South African Science and Technology Indicators 2010

PRODUCED BY THE NATIONAL ADVISORY COUNCIL ON INNOVATION INDICATORS REFERENCE GROUP

TABLE OF CONTENTS

FOREWORD

The NACI Indicators Reference Group (IRG) encompasses subject experts actively working in the field of monitoring and evaluation pertaining to the performance of the National System of Innovation (NSI). The work of the IRG is supported by members of the NACI Secretariat, who prepared this report for the NACI Council, and to whom the members want to express their sincere appreciation.

Sound measurement of innovation is crucial in policy formulation and implementation, assisting policy makers on several points: evaluating the efficiency of policies, in addition to monitoring spending in this regard, assessing the contribution of innovation to achieving social and economic objectives. Reporting on the measurement of innovation serves to legitimise public intervention by enhancing public accountability.

The South African Science and Technology Indicators 2010, an update of the 2009 report, provides an overall picture of South Africa's national system of innovation by presenting statistical data relating to trends and performance. This report should be seen as a collection of the core innovation indicators and includes extensive data obtained from a wide spectrum of data analysts and performance evaluators.

NACI's mandate is not to collect indicator sets but rather to interpret data. However, while interpreting the various data sets, NACI has received positive feedback from the research and economic community on making the data available on an annual basis. In publishing these results we therefore commend the contributions from various providers of data and data sets and would like to propose that the research and policy making community uses the data at will.

The general opinion for 2010 is that the National System of Innovation is well supported by Government initiatives on the Input side but still lacking adequate performance on the Output side, despite many government initiatives and incentives. This leaves the question to NACI on what recommendations should be made to support the innovation throughput processes. NACI Council Members thus continuously engage on pertinent issues, while deliberating and making recommendations to the minister on a constant basis, thus enhancing the NSI through relevant policy advice.

Gerhard Prinsloo
Chairperson: NACI Indicators Reference Group

2. KEY INDICATORS

Table 1: Key indicators – Trends

	2005	2006	2007	2008	2009	% change 2008 to 2009
Future R&D capacity						
Higher education (HE) enrolments (thousands)	735,070	741,020	761,084	799,387	837,779	5
SET enrolments as percentage of total HE enrolments	28.7	28.6	28.2	28.1	28.3	1
HE graduations (thousands)	120,375	124,620	126,641	133,063	144,852	9
SET graduations as percentage of total HE graduations	27.8	28.5	28.8	29.1	28.3	-3
SET PhDs	561	522	590	575	704	22
Matric passes (thousands)	347,187	351,217	368,217	344,794	334,609	-3
Mathematics passes as percentage of total matric passes	7.6	7.18	6.9	18.1	15.8	-13
Current R&D capacity and SET human capital						
Number of ISI publications	4,805	4,971	5340	6704	7045	5.1
World share in ISI publications (percentage)	0.53	0.55	0.55	0.59	0.61	3.4
R&D expenditure as percentage of GDP	0.92	0.95	0.93	0.92		
R&D expenditure by government (including science councils) and higher education (R billion)	5.7	7.1	7.7	8.5		
R&D expenditure in the business sector (R billion)	8.2	9.2	10.7	12.3		
FTE researchers per thousand of the workforce	1.5	1.5	1.5	1.4		

	2005	2006	2007	2008	2009	% change 2008 to 2009
Imported know-how						
Technical progress						
SA patents registered in USPTO	87	109	82	91	93	2.2
SA patent applications to EPO	55	59	58			
World share of SA patents in USPTO (percentage)	0.06	0.063	0.052	0.058	0.023	-60.3
Quality of life						
Real per capita GDP growth (constant 2000 prices)	3.5	4	3.8	1.9		
Income inequality as measured by Gini coefficient	0.683	0.685	0.66	0.666		
Competitiveness						
IMD rank	37	38	50	53	48	-9.4
WEF GCI rank	42	45	44	45	45	0.0

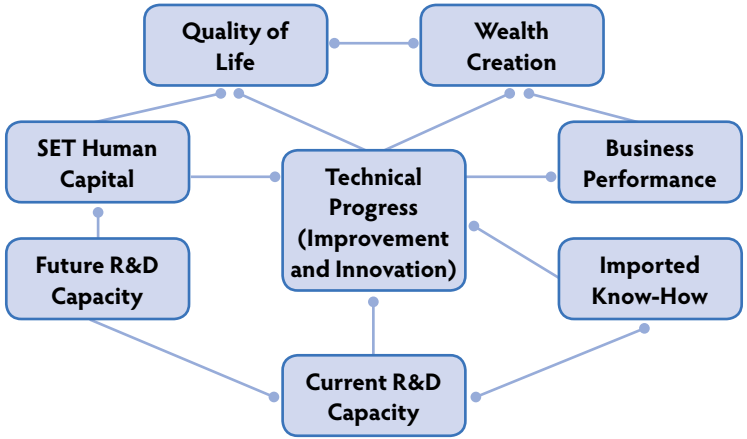
Explanatory note: A new Mathematics curriculum was introduced in 2008 with the effect that Mathematics is offered on one level only (no more Standard Grade (SG) and Higher Grade Data (HG)).

In the remaining sections of the report, more detailed indicator information is provided, together with the sources of the information and in some cases explanatory notes. The report is concluded with an overall assessment of the state of the NSI.

3. POLICY CONTEXT

Since August 2002 South Africa's national system of innovation has been developed, from a governmental perspective from the basis established in the National Research and Development Strategy (NRDS). This was represented visually in the NRDS as shown in the Figure below.

Figure 1: Key components identified by the national R&D strategy



Source: National Research and Development (R&D) Strategy 2002, Department of Science and Technology

This figure indicates that government dominantly takes responsibility for the functions **Future R&D Capacity** through, for example, the public education system that produces **SET human Capital** and feeds Current R&D Capacity. Public and private expenditures, properly articulated, leverage the core process of **Technical Progress** (which is mediated by incremental **improvements** usually from research and experimental development and design and engineering capacity in the economy. In addition the key process of **innovation**, the introduction on new products, services and institutional forms into the society and economy is underpinned by the knowledge resources (people and research development and engineering capacity) in the economy.

Business performance through the private sector, State Owned Enterprises, the health sector provides the engine that also relies on people and R&D capacity as well as new **Imported Know-How**.

These elements working together have as primary outcomes **Quality of Life** and **Wealth Creation**.

The NRDS included a number of indicators that could give insight into the progress and challenges faced by South Africa as the strategy was rolled out. These are linked to the systemic view presented in the strategy and outlined in the following table.

Since the NRDS was initiated the measurement system for the national system of innovation has strengthened considerably and new indicators have been introduced to give insight into how it is performing. The role of NACI is to diagnose and propose actions to further develop the system.

