R4.5 million). The balance comprised mobile satellite, paging, radio trunking and niche market services. Telkom remains the government-controlled monopoly provider of fixed line voice communication services. It also holds a 50% share in Vodacom, the larger of the two mobile operators. By the end of 2000 South Africa had approximately 5,5 million connected telephone lines and 9,4 million mobile subscribers shared between Vodacom (about 55%) and MTN (45%). (7.5 million, or 80% of the mobile subscribers were "active.")

Voice – fixed line

Telkom's programme of modernisation and rollout of fixed lines in order to meet its obligations according to the Telecommunications Act of 1996 continued apace and by April 2000 almost all the fixed lines were switched via digital exchanges. This means there are more than thirteen telephones per hundred population, far in excess of the average for the African continent. Telkom claims to have reached 15 of its 16 licence targets during the period 1999/2000, including rollout of new lines, numbers of lines in underserved areas, for priority customers, for villages, numbers of payphones and replacement lines.

[8] For an extensive study of the Telecommunications Industry in South Africa see Hodge, James (1999). The State of the Telecommunications Industry in South Africa and the Potential Costs/Benefits of Further Liberalisation. TIPS Annual Forum, Sept 19-22, Johannesburg. *http://www.tips.org.za/papers/showpaper.asp?ID=284*

Of particular relevance now are two private fixed line network operators in South Africa, namely Transtel and Eskom. While neither is entitled to compete with Telkom, between them, they have some 30 000km of microwave radio links as well as aerial open-wire routes, underground trunk cables, some optical fibre and satellite links. Once future policy directions for the fixed line operators are finalised, it can be expected that, given their existing infrastructures, one way or another Transtel and/or Eskom will bid to become the second national fixed line operator.

Voice – mobile

At the same time the cellular industry has been booming. The cellular subscriber base passed the fixed line base in 2000. One major reason for this is the innovative application of a "pay-as-you-go" business model developed in South Africa and now spreading throughout Africa. 88% of the mobile subscribers were pre-paid and 12% on subscription, underlining the importance of this business model. Both Vodacom and MTN are aggressively expanding their networks and so far some 70% of the country's population are covered by the two GSM networks. People in previously underserviced areas are making over 35 million calls (65 million minutes) per month from Vodacom's 2 135 community phone shops. The 9.4 million subscriber base is expected to reach 18 million by 2005.

In Feb 2001, a third cellular licence was awarded to the Cell C Consortium, and that network should be live by the end of 2001.

Data

Business and domestic data transmission in South Africa takes place over the countrywide network put in place by Telkom. The physical network comprises some 156 million kilometres of copper transmission circuits, 343 000 km of optical fibre (1998 figures and growing rapidly), as well as satellite and optical fibre international links. The Virtual Private Network sector in South Africa is growing rapidly and there are some 140 licensed VPN's in the country. Major providers of business connectivity over VPNs include Omnilink, FirstNet, AT&T, BCS Net, Internet Solutions and UUNet. The growth in the use of intranets, extranets and e-commerce ensure that this will be a very rapidly growing sector of the market. Other Telkom activities include the planning and installation of DECT wireless local loop facilities especially to service rural areas, A major project underway is supplementing the existing SAT-2 undersea fibre optic link to Europe with a SAT-3 link on the same route and the SAFE fibre link connecting South Africa to South East Asia. Those links will have a capacity of 20-40 Gbps and in due course provide an alternative link connecting Europe to the Far East.

Supplementing the already thriving non-Internet Electronic Commerce market, the Internet is proving to be a major catalyst for further growth in this segment. Despite the much-criticised lack of government policy and fact that the law is lagging behind practice in electronic commerce, individuals and businesses continue to adopt Internet-based business to consumer and business-to-business e-commerce practices with enthusiasm. Businesses will continue to discover new ways to integrate the information flow along the supply chain and adopt novel concepts such as e-marketplaces to the extent that the estimated 2000 B2B activity of R3.9 billion in South Africa is forecast to grow to R310 billion by 2005. At the same time consumers will continue to increase their online e-commerce activities, especially in areas such as online

banking, ordering and purchasing of consumer products, airline bookings, ticket purchases, information on products and services, etc.

2.3.3 IT Services

IT services comprise mainly consulting, custom application development, implementation and ICT education. The total size of this market was estimated as R7.2 billion in 1998. Annual growth rates at the time were of the order of 20%, which was double international growth rates. BMI's estimate for 2000 is R11.4 billion.

2.3.4 Internet Services

At one point South Africa was ranked 14th in the world with regard to registered Internet domains, well ahead of its position as regards other economic and communications indicators. The country can thus be regarded as an "early adopter" of the Internet. Recently it has "slipped" somewhat in the domain rankings and was in 26th position in January 2001, due in part to some slow down in the growth of Internet domains, but more significantly due to other countries moving ahead aggressively[9]. Current estimates suggest that there are about two million Internet users in South Africa, spread across the domestic, business and educational domains. The large Internet Service Providers are continuously increasing their local and international bandwidth, and estimates are that South Africa now has approximately 350 megabytes of international capacity[10].

The use of the Internet in schools is moving ahead particularly rapidly as a result of encouragement from the national and provincial education departments and the rapid growth of NGOs such as SchoolNet SA. The recent telecommunications policy guidelines propose a 50% subsidy for educational bandwidth costs (the so-called e-rate), which should provide a further boost to adoption of Internet services in that sector.

Household use of the Internet is also expected to grow rapidly with perhaps 10% of South African households accessing the Internet by 2003. The ability of just about all users in the country to access the Internet at local call rates via 0860 numbers and the recent launch of free Internet services by ABSA bank has clearly accelerated this trend, although, given international experience, it remains to be seen whether the free access business model is sustainable.

[9] www.nw.org

[10] See www.ispmap.co.za

3. Diffusion of ICTs into industries

> *" ….. firm level studies have shown that in order to get significant productivity effects out of the introduction of ICT technologies, the firm must engage in significant re-engineering in its internal operations and its relations with outside firms, and that it must commit significant resources to training employees to exploit the new technologies and systems. Without these organizational and training commitments, investment in ICT technologies is a waste of resources."*
>
> *Unpublished document, Department of Trade and Industry, South Africa*

Possibly even more important than the development of the ICT industry itself is stimulating the adoption of ICT in other major sectors of the economy. During the Foresight study referred to in Section 6 of this paper, the ICT Working Group studied the emphasis placed on ICT by members of the other eleven sectors in the study. It is noteworthy that ICT was understandably emphasised in some, such as Financial Services, but arguably much too little in others such as Manufacturing and Mining[11].

There is, however, minimal reliable information publicly available on the adoption of ICT in key sectors of the economy. This is a major deficiency for any thorough study of the role of ICT and prompts one of the key research opportunities discussed in Section 7 of the paper. In the paragraphs following in this section comments are made on ICT in Manufacturing and Financial Services. In those sectors as in all others information is very sparse. Follow up work should study the adoption of ICT in supply chain management in the retail sector, integration of databases and communications facilities across the public sector, the role of ICT in the Tourism industry, as well as the key adoption of ICT in the small business sector of the economy.

3.1 ICT Adoption in Manufacturing

The role of ICT in this sector is especially important in South Africa for several reasons, including:

- It is the major sector in the economy;
- Up to five years ago, reliable research put the overall ICT spend by South African manufacturing firms at about 1%, compared with developed world levels of 4%; and
- As noted later in this paper, the Department of Trade and Industry (DTI) has tabled a substantial proposal for a broadened industrial strategy, emphasising knowledge-based products and services.