Table 2: Key indicators that show the performance of the S&T system at a macro level and are the basis of long term planning for the NSI and its key functions

	Area	Indicator
Primary	Future R&D capacity	S&T proportion of higher education (HE) enrolments S&T postgraduate degrees Matriculants with mathematics and science
	Current R&D capacity	Publications Global share of publications R&D intensity
	Imported know-how	Technology balance of payments Imported high-technology equipment Imported information and communication technologies
Intermediate	Science, engineering and technology human capital	Researchers per thousand workforce S&T demography
	Technical progress (improvement and innovation)	Patents, high-technology start-ups Business innovation investment Key technology missions
	Business performance	Technology trade mix Proportion of high-technology firms Sectoral performance
High	Quality of life	Technology achievement
	Wealth creation	Technology-based growth

4. FUTURE R&D CAPACITY

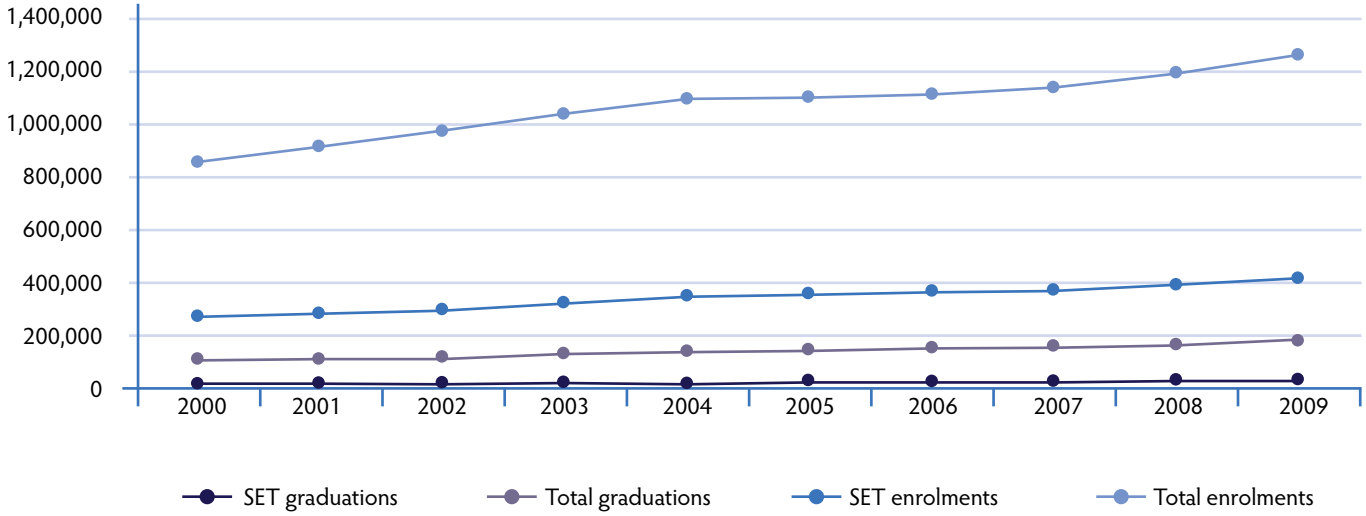
4.1. Set enrolments and graduations

Table 3: Higher education SET enrolments and graduations (2000 – 2009)

Year	SET enrolments	Total enrolments	% SET	SET graduations	Total graduations	% SET
2000	163,009	576,067	28.3	24,235	92,567	26.2
2001	169,245	626,440	27	25,087	95,776	26.2
2002	176,729	667,171	26.5	27,014	101,037	26.7
2003	193,864	705,246	27.5	29,698	108,215	27.4
2004	202,547	744,474	27.2	31,490	117,205	26.9
2005	210,706	735,070	28.7	33,506	120,375	27.8
2006	211,584	741,020	28.6	35,555	124,620	28.5
2007	214,687	761,084	28.2	36,429	126,641	28.8
2008	224,948	799,387	28.1	38,764	133,063	29.1
2009	237,058	837,779	28.3	40,971	144,852	28.3

Source: Department of Education, HEMIS

Figure 2: Higher education SET enrolments and graduations (2000 – 2009)



Explanatory note: Higher education enrolments and graduations data include all public higher education institutions. SET includes the Classification of Educational Subject Matter (CESM) 2008 categories: Agriculture, Agricultural Operations and Related Sciences, Architecture and the Built Environment , Computer and Information Sciences, Engineering, Health Professions and Related Clinical Sciences, Family Ecology and Consumer Sciences, Life Sciences, Physical Sciences, Mathematics and Statistics and Military Sciences.

Table 4: Blacks SET enrolments and graduations (2000 – 2009)[1]

Year	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
% Enrolments	65.7	67.1	67.8	70	70.5	71.2	72.2	73.1	74.6	75.4
% Graduations	53.6	53.9	56.1	58.6	60.8	61.1	62.8	65.0	66.0	67.3

Source: Department of Education, HEMIS

Table 5: Post-graduate SET enrolments and graduations (2000 – 2009)

Year	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
% Post-graduate SET Enrolments	12.6	13.4	14.0	13.7	14.2	14.0	14.1	14.5	14.9	15.0
% Post-Graduate SET Graduations	22.5	23.0	22.9	23.5	23.9	24.0	22.8	21.5	23.0	25.7

Source: Department of Education, HEMIS

Table 6: Female SET enrolments and graduations (2000 – 2009)

Year	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
% Female Enrolments	43.8	44.5	44.7	44.9	44.7	43.5	43.8	44.1	44.5	50.0
% Female Graduations	48.4	48.8	48.2	48	49	48.9	48.7	49.2	49.3	49.2

Source: Department of Education, HEMIS

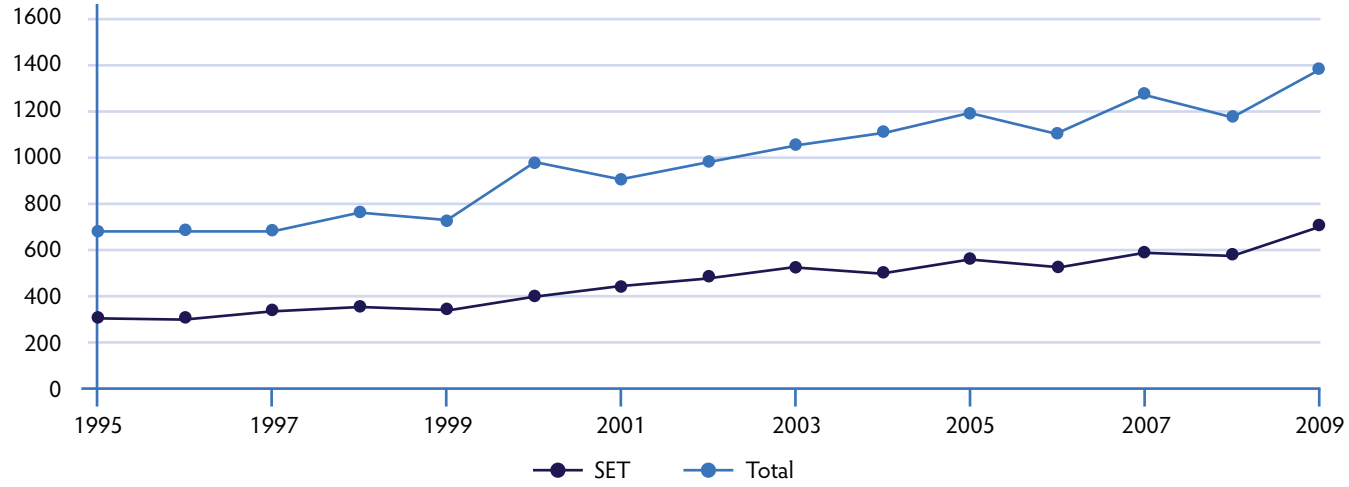
[1] In the compilation of this report all reasonable attempts were made to acquire the most recent available information. The time lag between the date of the information provided in this report and the publication date can be ascribed to various factors including data auditing and approval processes and frequency of collection and publication of data.

Table 7: Doctoral degrees awarded by South African universities (1995 – 2009)

Year	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
SET	304	301	334	353	342	397	437	482	522	499	561	522	590	575	704
TOTAL	679	684	682	761	723	972	900	978	1,052	1,105	1,189	1,100	1,274	1,182	1,380

Source: Department of Education, HEMIS

Figure 3: Doctoral degrees awarded by South African universities (1995 – 2009)



Explanatory note: Data include doctoral degrees awarded by all public higher education institutions.