Although the 21st Century is often spoken about as the knowledge century, it would probably be true to say that the 20th Century was really the century of manufacturing. The groundbreaking discoveries of researchers and scientists were turned into viable commercial products through

[11] Foresight report, *www.dacst.gov.za*

equally dazzling improvements in the manufacturing process, from production line automation to Just-in-Time (JIT) manufacturing. In the ICT Industry itself, the ability to pack more and more memory or circuitry onto a chip was itself a marvel of innovation. The ICT industry enabled manufacturers to change many of the old paradigms about how and where they compete.

Because of the easy and rapid access to more and better information, the distribution and supply chain management process has been revolutionised. Common products that have shown little change for decades have suddenly acquired interesting new electronic capabilities that affect the way in which they are marketed and supported. More sophisticated consumers require that even traditional products also provide a selection of services e.g. a motor vehicle with an installed cell phone, a global positioning system (GPS) and an anti-theft satellite tracking system.

Numerous authors have emphasised the importance of utilising the knowledge available to a company, from both internal and external sources. A newly defined discipline, Knowledge Management, is developing the theoretical underpinning for what will certainly be a very important weapon in the drive to obtain competitive advantage.

The history of ICT adoption in Manufacturing in South Africa goes back a long way, with early installations of mainframe equipment taking place notably in the multinationals of the oil industry, and then in local growth industries such as beverages (South African Breweries, Stellenbosch Farmer's Winery) in the chemical industry (AECI) and in the fabricated metal industry (ISCOR) from the late 1960's and early 1970's.

Applications reached an advanced stage in some cases, with process control computers and software being installed to monitor the refining of petroleum products, and production control being effected through software that became increasingly integrated in the supply chain.

There is no doubt that applications have steadily become more sophisticated, and the Manufacturing Industry itself has become increasingly complex, as evidenced by its subdivision into over 30 ISIC categories, for example.

Global companies such as the motor vehicle manufacturers have continued to improve productivity through techniques such as the increasing use of robots on the assembly lines and supply chain management. A higher percentage of the components in today's car are electronic and the manufacture, maintenance and repair of these components is also largely electronic. Increasing use is being made of the Internet to attract potential buyers, and competition is driving margins ever lower.

The importance of the Manufacturing Sector in the economy of the country is highlighted by the fact that it represents about 20% of total GDP at over R112-billion (market related prices)[12]. The ICT Sector in totality is estimated to be worth about R70-billion, much of it subsumed within the other ISIC categories such as the Wholesale and Retail trade and of course Manufacturing itself.

[12] Statistics SA, Releases, GDP figures.

Nevertheless, information available on both the annual spend on ICT products and services within manufacturing is sparse, and consolidated figures on the presently installed base are only available for the larger firms and are out-of-date and erratic. Attempts have been made to try to survey the major companies in South Africa under the categories of annual budget, server and workstation architecture, LAN architecture, Internet bandwidth, etc and a number of manufacturing companies appear in these surveys. The results are neither comprehensive nor particularly useful.[13]

A thorough understanding of the Manufacturing Sector would require answers to questions such as:

- What percentage of the components in a particular product are electronic?
- Are these components made by companies in the ICT Sector and assembled by the manufacturer or made by specialist firms?
- What criteria should be used to determine if a company is moving from a supplier of product to one of services?

3.2 ICT in Financial Services

According to Stats SA,[14] the Finance, Real Estate and Business Services Sector contributed R107-billion to GDP in 2000, second only to the Manufacturing Sector.

Banks have long been extensive users of ICT, and a high proportion of the revenue accruing to Telkom is due to the transaction load generated by the banks[15]. Automatic Teller Machines are a familiar sight in South African towns, and the increasing use of internet banking is likely to increase the transaction load further, shifting it from traditional branches.

The Financial Services Sector has also been deeply influenced by the changes precipitated by the ICT Sector. Since this sector is in many ways a 'pure' information industry, access to better and faster information has led to the extension of services to previously under-served communities (e.g. microlending), the proliferation of a vast array of financial services products (see the growth of Unit Trusts, for example), increasingly sophisticated loyalty programs using 'virtual money' (e.g. eBucks) and increasing competition from companies outside of the industry.

Banks have been proactive in driving changes to their cost structures; they had the benefit of long-standing sophisticated use of ICT, and South African Banks in particular have a proud record of conceiving and implementing world-leading applications (e.g. SASWITCH) well ahead of Europe or the United States.

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[13] See for example, the 1999 IT Users Handbook, Computing SA

[14] Statistics SA, *www.statsssa.gov.za*, GDP Quarterly releases

[15] The four largest consumers of telecommunications services in South Africa are all banks: First national, standard, ABSA, Nedcor (BMI-TechKnowledge Communications Handbook 2001, p. 499).

Because changes in the way their services are marketed and supported often affect the consumer directly, changes to certain aspects of the banking industry are more transparent. Nevertheless, as in Manufacturing, information concerning the usage of ICT in this Sector has not kept pace with the industry.

Perhaps even more fundamentally, is the present classification system useful in an age where vertical integration is increasingly common and the boundaries between products and services blur?

The ICT and Manufacturing Sectors are not mutually exclusive; to understand how they are presently interacting requires a 'mapping' of the one onto the other. This will be a time-consuming and costly process; however until it is done, we cannot say that there is a thorough understanding of the changes taking place in this Sector.

4. Supply and Demand in the ICT labour market

Much attention has been given over the past two years to the perceived shortage of available skills in the ICT industry – this concern was raised as a high priority during many of the workshop discussions leading up to the development of the SAITIS Baseline Studies, the SAITIS ICT Sector Development Framework[16], and the formation of the Sector Education and Training Authority for the ICT sector (ISETT SETA). The ICT skills shortage needs to be seen, however, in the context of the entire education system, from the primary and secondary school education to the potential pipeline of students who will be emerging from the tertiary education system with appropriate subjects in the areas of science, mathematics and technology-related disciplines[17].

Quoting from a recent study by UNISA's Bureau for Market Research,

> "….. *the educational profile of South Africa's population is of such a nature that the South African workforce is not educationally equipped to keep the modern sector of the economy growing without tension. For example, of all people older than 20 in 1999, there were only 884 000 people with a degree or higher educational qualification in South Africa, while only a further 1 033 000 had a grade 12 qualification with a diploma or certificate. The implication of this is that only about 8 % of the population older than 20 or about 4,2 % of the total South African population (as projected by Van Aardt & Van Tonder 1999) had a matric plus some form of post-matric education or training. In terms of percentages this means that in 1999 only about 8 % of the South African population of 20 years and older could be classified as falling into the high-level human resources (HLHR) category*."[18]

[16] See *http://www.saitis.co.za/docs/publications.html* for a full electronic version of the framework.

[17] For a detailed discussion on the definitional problems related to what encompasses a "skills shortage", see the report produced by the Bureau of Market Research, University of South Africa. August 2001. Working Document: Key Skills Shortages and the Fast Tracking of Skills Development. Based on the South Africa 2001 survey by the SA Institute of Race Relations (SAIRR), p. 24.

[18] Ibid p.1

An additional factor that has to be considered is the impact of the HIV/AIDS pandemic, with figures indicating that the South African population, now standing at about 43,7 million, could decline by as much as 10,5 million people by 2015. South Africa is among the countries worst affected in the world.