Table 8: South African research chairs (2006 – 2010)

Year	2006	2007	2008	2009	2010
Research chairs	2	32	69	69	79

Source: National Research Foundation

Figure 4: South African research chairs (2006 – 2010)

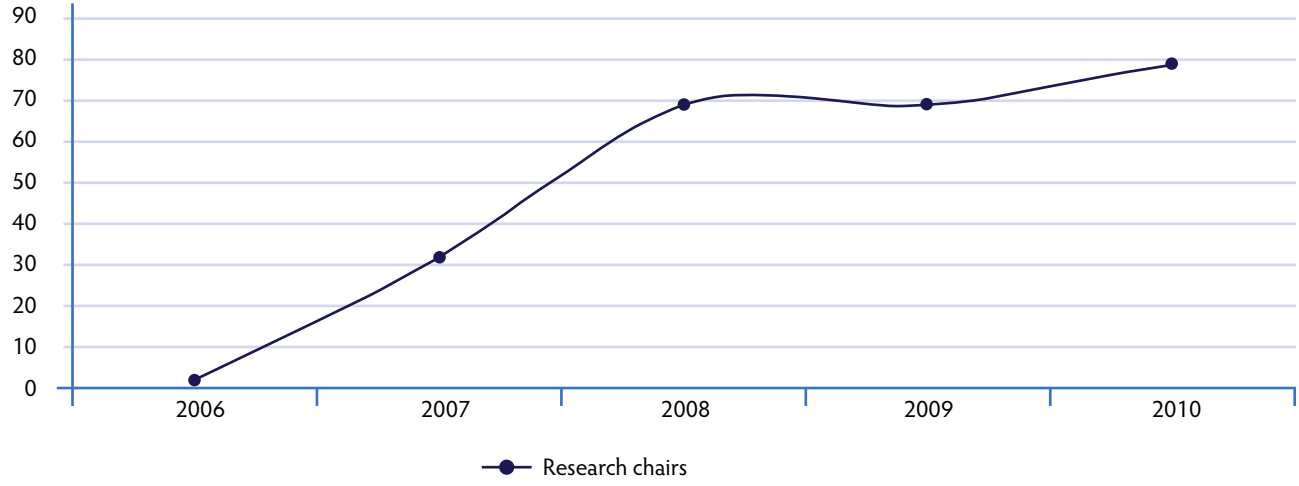


Table 9: Gross enrolment ratios in higher education: Selected countries

Country	Gross Enrolment Ratio *
Finland	0.93
Korea	0.93
USA	0.82
North America and Western Europe	0.70
Israel	0.58
Brazil	0.25
South Africa	0.15
India	0.12

*Most recently available information for each country: Ratio of the number of students enrolling for higher education to the total number of people in a comparative age cohort.

Source: UNESCO Institute for Statistics, World Education Indicators

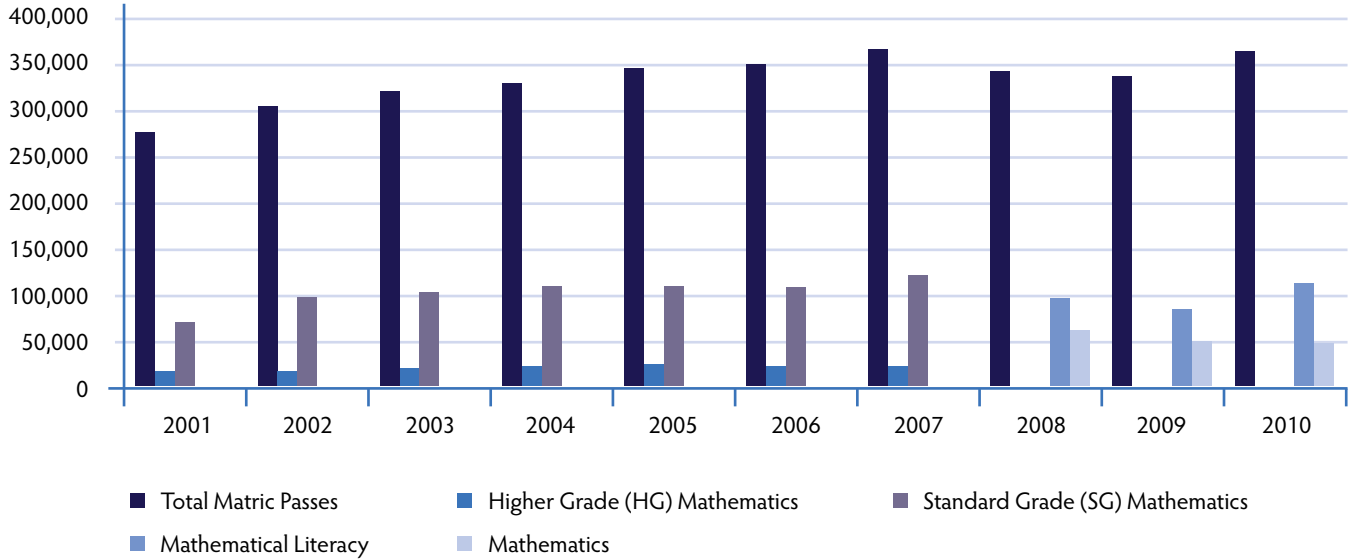
4.2. Matric mathematics

Table 10: Matriculants with mathematics (2001 – 2010)

	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Total Passes	277,206	305,774	322,492	330,717	347,184	351,217	368,217	344,794	338,577	364,513
Higher Grade (HG) Mathematics	19,504	20,258	23,412	24,143	26,383	25,217	25,415	-	-	-
Standard Grade (SG) Mathematics	72,301	101,289	104,707	109,664	112,279	110,452	123,813	-	-	-
Mathematical literacy	-	-	-	-	-	-	-	100186	86156	114044
Mathematics	-	-	-	-	-	-	-	62,388	52,866	50,195

Source: Department of Basic Education

Figure 5: Matriculation with mathematics (2001–2010)



Explanatory note: A new Mathematics curriculum was introduced in 2008 with the effect that Mathematics is offered on one level only (no more Standard Grade (SG) and Higher Grade Data (HG)).