The SAIRR South African Survey 2001[19] reported that the number of people with HIV increased from 3,6-million to 4,2-million between 1998 and 1999. Many of those dying of AIDS will fall across all levels of the potentially economically active part of the population - this is likely to have an impact on the future availability of ICT skills. The Hospital Association of South Africa predicts a life expectancy, without AIDS, of 68.2 years in South Africa by 2010, but 20 years lower (48 years) with AIDS.

4.1 The Supply Side - Schooling and access to ICTs

Minister Kader Asmal has put a high priority on redressing the shortage of learners who take mathematics and science at school level and already there are initiatives underway to address this problem – through the allocation of bursary funds for prospective maths and science teachers, the creation of an ICT framework to support rollout of connectivity to schools, and strengthening teacher education programmes in these areas. It is therefore appropriate to present a brief overview of data on the potential pool of learners emerging from the education system.

The available statistics on schools and educators are poor. Beyond the HSRC's Register Of School Needs, the statistics generated at provincial level and national statistics are incomplete, and/or out of date. The Minister of Education, Kader Asmal, has instigated studies to assess the state of schools and teachers (including qualifications), but to date these are not readily available. Based on the HSRC / Department of Education 1996 Register of School Needs survey, there are 27 066 schools of which 2 241 have computers, with a total of 34 843 between them. Thus only about 8% of schools had access to computers in 1996.

A breakdown per province indicates the predominance of facilities in the Western Cape and Gauteng, and surprisingly the Northern Cape.[20]

[19] South African Institute of Race Relations (SAIRR) 2001. South Africa Survey 2001. Johannesburg, South Africa.
[20] The total number of schools varies slightly between the figures quoted above and those analysed by SchoolNet – this discrepancy can probably be attributed to the requirement for two or more PCs and the presence of a telephone.

Province	Schools	% total	Learners	% total	Educators	% total
Eastern Cape	197	3%	102,063	5%	4,906	8%
Free State	146	5%	74,655	9%	3,254	13%
Gauteng	566	25%	366,721	25%	17,038	32%
Kwazulu-Natal	331	6%	227,553	8%	10,008	13%
Mpumalanga	108	6%	58,853	6%	2,531	10%
Northwest Province	101	4%	54,752	6%	2,306	7%
Northern Cape	97	18%	37,105	19%	1,666	23%
Northern Province	23	1%	13,477	1%	695	1%
Western Cape	498	28%	295,999	33%	13,419	38%
TOTAL	**2,067**	**8%**	**1,231,178**	**10%**	**55,823**	**15%**

Table 1: Number of schools, and learners and educators at those schools, equipped with electricity, exchange-line telephones, and two or more computers[21].

While the Table shows that over 2 000 schools had the *potential* for Internet access, at the time probably fewer than a thousand had actually effected Internet connections. Since then, due to the activities of a number of organisations such as SchoolNet SA, the Western Cape Schools Network, Computers for Kids, and GautengOnline, these numbers appear to have grown substantially. Preliminary data from the as yet unpublished 2000 Schools Register of Needs suggest that over 8 000 schools now have computers (30% of all schools) and 2 800 have Internet access.

Of particular concern is that students with university-level exemption stood at 68 626 for 2000 (as against an expected 157 000). Of these, only 19 327 passed Mathematics on the higher grade. This has major implications for any fast-tracking skills development process where one would wish to see a larger pool of potential students with a maths background.

4.2 The Supply Side - Tertiary education / ICT professionals

Graduates

Enrolments in South Africa's universities and technikons have been below target and are now below 1996 levels (600 000, as compared to 580 000 at the end of 2000). In addition, the dropout rate for graduates is increasing with a staggering 120 000 dropping out each year. The recently developed National Higher Education plan thus places emphasis on increasing graduate rates and also increasing the number of HDIs (blacks, women and the disabled) emerging from the tertiary education system. As the data below will show, without extensive intervention it is unlikely that the ICT industry, and other sectors, will be able to meet its employment equity targets.

An analysis based on the 1999 HSRC Register of Graduates, which covers university and technikon graduates, illustrates the disparate picture regarding race and gender. It also illustrates the low numbers of ICT graduates that are emerging from the tertiary system. This

[21] S.Marquard, SchoolNet SA, *www.school.za*, based on the 1996 Register of School Needs.

data does not take into account the numbers of graduates trained in certificated private institutions. To our knowledge, there is as yet no data available in this area.

***Some figures for 1999 Graduates in South Africa*[22]**

Total graduates: 580 000

Total ICT graduates: 10 858

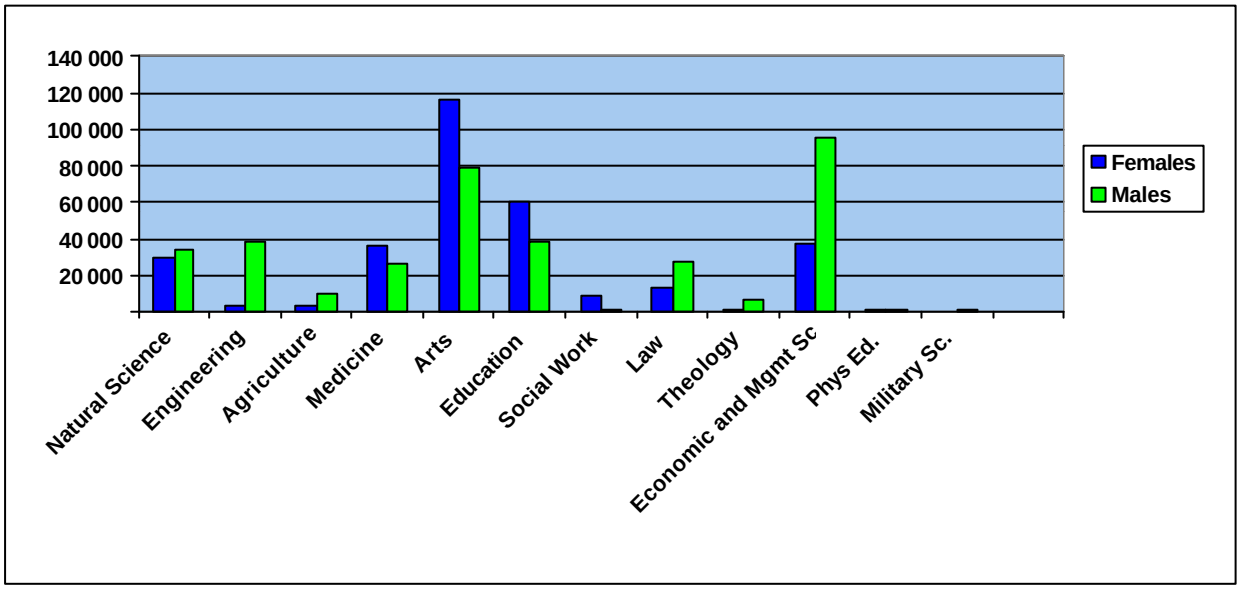
ICT graduates

Females	3 779 (35%) - of these, 86% are white
Males	7 079 (65%)