5. CURRENT R&D CAPACITY

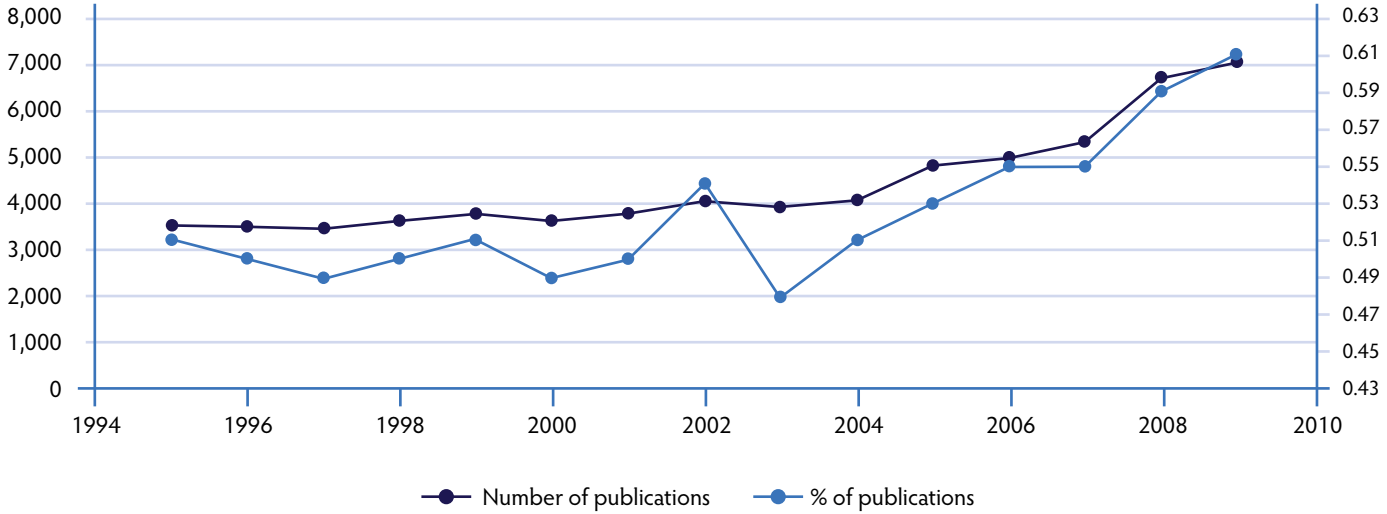
5.1. Publications

Table 11: Number of SA publications and world share (1995-2009)

Year	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
% of publications	0.51	0.5	0.49	0.5	0.51	0.49	0.5	0.54	0.48	0.51	0.53	0.55	0.55	0.59	0.61
Number of publications	3,522	3,491	3,447	3,606	3,776	3,614	3,775	4,049	3,910	4,063	4,805	4,971	5,340	6,704	7,045

Source: "National Science Indicators Database", Institute for Scientific Information, Philadelphia

Figure 6: Number of SA scientific publications in ISI journals and world share (1995 -2009)



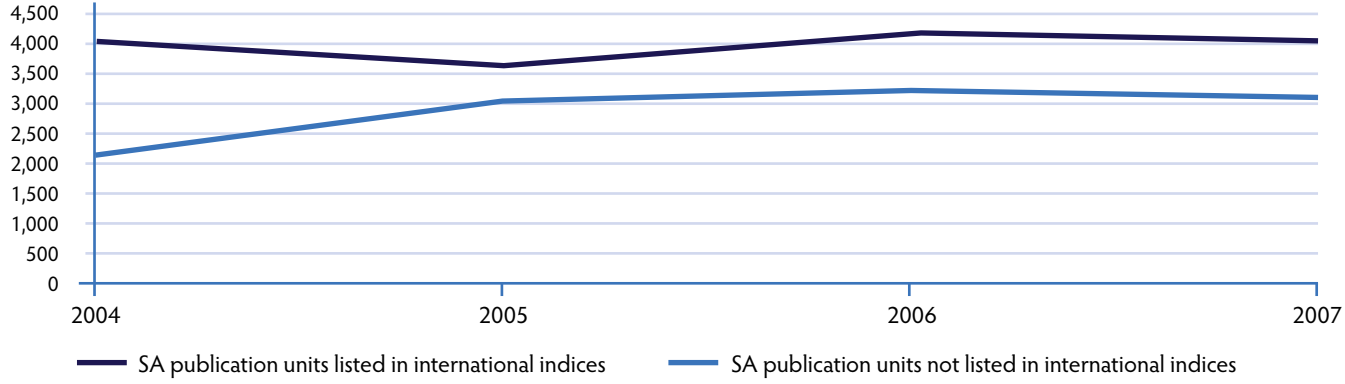
Explanatory note: Scientific publication (or research publication) refers to research literature of different types including articles, notes, summaries, letters to the editor, reports, notices, discussions and books, which contain new knowledge with information on research of significance to the scholarly community.

Table 12: Recognized research output produced by public higher education institutions (2004-2007)

Year	2004	2005	2006	2007
SA publication units listed in international indices[1]	4,052.45	3,653.10	4,183.50	4,052.53
SA publication units not listed in international indices[2]	2,104.44	3,018.60	3,220.10	3,110.72

1. Includes publications in journals listed in Sciences Citation Index of the Institute of Scientific Information (ISI), the Social Sciences Citation Index of the ISI, the Arts and Humanities Citation Index of the ISI and the International Bibliography of Social Sciences (IBSS).
2. Includes publications in South African journals not appearing in the above indices, but whose seat of publication is in South Africa and which meet criteria set by the DoE.

Figure 7: Recognised research output produced by public higher education institutions (2004-2007)



Source: Department of Higher Education and Training

Explanatory note: Recognised research output, in terms of the "Policy and Procedures for the Measurement of Research Output for Public Higher Education Institutions, 2003" comprise journals, books and proceedings measured in terms of publication units. A number of one unit and half a unit is allocated to publications in journals and proceedings respectively, while a maximum of five units is allocated to books.

Table 13: Distribution of article equivalents among female and male scientists (1995-2005)

%	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Female	21	22	21	22	22	22	25	25	25	25	25
Male	79	78	79	78	78	78	75	75	75	75	75

Source: NACI (2008): "Baseline Report on Women in Science, Engineering and Technology", commissioned to CREST

Figure 8: Distribution of article equivalents among female and male scientists (1995-2005)

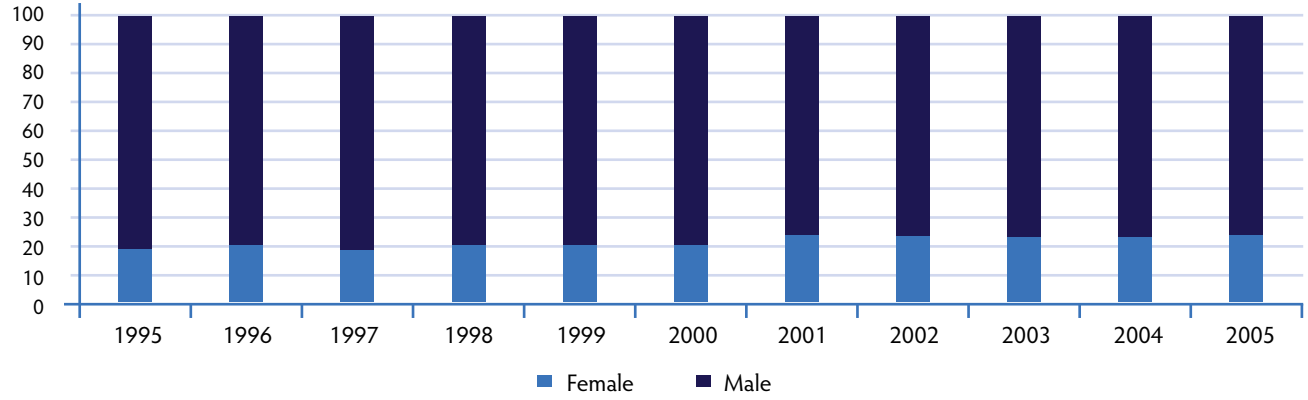


Table 14: Activity indices and relative impact of selected industry related scientific fields (2002-2006)