Electrical / Electronics Engineering

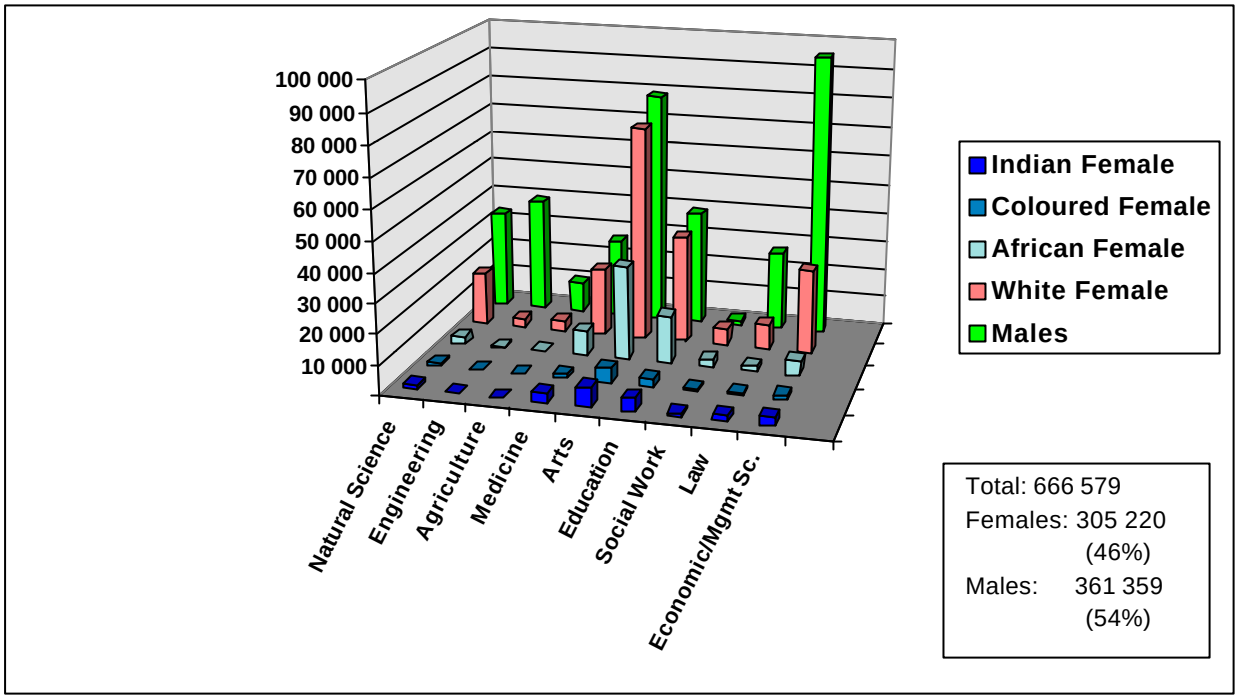
Females	313 (4%) - of these, 87% are white
Males	8 186 (96%)

Figure 1. Graduates by Gender per Discipline



[22] Human Sciences Research Council (HSRC). 1999 Register of Graduates.

Figure 2. Graduates by Gender and Race per Discipline (HSRC Register of Graduates, 1999)



Figures 1 and 2 illustrate the low numbers of women and black[23] graduates that are emerging in technology-related subjects, which are also the ones from which the pool of ICT graduates is likely to emerge.

A recent report by the South African Department of Trade and Industry[24] indicates that the support of postgraduate study in the areas of engineering, the management of enterprises and the management and diffusion of information technologies [IT] will be necessary but not sufficient to increase the numbers of graduates required for South Africa to participate in the new economy. Alternative mechanisms involving closer collaboration between learners in the workplace and those emerging from the schooling system will have to be developed.

ICT professionals

Unlike other professions where professional bodies exist, there is no mechanism for calculating accurately how many ICT professionals are available in the country. An additional problem relates to the definitional aspects in that not all organisations use the same categories for defining ICT staff, thus making comparison more difficult[25].

[23] Black in this case refers to African, Coloured and Indian.

[24] South African Department of Trade and Industry (July 2001). Study On The Development Of High Level Skills In Engineering, Information Technology And Management (unpublished).

[25] This is by no means a unique South African experience. A publication, "Building a Workforce for the information Economy", prepared under the auspices of the National Research Council in the United States, produces estimates of the size of the IT workforce which range between about 1,65 million to 3,35 million, depending on the study, methodology and definition of what constitutes an IT worker (*http://books.nap.edu/html/IT_workforce/).*

Estimates of the size of the workforce vary considerably, from a low 54 000 in the Employment Report by the International Labour Organisation, to higher figures of between 103 000 and 125000. Estimates from Forge-Ahead BMI-TechKnowledge's survey of black IT companies and professionals, indicate that there were about 5 000 black IT professionals in South Africa in 2000.

Country	ICT Employment Total (000)	Average Annual % growth total
Austria	132	5.4
Belgium	143	1.3
China	1604	4.3
Denmark	122	4.4
Finland	118	7.0
France	905	2.5
Germany	1255	2.0
Ireland	97	18.0
Italy	632	0.9
Luxembourg	6	12.2
Netherlands	302	2.3
Portugal	68	-3.8
South Africa	54	n/a
Sweden	214	5.2
United Kingdom	1338	4.0
EU15	5712	3.9

Source: International Labour Office (ILO), "World Employment Report 2001: Life at Work in the Information Economy

Table 2: Employment in the ICT sector: Selected countries 1999

Several studies have been conducted to date, but none of these can be regarded as comprehensive. Some significant studies include:

- 1998 HSRC Telecommunications Studies – unpublished
- 1998 HSRC Study, "The SA Labour Market: Future Trends and Workforce Needs" – probably the most comprehensive study to date with some figures on ICT professionals
- 2000 SAITIS Baseline Studies – a survey of IT companies and overview of available data on ICT jobs and skills
- 2001 UNISA Bureau of Market Research, "Key Skills Shortages and the Fast Tracking of Skills Development"
- BMI-TechKnowledge

4.3 The Demand side – Determining Skills Shortages in ICTs

Estimates are that about 235 000 more professionals and managers will be required in South Africa.[26] Several studies have been conducted to estimate the longer-term skills shortages for various categories of ICTs. To date, all of these studies have involved relatively small sample sizes and the results have varied widely. Until recently, most of the labour studies on ICTs were

under-resourced. The proposed SAITIS project to investigate Labour Market Statistics is the first significant effort to gain better insights into this part of the labour market.

The HSRC's[27] 1998 Labour study concluded the following:

Occupation	Positions in 1998	1998-2003		Vacancies arising from	
		Growth in Demand	Needing Filling	New Demand	Need for Replacement
Electrical/Electronic Engineers	4 462	15-40%	1 000 - 1 999	55%	45%
Electrical and related engineering technologists/technicians	20 546	10-15%	5 000 - 8 000	52%	48%
Computer programmer	10 059	40%+	5 000 - 8 000	88%	12%
Computer systems analyst & related	11 504	40%+	5 000 - 8 000	87%	13%
Other computer science (e.g. database administrator, software systems engineer, computer consultant)	7 108	40%+	2 000 - 4 999	87%	13%

Table 3: Current and Forecast Employment for Specified IT-related Professions in the Overall Labour Market, 1998 – 2003.

The more recent BMR study has found that there will be no convergence of supply and demand during the period ending in 2009, that there is an oversupply of engineers and specialist managers. Further analysis of the qualitative data emerging from interviews did however reveal that the analysis obscured the over- and undersupply of various types of engineers and managers i.e. there was an undersupply of electrical and electronic engineers and an oversupply metallurgical and mining engineers. Likewise there is still a high demand for financial managers but an oversupply of labour relations management skills.