Field	Activity Index	Relative Impact
Geology/Petrology/Mining	7.70	0.52
Entomology/Pest Control	3.80	1.09
Biotechnology and Applied Microbiology	1.20	0.74
Engineering Mathematics	1.20	0.94
Inorganic and Nuclear Chemistry	1.20	0.91
Chemical Engineering	1.00	1.01
Research/Laboratory Medicine and Medical Technology	0.90	0.88
Spectroscopy/Instrumentation/Analytical Science	0.80	0.76
Metallurgy	0.60	1.21
Instrumentation/Measurement	0.60	0.85
Environmental Engineering/Energy	0.70	0.39
Civil Engineering	0.70	0.72
Mechanical Engineering	0.70	0.58
Engineering Management	0.60	0.78
Physical Chemistry/Chemical Physics	0.60	0.65
Computer Science and Engineering	0.50	0.54
Information Technology and Communication Systems	0.50	0.64
Materials Science and Engineering	0.40	0.63
Artificial Intelligence, Robotics and Automation	0.40	0.82

Field	Activity Index	Relative Impact
Electrical and Electronic Engineering	0.30	0.56
Aerospace Engineering.	0.30	0.12
Radiology, Nuclear Medicine and Imaging	0.30	0.66
Applied Physics/Condensed Matter	0.30	0.55
Nuclear Engineering	0.30	0.65

Source:"National Science Indicators Database", Institute for Scientific Information, Philadelphia

Table 15: Activity vs impact of selected industry related fields (2002-2006)

	Low Activity (bottom 25%)	Moderate Activity (middle 50%)	High Activity (top 25%)
High Impact (top 25%)		Research/Laboratory Medicine and Medical Technology Metallurgy	Entomology/Pest Control Chemical Engineering Engineering Mathematics Inorganic and Nuclear Chemistry

	Low Activity (bottom 25%)	Moderate Activity (middle 50%)	High Activity (top 25%)
Moderate Impact (middle 50%)	Nuclear Engineering Radiology, Nuclear Medicine and Imaging	Instrumentation/Measurement Artificial Intelligence, Robotics and Automation Engineering Management Civil Engineering Physical Chemistry/Chemical Physics Information Technology and Comm. Systems Materials Science and Engineering Mechanical Engineering Spectroscopy/Instrumentation/Analytical Science	Biotechnology and Applied Microbiology
Low Impact (bottom 25%)	Electrical and Electronics Engineering Applied Physics/Condensed Matter Aerospace Engineering	Computer Science and Engineering Environmental Engineering/Energy	Geology/Petrology/Mining

Explanatory note: The activity index characterises the relative research effort a country devotes to a given subject field. An activity index of 1 indicates that the country's research effort in a given field corresponds precisely to world average. An index greater than 1 reflects higher than average effort dedicated in the field under study and an indicator less than one, a lower than world average effort. The relative impact indicates the citations attracted by the country's publications in a particular field in comparison to the citation impact for the field as a whole worldwide. A relative impact of one indicates that the country's citation impact in the particular field corresponds precisely to the world average.

5.2. R&D

Table 16: Expenditure on R&D as a percentage of GDP (1991/92 - 2008/09)

Year	1991/92	1993/94	1997/98	2001/02	2003/04	2004/05	2005/06	2006/07	2007/08	2008/09
%	1.042	0.75	0.69	0.73	0.81	0.87	0.92	0.95	0.93	0.92
R&D expenditure R'000	2,786,087	2,594,107	4,103,000	7,488,074	10,082,559	12,009,981	14,149,239	16,520,600	18,624,000	21,041,000

Source: 1991-1998 FRD,DACST, 2001-2007 CeSTII, DST

Figure 9: R&D expenditure and intensity (1991/92 – 2008/09)

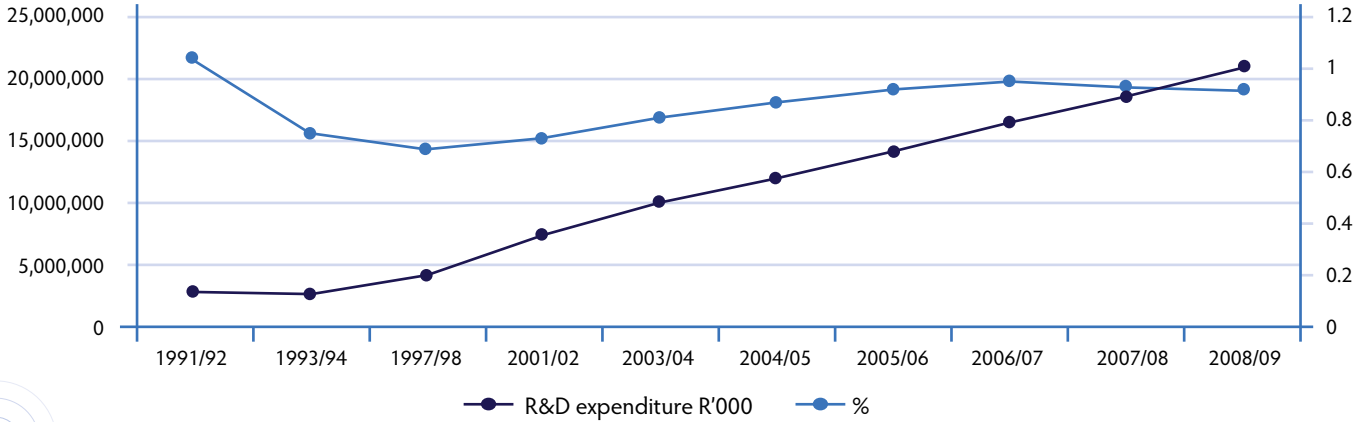


Table 17: Gross expenditure on R&D as percentage of GDP (selected countries, 2008)

	Country							
	Israel	Finland	Korea	USA	Canada	Australia	South Africa	Turkey
GERD/GDP percentage	4.64	3.40	3.22	2.61	1.88	1.78	0.93	0.76

Source: OECD (2008) "Main Science and Technology Indicators"

Table 18: Distribution of R&D expenditure across sectors (1993/94 – 2008/09)

Year	Business enterprise	Government (including Science Councils)	Higher education	Not-for-profit
1993/94	R 1,336,224	R 810,658	R 415,575	R 31,648
1997/98	R 2,216,030	R 1,379,838	R 496,052	R 11,078
2001/02	R 4,023,342	R 1,497,614	R 1,895,980	R 71,137
2003/04	R 5,591,787	R 2,211,105	R 2,070,957	R 208,709
2004/05	R 6,766,423	R 2,511,287	R 2,534,105	R 198,165
2005/06	R 8,243,346	R 2,947,286	R 2,732,218	R 226,388
2006/07	R 9,243,275	R 3,765,044	R 3,299,163	R 213,116
2007/08	R 10,738,456	R 4,040,493	R 3,631,473	R 223,202
2008/09	R 12,332,012	R 4,277,019	R 4,191,366	R 240,649

Source: 1991 – 1998 FRD, CesTII DST R&D Surveys

Figure 10: R&D expenditure trends (1993/94 – 2008/09) (billion rand)