The 1998 HSRC Telecommunications Study revealed similar trends:

Broad Occupation	Number of Employees		Composition		Growth
	1998	2003	1998	2003	1998-2003
Professional	22 280	25 665	23,0%	24,9%	15%
Managerial	4 742	5 470	4,9%	5,3%	15%
Clerical/sales/ service	16 120	17 804	16,7%	17,2%	10%
Artisan	8 463	8 733	8,8%	8,5%	3%
Semi-/unskilled	45 082	45 532	46,6%	44,1%	1%
Total	**96 687**	**103 204**	**100%**	**100%**	**7%**

Source: 1998 HSRC Telecommunications Study

Table 4: The Telecommunications Sector – Forecasts for Employment by Broad Occupation (1998 and 2003)

[26] SAIRR Newsletter (No 4/April 2001) Higher Education: Huge Challenge To Produce Top Skills. *www.sairr.org.za*

[27] Human Sciences Research Council (1998). The SA Labour Market: Future Trends and Workforce Needs

What has yet to be seen is what effect the global slowdown in the ICT sector is going to have on skills, the brain drain and possibly brain gain from industrialised and industrialising countries such as India.

5. (Re)Defining the ICT Industry

The ICT Industry is becoming harder to define every day. Micro-miniaturisation and the ongoing applicability of Moore's Law has meant that processing power is included in many standard household appliances - in wrist watches, motor cars, alarm systems, refrigerators - in fact, almost everything. Industries that previously were regarded as discrete such as broadcasting, now show so much overlap with other areasof information and communications technology that separation is increasingly problematical. In trying to understand the industry, the question that then arises, concerns the way to classify the resulting products so that real economic activity and growth rates can be measured.

The usefulness of a classification system depends largely on the objectives of the users. The following are some of the categories of users that can be expected to be interested in measures of the ICT Sector:

- Government and private sector economists or financial analysts looking for trends in measures such as GDP, manufacturing output, retail sales. etc. who require a consistent measure of industry activity in order to make time-based or country-based comparisons;

- Policy makers who wish to measure progress against baseline indicators to track the impact of particular policy decisions within a country or region;

- Local and international investors interested in overall sector growth but also in trends in specific parts of the industry e.g. sales of mobile phone or Internet connections;

- Competitive Intelligence Analysts within the private sector;

- Senior company management

- Researchers and academics

Presently, most of these groups use different sources to obtain their information. Only the first group uses the 'official' industry numbers to any extent.

The reasons for this are not hard to discern and are expanded on in the sections that follow:

5.1 The Official Classification Systems in Use

For the purposes of economic reporting, nearly all countries use either the ISIC (International Standard Industry Classification), SIC (Standard Industry Classification developed in the USA)

or NAICS (North American Industry Classification System). Statistics South Africa uses SIC codes which map onto ISIC Codes used by the OECD.

To frame the discussion that follows, a short history of the development of the two major systems in use (ISIC and NAICS) is included:

When the United Nations Statistical Commission met for the first time shortly after the Second World War, its objectives were to develop key statistics worldwide and make them as comparable as possible,[28]

Before the Second World War, the emphasis in collecting statistics was geared towards understanding and combating unemployment and supporting the development of a macroeconomic theory that was applicable to all countries. After the war, emphasis shifted towards reconstruction – either to replace devastated industries or to shift their emphasis away from wartime production.[29]

ISIC was launched during this period, and is still the general-purpose classification system used by most countries. It is an establishment-based classification system, using the primary activity of the establishment as the basis for classification (whether the establishments were in a demand-based industry or production-based industry). However, as Ryten so pithily says,

> *"Catastrophes, man or God-made, have one positive effect on statistical paradigms. They allow them to be changed without apology to users. Conversely, times that are not marked by convulsion tend to see a sustained but much slower shift in the nature of the problems and concerns mostly ignored by obstinacy in holding on to statistical paradigms for the sake of continuity".*[30]

Ryten then goes on to list a number of points that need to be considered when moving towards a future ISIC; these essentially relate to the significant change in the economic landscape brought about by convergence of industries and globalisation. He makes the point that

> *" …. as a result of its perceived irrelevance, ISIC Rev.3 has been neglected by prospective users to a greater extent than any of its predecessors, largely because of the gap between the limited novelty of the classification and the problems it purported to address."* [31]

In the United States, the Standard Industry Classification System, used since the 1930's, and similar to ISIC in concept, came under increasing criticism during the 1990's as being outmoded

[28] Fifty Years of ISIC: Historical origins and future perspectives: Jacob Ryten, United Nations Department of Economic and Social Affairs Statistics Division. Fourth Meeting of the Expert Group on International Economic and Social Classifications, November 1998.
[29] Ibid, p 2
[30] Ibid, p 3
[31] Ibid, p 3

and unhelpful.[32] The Economic Classification Policy Committee (ECPC) was established in 1992 after the need to establish a new classification system was clear. It followed the signing of the North American Free Trade Agreement (NAFTA) and led to the development of NAICS in conjunction with Mexico and Canada.

NAICS is based on a production-oriented economic model, i.e. industries are grouped together based on the production processes used to produce a good or service. It is felt that this will serve to provide comparable statistics to measure key indicators (productivity, unit labour costs) that can be used between participating countries.

According to Ambler,[33]

> *" NAICS provides a better way to classify individual businesses. It focuses on new and emerging industries, industries engaged in producing advanced technologies, and service producing industries".*

NAICS provides for an Information Sector that includes industries in the communications, publishing and broadcasting arenas and has recognised nine new service sectors, including Professional, Technical and Scientific Services; Health and Social Assistance; and Arts, Entertainment and Recreation. It is a six-digit system and provides for country comparability at the five-digit level, with the sixth digit being used by individual countries to cater for particular differences.[34]

Even so, there are differences between the country implementations of NAICS that have effectively led to three versions, one for each of Canada, Mexico and the USA.

Attempts have been made to provide compatibility with ISIC Codes at the 5-digit (NAICS) and 2-digit (ISIC) level. There remain difficulties in comparison and approach. As Ambler states,

> *"One of the most obvious differences between NAICS and ISIC is the amount of detail. In most cases NAICS is more detailed and recognizes many more high-tech and service industries."* [35]

5.2 Definitions adopted by the South African Information Technology Industry Strategy (SAITIS)

SAITIS was conceived in 1994 and began implementation in 1999 with assistance from the Canadian International Development Agency (CIDA). During the early stages a 'Baseline Study'

[32] See the Web Site of the US Census Bureau, *www.census.gov*
[33] NAICS and ISIC – Now and the Future : Carole A. Ambler, Bureau of Census, USA in United Nations Department of Economic And Social Affairs, Statistics Division: Fourth Meeting of the Expert Group on International Economic and Social Classification
[34] Ibid, p 2
[35] Ibid, p 3

was established to establish the status of and important trends in the ICT Industry in South Africa. [36]

The definition of the ICT Sector used by the SAITIS project is the OECD one:

> *"The industries that produce the products (goods and services) that support the electronic display, processing, storage and transmission of information."*

The definition excludes the 'content' industries such as broadcasting.

The ISIC (Rev 3) industries, which are included in the ICT Sector and approved by delegates attending the Second Ad Hoc Meeting of Indicators for the Information Society under the aegis of the ICCP Statistical Panel, are as follows:

Manufacturing	
3000	Manufacture of office, accounting and computing machinery
3130	Manufacture of insulated wire and cable
3210	Manufacture of electronic valves and tubes and other electronic components
3220	Manufacture of television and radio transmitters and apparatus for line telephony and line telegraphy
3230	Manufacture of television and radio receivers, sound or video recording or reproducing apparatus, and associated goods
3312	Manufacture of instruments and appliances for measuring, checking, testing, navigating and other purposes, except industrial process control equipment
3313	Manufacture of Industrial Process control equipment
Services - goods related	
5150	Wholesale of machinery, equipment and supplies
7123	Renting of Office machinery and equipment (including computers)
Services - Intangible	
6420	Telecommunications
7200	Computer and related activities

The above codes can be equated to SIC codes currently used by Statistics South Africa.