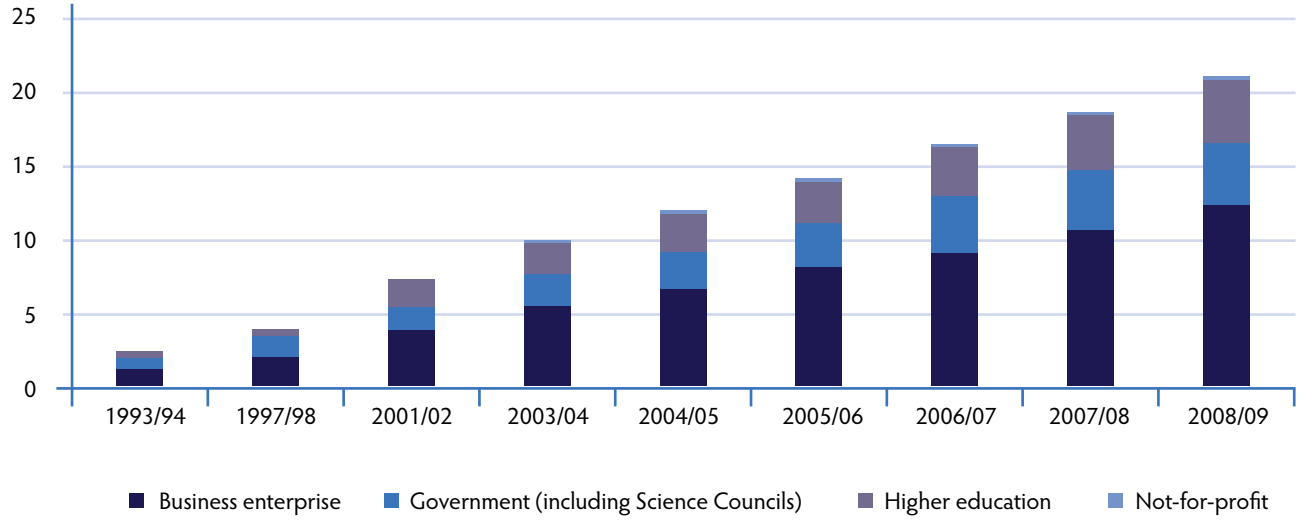


Table 19: R&D expenditure by type of research (2007/08) (R'000)

	Business	Government	Higher Education	Not-for-profit	Science Councils
Basic research	934,246	322,270	1,709,334	65,337	804,731
Applied research	3,081,937	599,162	1,262,425	119,982	1,314,770
Experimental development	6,733,012	232,967	650,102	1,262,425	766,593

Source: DST (2009) National Survey of Research and Experimental Development 2007/08

Figure 11: R&D expenditure by type of research (2007/08) (billion rand)

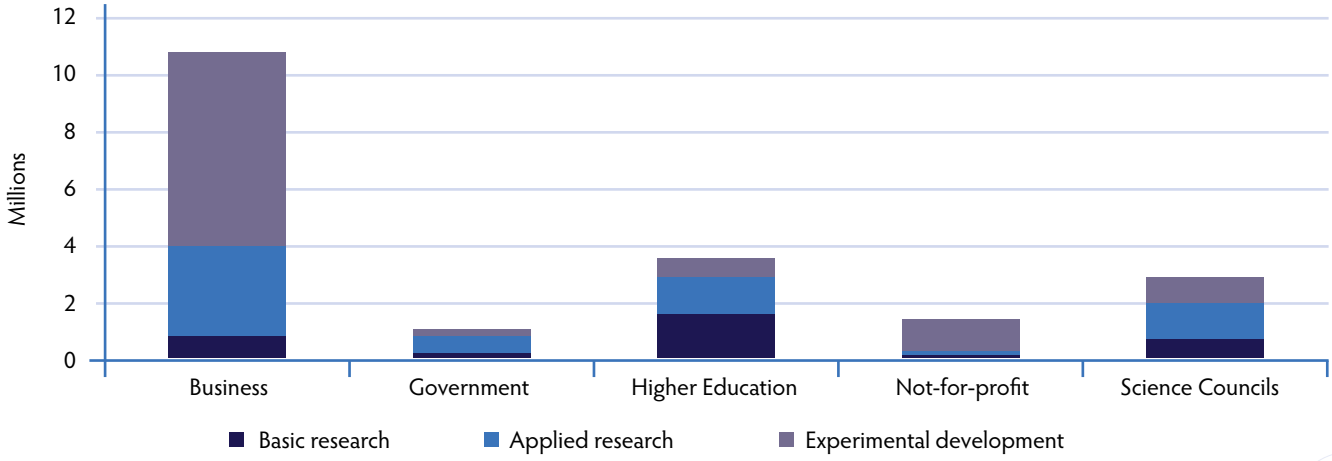


Table 20: R&D expenditure by source of funding (2007/08) (R'000)

Source of funding	Performing Sector						
	Business	Higher Education	Science Councils	Government	Not-for-profit	Total	%
Business	7133913	519804	263098	5343	23791	7945949	42.7
Government	2326728	1026654	1874511	1091049	33399	6352341	34.1
HE		1734903				1734903	9.3
Foreign	1180193	320286	298906	56172	131525	1987082	10.7
SC			422811			422811	2.3
Other SA	97622	20215	26768	1835	28162	174602	0.9
NPO					6325	6325	0.03
Total	**10738456**	**3621862**	**2886094**	**1154399**	**223202**	**18624013**	
%	**57.7**	**19.4**	**15.5**	**6.2**	**1.2**		

Source: DST (2009) National Survey of Research and Experimental Development 2007/08

Figure 12: R&D expenditure by source of funding (2007/08) (billion rand)

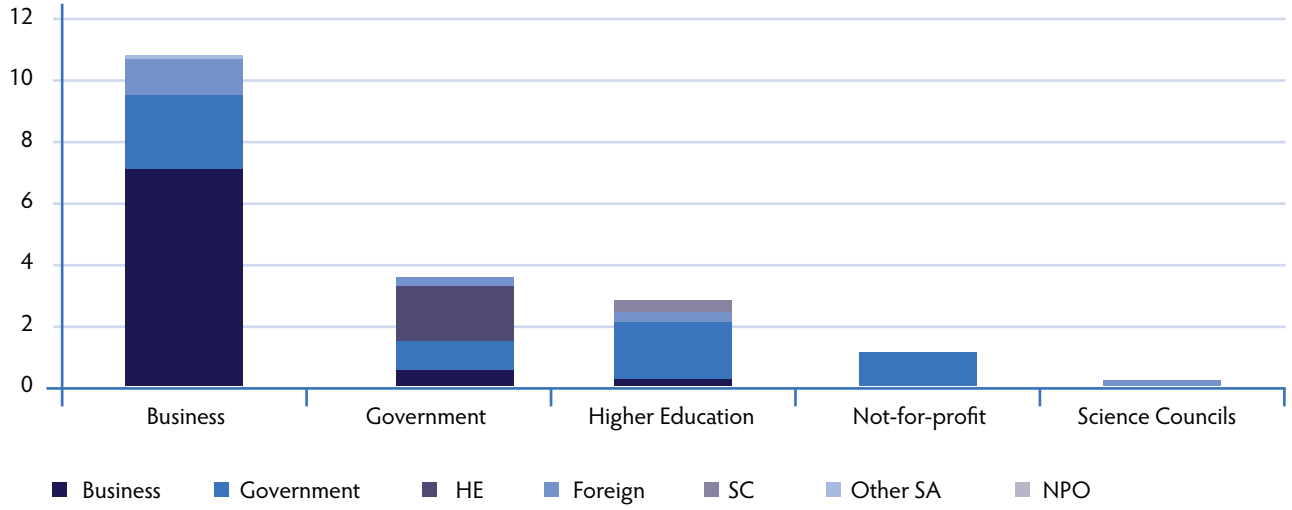


Table 21: R&D expenditure by province (2007/08) (R'000)

Province	Performing Sector						
	Business	Government	Higher Education	Not-for-profit	Science Councils	Total	%
Eastern Cape	283488	122191	276740	6164	138342	826925	4.4
Free State	786225	62116	180713	1255	67901	1098210	5.9
Gauteng	6142233	292757	1260991	115499	1809272	9620752	51.7
KwaZulu-Natal	1302260	76458	459299	42141	201009	2081167	11.2
Limpopo	71687	40217	79716	4602	67562	263784	1.4
Mpumalanga	196368	74690	105629	9930	66333	452950	2.4
North-West	193339	42500	166137	2207	49390	453573	2.4
Northern cape	7450	66921	48277	2038	45250	169936	0.9
Western Cape	1755404	376550	1044360	39367	441036	3656717	19.6
Total	**10738454**	**1154400**	**3621862**	**223203**	**2886095**	**18624014**	**100.0**