There are many grey areas where the inclusion or exclusion of certain ISIC codes has been debated. For example, the Reproduction of Recorded Media industry (ISIC 2230), which was felt to belong to the 'content' industries). This chapter will not enlarge on this debate.

However, the Baseline Study highlighted the need for a generally available and consistent source of key industry indicators, and particularly indicators that could more accurately reflect the nature of the move towards a service-based ICT industry.

5.3 Difficulties in Determining Key Indicators for the ICT Industry

The ISIC and NAICS classification systems have not kept pace with the fast-moving nature of the ICT Industry as is illustrated by the examples below:

[36] See www.saitis.co.za

- The terminology itself is outdated e.g. manufacture of electronic valves and tubes);

- It is often difficult to determine where particular products should be classified e.g., manufacture of optical fibre);

- The fastest growing segment of the ICT Sector (Telecommunications) is classified under 'Services - Intangible', which seems incongruous given the size and nature of this market.

- Modern equipment often poses a classification problem. For example, how would one classify a Personal Digital Assistant (PDA) with a cellular phone capability and a built-in Global Positioning System? This equipment could be classified as a computer, a radio transmitter/receiver, a sound (and maybe video) recorder, and a navigation instrument.

- The convergence of technologies is posing particular problems, and the separation of the 'content' (media) and ICT Industries seems destined to provide increasing complications where common delivery mechanisms e.g. cable are used, and where users are charged on the bandwidth used, irrespective of what is being sent. For example, where would a Web Portal such as M-Web be classified? M-Web creates content and moves and displays it.

In broad terms, the OECD defines the 'information economy' as consisting of both the industries that produce content and those that move and display the content. (ICT Industries), yet the industry classification system that is used does not allow this level of definition to be put into practice.

- The definition of a 'content' industry is also a fundamental problem. Is a software programme 'content'? Here, it should be noted that NAICS includes software publishing under the Publishing category of the Information Sector. If the Reproduction of Recorded Media Industry belongs to the content sector, where does Napster fall?

- The use of microprocessors within other industries such as automotive has lead to the integration of products by manufacturers outside of the ICT Sector, and many ICT components are supplied to the ICT sector by other industries e.g. the Plastics industry.

The conclusion that can be drawn is that the SIC codes were established for an Industrial paradigm and are manufacturing oriented, with little definition possible in the Services sector. The high level of vertical integration apparent in the most ICT Sectors, including South Africa, is therefore not easy to capture within the SIC framework.

On one level, these questions may not be important because private companies in the ICT Sector make little use of official industry statistics. They obtain most of the information they need from market research organisations such as BMI TechKnowledge (and the associated

IDC) and the Gartner Group, with international trends being derived from a variety of industry-watchers and bodies such as the International Telecommunications Union (ITU). However, using a classification system that does not reflect the realities on the ground will lead to erroneous conclusions about the direction that industry or industry segments are taking.

5.4 Defining suitable indicators for all Stakeholders

Is there a solution to this or would we be better off catering for different requirements through different indicators? To answer this one needs to understand what these requirements are. It seems that there are essentially two groups of interested parties:

- Those wanting to extract long-term trend data concerning the overall ICT Industry (however defined); and

- Those wanting to focus on the growth or decline of particular segments or products (e.g. Internet cafes, laptop computers).

An additional complication is introduced by the fact that developing countries have their own particular set of difficulties in capturing much of this data anyway. Marshall T. Moseki [37] has outlined some of the difficulties experienced by Botswana in implementing ISIC Revision 3, ranging from classification difficulties to the inability to get accurate information from industry. This problem is likely to be even more acute where the informal sector constitutes a large portion of the economy, as it does in many African countries.

Appreciation of the second requirement has led to initiatives to begin the development of a product classification system to complement the general industry classification system. NAICS is planning to develop a demand-oriented product system to cover all products by 2007, for example. The project will be implemented in phases, with Phase 1 covering selected service sectors, of which the information sector is one.[38] Similarly, NAICS is providing e-Commerce statistics on their website.[39]

For the first group, the volatility of products and classification is probably less important than consistency in the definition of what constitutes the ICT Industry. In many ways it represents a 'clean slate' approach because trend figures do not exist, or if they do exist, nobody is paying any attention to them.

The lack of suitable measures for the ICT Industry has led to a number of private organisations seizing the opportunity that this represents to produce a variety of reports and handbooks that serve a market need; while this should be encouraged, there are drawbacks in relying too heavily on these sources, which include:

[37] Issues and Problems encountered in the implementation of ISIC Rev 3: Marshall T Moseki: Paper to be presented to the Expert Group on International Economic and Social Indicators
[38] Carole A. Ambler, ibid
[39] www.census.gov/epcd/www/naics.html

- The resulting reports are expensive and not as accessible as Statistics South Africa;
- There are inconsistencies in figures produced by different organisations;
- The underlying methodology used is not transparent;
- Since reports are market-driven, industry segments that are not 'flavour-of-the-day' are dropped; and

It is clear that South Africa needs to develop a better system for providing key indicators on the ICT Industry to all interested parties.

This must take the realities of the cost and complexity of managing such a system within a developing country context, and should best be handled as a project by the responsible ministry.

6. Future Directions

Clearly the ICT sector in South Africa is vibrant and growing rapidly; there is also strong and growing government commitment to continue exploiting ICT for economic and social goals. This was demonstrated by the presidential announcements early in 2001 to launch both an international and a national commission on ICT.

Despite the lack of significant progress in the availability of updated ICT-related data in the public domain since early 2000, there are at least five major national initiatives that are providing tangible directions for the future growth of the industry.

6.1 The National Research and Technology Foresight Programme

The Department of Arts Culture Science and Technology spearheaded the Foresight programme, funded in part by the British Council. It set out to create "macro-scenarios" for South Africa and to apply those scenarios to twelve specific economic sectors, including ICT. The ICT Working Group in particular used the scenarios, completed specific analyses of strengths and weaknesses related to ICT and carried out a Delphi survey of professional opinion in the country. All the empirical inputs were synthesised and led to a series of recommendations to shape the most appropriate medium to long-term research and technology directions. Investment in clusters of technologies such as "FutureWeb" were strongly emphasised, building on the country's professional expertise to make the country a global player in whatever ways the current Internet arena may unfold, as well as developments in areas such as "e-tagging" of people, animals, plants and inanimate objects. The country could build on its strengths by focusing on the needs of developing countries[40].

[40] See *www.gov.za/dacst*

The outcomes of Foresight are already helping to shape funding priorities in other national programmes such as the National Research Foundation's special focus area on ICT, the DACST Innovation Fund's project awards under their Information Society caption, and also their Lead Programmes Fund.

DACST has also recently awarded a tender to undertake a scan of the ICT sector, so that a roadmap can be developed for priority technologies. The objectives of the roadmapping for the ICT sector are to establish:

- Economic fundamentals that impact on the ICT sector;
- The current and future political impact on the ICT sector;
- The current and future social trends and how they might impact on the sector;
- Local and export market opportunities within the various sub-sectors within the ICT sector considering international trends impacting on the sector; and
- International trends in research, development and innovation and potential product markets that might emerge from these and in turn be commercialised.