Source: DST (2009) National Survey of Research and Experimental Development 2006/07

Figure 13: R&D expenditure by province (2007/08) (billion rand)

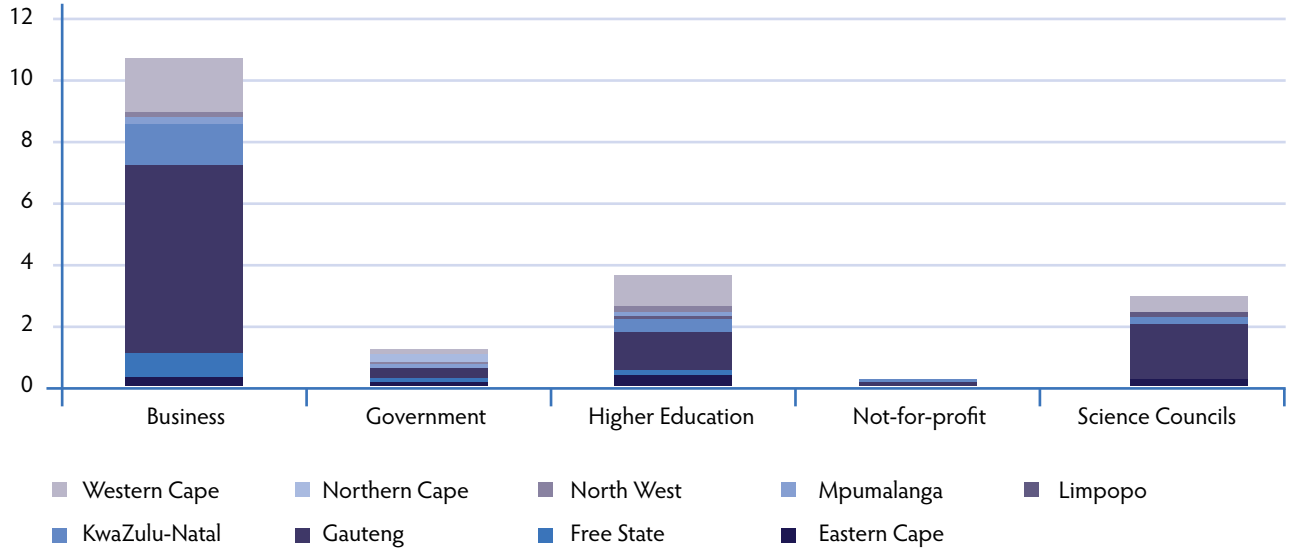
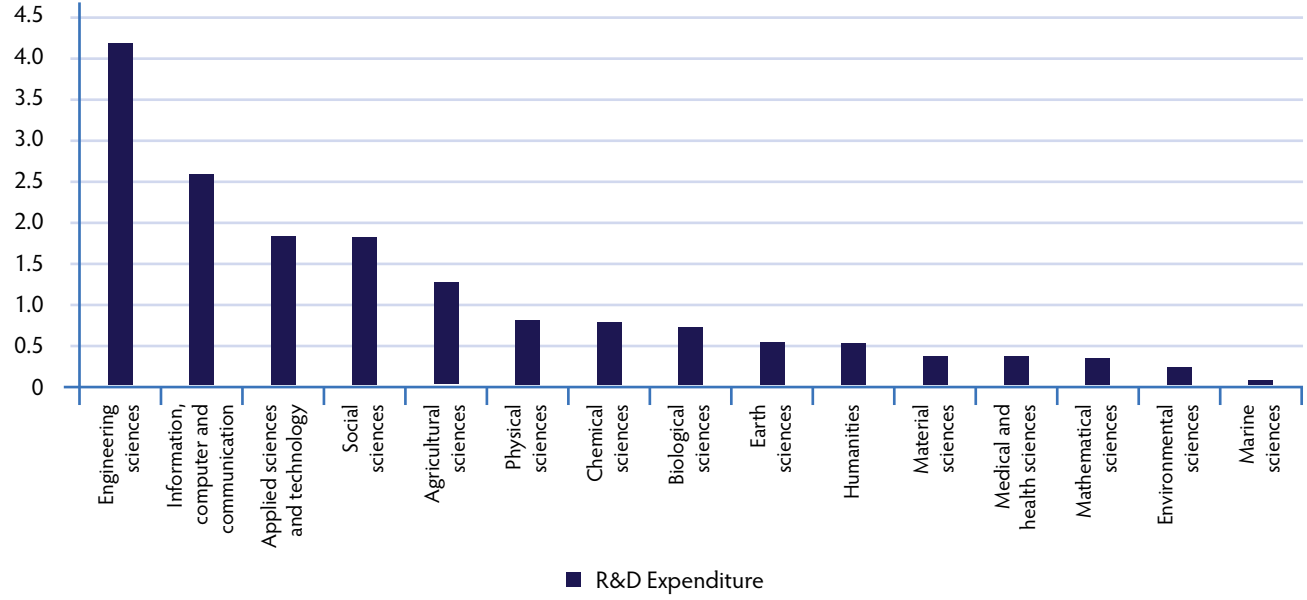


Table 22: R&D expenditure by research field (2007/08) (R'000)

Research Field	R&D Expenditure	% of total	Cumulative % of total
Engineering sciences	4,189,408	22.5	22.5
Information, computer and communication	2,598,218	14.0	36.5
Applied sciences and technology	1,832,546	9.8	46.3
Social sciences	1,809,308	9.7	56.0
Agricultural sciences	1,264,628	6.8	62.8
Physical sciences	793,006	4.3	67.1
Chemical sciences	784,145	4.2	71.3
Biological sciences	723,280	3.9	75.2
Earth sciences	524,133	2.8	78.0
Humanities	508,373	2.7	80.7
Material sciences	365,813	2.0	82.7
Medical and health sciences	358,726	14.0	96.7
Mathematical sciences	341,624	1.8	98.5
Environmental sciences	222,514	1.2	99.7
Marine sciences	50,579	0.3	100.0
Total	**16,366,301**		

Source: DST (2009) National Survey of Research and Experimental Development 2006/07

Figure 14: R&D expenditure by research field (2007/08) (billion rand)