The study will consider the areas of IT hardware and software, telecommunications equipment and services, and IT professional services.

6.2 The SAITIS ICT Sector Development Framework

Arguably the most extensive and important national initiative to grow the ICT sector is the SA Information Technology Industry Strategy (SAITIS) project mentioned previously. Spearheaded by the DTI and funded largely by the Canadian International Development Agency, this project is now drawing to the end of its three-year life. Along the way it consisted of many analytical components and engaged large numbers of stakeholders in ICT both here and abroad. Major outputs to date include the Baseline Studies already mentioned in this paper, the SAITIS website, which comprises a rich set of information related to ICT in South Africa, and the ICT Sector Development Framework launched in November 2000. The framework is a synthesis of the analytical work that preceded it on the project and identifies four areas for specific goal and objective setting and follow on implementation projects: the ICT Sector itself, ICT Usage in other economic sectors, ICT Innovation and ICT Human Resources. The framework lays out detailed goals, objectives and strategies in each area and offers some twenty-three possible follow on projects.

Subsequent to the launch of the framework, further detailed discussions refined the list of recommended projects and led to a smaller set of projects for which Terms of Reference were—or are still being —prepared and funds awarded. These include:

- ***Impact Analysis of Current ICT Initiatives***: First phase complete and results available on the SAITIS website. Over a hundred substantial ICT initiatives—groups, programmes and projects—are listed, categorised and correlated with the SAITIS framework. *This source should be the first stop for anyone contemplating a new project related to the ICT sector in South Africa.*

- ***Development of an ICT Sector Portal***: Design is underway of a portal comprising Internet-based information, services and applications to assist ICT companies and grow the ICT sector. This project is being carried out with the collaboration of Information Industry South Africa, the new umbrella body for the ICT sector.

- ***Collection of ICT Labour Market Statistics***: A contract has been awarded to improve the collection of information on the ICT labour market. This project has attracted significant supplementary funding from the Department of Labour.

- ***Development of a National Youth Internship Program***: A contract was awarded to devise ways to help non-ICT graduates from tertiary institutions that have some ICT skills to find jobs in the ICT or ICT-enabled sectors.

- ***Identify Suitable Business Models for Internet Entrepreneurs:*** Terms of reference are being finalised for a survey of activity and best practice in the ICT-related SMME domain (e.g. phone shops, multi-purpose telecentres and other businesses based on Internet access).

- ***Analysis of Western Cape, Gauteng and Kwazulu-Natal ICT Cluster Developments:*** Terms of Reference being finalised to conduct on-the-ground study of what is working and what not in these cluster initiatives.

6.3 The Department of Trade and Industry's Industrial Policy and Other Initiatives

On May 21 2001 the Department of Trade and Industry issued a discussion document to inform a new Industrial Strategy for South Africa. It is entitled "Driving Competitiveness: An Integrated Industrial Strategy for Sustainable Employment and Growth.[41]" This paper will not attempt to précis the very detailed exposition of the proposed strategy since it is the subject of other presentations at this conference. Suffice to say the strategy sets out a persuasive argument to extend the traditional boundaries of manufacturing strategy to embrace upstream design and development aspects as well as downstream functions such as marketing. A fundamental theme is that manufacturing firms are facing a myriad of changes occasioned among other things by changes in information technology, the use of the Internet by suppliers, manufacturers and customers, rapid advances in innovation and the changing customer demand. It notes a shift in world trade away from commodity production and raw material intensive simple manufactured goods to increasingly knowledge intensive goods and services.

[41] www.dti.gov.za

Accordingly,

> *"Our industrial strategy cannot . . . focus solely on production. It will seek to integrate both backward and forward linkages with production. Of particular importance here will be the development and enhancement of our existent capacities in knowledge-driven activities. This will rest upon the development of leading edge logistics - an essential foundation for this integration."*
>
> *"Government support to all manufacturing firms and sectors will increasingly take the form of policies that are designed to enable firms to effectively produce and assimilate knowledge. Government will seek policies which, for example, facilitate the more effective use of knowledge on the part of internationally, competitive raw material-intensive manufacturers. Such policies will aim at further enhancing their competitive position in existing activities, but also encourage them to engage in those activities downstream and closer to the market, which tend to be more knowledge-intensive, and that could generate higher returns, employment and value added. For those industries that are not currently competitive, policies will similarly progressively seek to enhance their competitive position by facilitating the more effective production and use of knowledge."*

These extracts reflect a strategy that will rely increasingly on the application of modern ICTs and particularly those aspects of ICT related to knowledge management to enhance global competitiveness and increase employment in the country. There are many implications as regards the ICT industry, telecommunications infrastructure and skills upgrading which have been discussed elsewhere in this paper.

The Department of Trade and Industry is also in the process of developing a number of initiatives that will directly address some of the problem areas that have been identified in this paper. Many flow directly out of the SAITIS project already mentioned above, while others will supplement and follow on after the completion of SAITIS at the end of this year. One of the most significant, as reflected by the paucity of available research material, is the diffusion of ICTs into priority industrial sectors. The purpose of this project is to provide a better information base for those in vertical markets for ICT, and also to provide local ICT vendors and service providers with better information on what the future ICT requirements are likely to be. Three sector areas have been selected:

- Traditional sectors which would include sectors such as mining, agriculture and manufacturing;

- Service sectors which would include government services as well as others such as education and tourism; and

- New Economy Sectors which would cover sectors such as telecommunications, e-commerce, biotechnology and software manufacture/systems development.

Sub-sectors would have to be considered in cases where the sector is not very homogenous. This is a very positive step in developing more insights into diffusion processes in the South African industrial sectors.

6.4 The Department of Communications Electronic Commerce Initiative

The Department of Communications has been and continues to be engaged in leading edge telecommunications initiatives under the rubric Info.Com 2025. Of special interest to the ICT and business community is the Department's promotion of electronic commerce and in particular spearheading moves towards an electronic commerce policy for South Africa. A long—and some would say excessively protracted—process is still underway to gather public opinion on many aspects of e-commerce, including privacy and security issues, domain name system management, electronic payment systems, regulatory issues, etc. etc. A discussion document was followed by a working group process that engaged many role-players in the public and private sector, the commissioning of a set of papers prepared by South African academics, the release of a Green Paper on Electronic Commerce, and a colloquium on "e-Law." Presently this process is still underway with draft legislation to cover particular aspects of e-commerce being prepared[42].

6.5 The Information Systems, Electronics and Telecommunications Technologies Sector Education Training Authority (ISETT SETA)

One of the fundamental flaws of the South African education and training system has been its separation of education from training. To bring about a better match between the needs of the workplace and educational institutions, Sector Education and Training Authorities (SETAs) have been established. These structures provide linkages between learning in the workplace learning and the National Qualifications Framework, and are responsible for developing human resources within their respective sectors. The ISETT SETA is one of the 25 SETAs established by the Skills Development Act of 1998, each of which addresses a particular economic sector. The ISETT SETA addresses three sub-sectors:

- *The IT Sector,* which has been dominated by the private sector, comprising predominantly multinationals*;*
- *The Electronics Industry Sector;* and
- *The Telecommunications Sector*, which has been heavily government controlled.

Given the rapid changes that characterise today's economic markets, the convergence of technologies and skills used within the IT, Telecommunications and Electronic sub-sectors, it was necessary to create a structure that reflects these realities.

The establishment of the ISETT SETA has met many problems:

[42] *www.ecomm-debate.co.za*

1) It was not originally one of the planned SETAs and required strong motivation from the industry that it should have its own SETA;

2) Because of the paucity of available data on the size and nature of the ICT industry, it has experienced considerable problems in trying to determine where its user base lies and how much revenue would be generated through the skills development levies on companies;

3) Few have given thought to longer-term career planning and the future ICT skills needs within the priorities of the country; once again data is scarce and there is no comprehensive database of labour market statistics indicating where likely skills gaps will be found in the medium term.

4) The spread of ICT skills is uneven across the country. Gauteng, the Western Cape and Durban share 95% of these skills. If the concept of an Information Society is to become a reality, it is imperative that massive investments be made in rural and remote areas. Skills within the sector also reveal gender and race dimensions. There are proportionately fewer women and blacks in strategic positions within the sector.

5) Multinational companies dominate the sector, particularly the IT sub-sector. Black ownership of and participation in the sector is relatively small, as is participation by women. The growth of the sector will depend among others, on its ability to stimulate and accelerate black participation and ownership within the sector.

It is currently collaborating with the SAITIS project and the Department of Labour to support research on key skills shortages and the fast tracking of skills development.

7. Research Challenges in the ICT sector

It is self-evident that the ICT arena is evolving at an extraordinary pace and is likely to continue to do so for the foreseeable future. It is impossible to predict accurately what technologies will win and how human beings will appropriate them to their needs. What does this mean for ICT research in South Africa?

The starting point for this discussion must be that there are many large and small, but essentially fragmented attempts to research ICT in South Africa. Much good research is taking place in South African universities—in many different faculties that probably do not talk to each other very frequently: Computer Science, Economics, Business Systems, Law, Social Science, Electronic Engineering, amongst others. More research is underway in technikons. And then there is research in the private sector, consultants and others conducting research funded by firms and international funding agencies. So the ICT research arena is essentially interdisciplinary and crosscutting, and must cope with a rapidity of change unheard of in many other research disciplines. This suggests the first challenge:

- We should be making serious efforts to communicate ICT-related research programmes, projects and results more widely and effectively, both within institutions and between them, as well as between disciplines. The linkage between researchers and the industry needs to be strengthened to allow new thinking to penetrate into the existing businesses that will face new challenges in the new economy. While variety, repetition and red herrings are inevitable and desirable in some ways, there is much to be gained from a degree of coordination. Particularly this is so when public moneys are being spent to gain the most from a diminishing research community. The importance of creating portals should be given greater emphasis, be they through the Trade and Industrial Policy Secretariat (TIPS), or through the SAITIS project.

- It is crucial that we establish and make public simple and effective measures of the ICT industry. The old saw "if you can't measure it, you can't manage it" applies. The arguments presented in this paper on the problem of definition and classification will continue to haunt us while we battle with a new economy. Systematisation of data on the ICT sector (including the skills aspect) is a priority.

- We need to pay much more and deeper attention to the phenomenon of "convergence." What is our best estimate of how computers, communications and content are going to overlap and merge?

- What are the implications of such convergence for government policy and regulation?

- What are the impacts of ICTs in various industries on productivity, labour patterns, domestic and global competitiveness, innovation, value-addition, etc.?

- How can we strengthen the knowledge base on the diffusion of ICTs into other sectors?

- What are the impacts of particular policy directions in telecommunications, broadcasting and IT? Can we strengthen the role of the regulator through more intensive research into such areas?

- Do we really understand the "digital divide?" Does it exist? How can we most effectively deal with it in South Africa? What are the underlying successful business models that will allow greater SMME activity in ICTs to take place?

We can pose many questions such as these. Who should be responding to them? Government through departments such as Arts, Culture, Science and Technology (DACST); Trade and Industry (DTI); and Communications (DoC); and the government agencies responsible for disbursing research funds are clearly at interest and should be playing a leading role in shaping the country's research agendas. The DASCT Foresight Project, Innovation Fund and ongoing activities of the National Research Foundation are important examples. So too are the DTI's THRIP, SPII and other programmes, and DoC's engagement of the academic community in the Electronic Commerce initiative. Clearly the universities and technikons must engage. So should the private sector. There is minimal evidence of private sector ICT research in this country

(perhaps Telkom's Centres of Excellence are a notable exception), and yet ICT is largely an applied research area in this country and will benefit greatly from a more effective dialogue between the private sector and academia.

References

BMI-TechKnowledge (2001*). Communication Technologies Handbook 2001*. *www.bmi-t.co.za*

Computing SA (1999). *The 1999 IT Users Handbook.*

Day, R.S. (Compiler) (May 1998). The State of the Information and Communications Technologies Sector in South Africa. *www.dacst.gov.za/foresight*

Engineering News Online (2 September 2001). *Workshop kickstarts R8m skills initiative*. *www.engineeringnews.co.za/itwork/?show=846*

Hodge, J. & Miller J. (July 1997) *Information Technology in South Africa: The State of the Art and Implications for National IT Policy*, in press, UN University. *www.uct.ac.za/depts/dpru*

Hodge, James (1999). *The State of the Telecommunications Industry in South Africa and the Potential Costs/Benefits of Further Liberalisation.* TIPS Annual Forum, Sept 19-22, Johannesburg. *http://www.tips.org.za/papers/showpaper.asp?ID=284*

Human Sciences Research Council (September 1998*). Investigation into the Demand for and Supply of high Level Human Resources for the Telecommunications Industry: Final Report.*

Human Sciences Research Council (1998). *The SA Labour Market: Future Trends and Workforce Needs.*

Human Sciences Research Council (1999). *1999 Register of Graduates*.

International Labour Office (ILO), *World Employment Report 2001: Life at Work in the Information Economy.*

ITWEB *2001 IT Salary Survey* (March 2001).

James, Tina (Editor) (2001, in press*). An Information Policy Handbook for Southern Africa: A Knowledge Base for Decision-makers.*

Ryten, J. (November 1998). *Fifty Years of ISIC: Historical origins and future perspectives*. United Nations Department of Economic and Social Affairs Statistics Division. Fourth Meeting of the Expert Group on International Economic and Social Classifications.

SAITIS (January 2000) South *African IT Industry Strategy Baseline Studies: A Survey of the IT Industry and Related Jobs and Skills in South Africa. www.saitis.co.za*

SAITIS (November 2000). *ICT Sector Development Framework*. *http://www.saitis.co.za/docs/publications.html*

SchoolNet SA. *www.school.za*

South African Department of Arts, Culture, Science and Technology (1999). *The National Research and Technology Foresight Project: Information and Communication Technology*. *www.gov.za/dacst*

South African Department of Communications. *www.docweb.pwv.gov.za*

South African Department of Communications. Press release on the proposed changes to the Telecommunications Act. *http://docweb.pwv.gov.za/docs/pr/2001/prpoldir.html*

South African Department of Labour – Statistics *www.labour.gov.za*

South African Department of Trade and Industry (July 2001*). Study On The Development Of High Level Skills In Engineering, Information Technology And Management*. (unpublished).

South African Institute of Race Relations (SAIRR) 2001. *South Africa Survey 2001*. Johannesburg, South Africa.

Statistics SA. *www.statssa.gov.za*

United States National Research Council (October 2000). *Building a Workforce for the Information Economy. Appendix B: Estimating the Size of the IT workforce*. Pre-publication. *http://books.nap.edu/html/IT_workforce/*

University of South Africa (UNISA) Bureau of Market Research (August 2001). *Working Document: Key Skills Shortages and the Fast Tracking of Skills Development*. Unpublished.