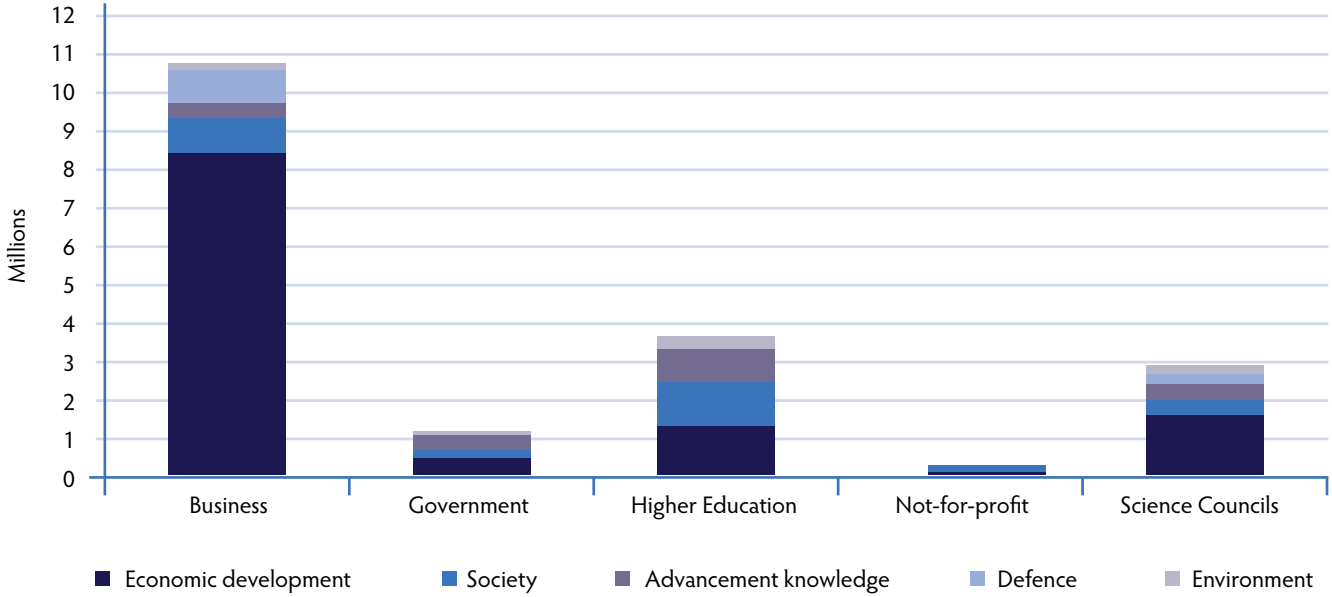
Explanatory note: SA's R&D effort was classified into 15 broad fields of research and based on recognised academic disciplines and emerging areas of study.

Table 23: R&D expenditure by socio-economic objective (2007/08) (R'000)

Socio-Economic Objective	Performing Sector						
	Bus	Gov	HE	NPO	SC	Total	%
Economic development	8399187	429646	1271620	63450	1560688	11724591	63.0
Society	915567	265948	1149091	129159	368010	2827775	15.2
Advancement knowledge	358242	355434	878959	23271	465468	2081374	11.2
Defence	900909	0	4328	1438	228603	1135278	6.1
Environment	164552	103372	317863	5885	263325	854997	4.6
Total	10738457	1154400	3621861	223203	2886094	18624015	100.0

Source: DST (2009) National Survey of Research and Experimental Development 2006/07

Figure 15: R&D expenditure by socio-economic objective (2007/08) (billion rand)



Explanatory note: The socio-economic objective classification provides an indication of the sector of the national economy which will be the main beneficiary of the R&D.

5.3. R&D tax incentives

Number of applications received	80
Operational R&D expenditure claimed	R 687.1 million
Capital R&D expenditure claimed	R 76.9 million
Total R&D expenditure claimed	R764.0 million
Estimated tax revenue forgone	R99.6 million
Total R&D personnel involved	1 699

Source: DST (2009) Report on R&D Tax Incentive Programme and Trends in R&D Expenditure in South Africa 2007/08

R&D Tax Incentive Programme

The R&D tax incentive programme is one of the measures implemented to realise the goal set in the NRDS, of increasing R&D expenditure to 1% of GDP by 2008. It encourages private sector companies to acquire capital assets, labour and technology for R&D in the manner they consider most productive and then to claim the tax incentive. R&D tax incentives are meant to remedy private sector underinvestment in R&D and innovation activities. The incentive includes a tax deduction of 150% in respect of actual expenditure incurred on eligible activities and provides for an accelerated depreciation of assets used for R&D over three years at the rate of 50:30:20.

The Income Tax Act requires DST to report on the aggregate expenditure on R&D activities and the direct benefits of such activities in terms of economic growth, employment and other government objectives. This allows government to assess the impact of the R&D Tax Incentive Programme on the economy and society.

6. IMPORTED KNOW-HOW

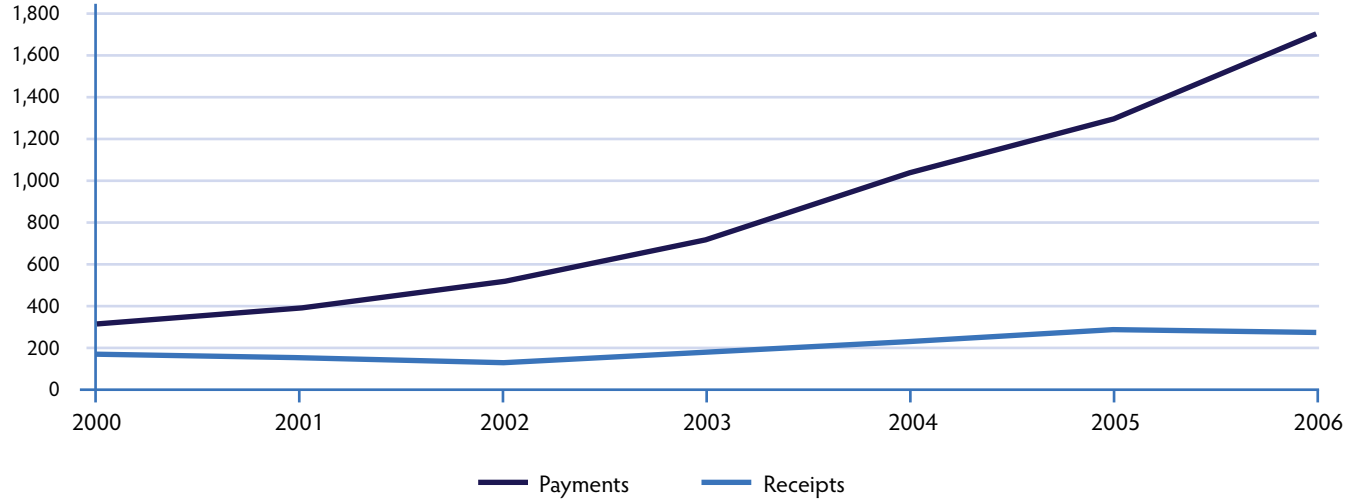
6.1. Technology balance of payments

Table 24: SA technology balance of payments (1997 – 2006) (million current US $) (add note)

	2000	2001	2002	2003	2004	2005	2006
Payments	312	396	523	719	1,040	1,303	1,704
Receipts	174	149	133	188	238	276	262

Source: OECD.stat (beta version) at http://stats.oecd.org

Figure 16: SA technology balance of payments (1997 – 2006) (million current US $)



Explanatory note: The technology balance of payments registers the commercial transactions related to international technology and know-how transfers. It consists of money paid or received for the use of patents, licences, know-how, trademarks, patterns, designs, technical services and for industrial research and development carried abroad.

6.2. High-technology manufacturing exports and imports

Table 25: High technology manufacturing industry: Exports and imports (million rand, 2005 to 2009)

		2005	2006	2007	2008	2009
Exports	High-technology manufacturing	13,930	16,638	19,985	24,207	15,085
	Total manufacturing	212,775	252,601	316,193	417,286	287,373
	Percentage	6.5	6.6	6.3	5.8	5.2
Imports	High-technology manufacturing	80,573	95,425	101,357	122,778	85,021
	Total manufacturing	295,409	381,822	462,400	561,388	428,418
	Percentage	27.3	25	21.9	21.9	19.8

Source: http://www.thedti.gov.za/econdb/raportt/rapsihicurrent.html

Figure 17: High technology manufacturing industry: Exports and imports (billion rand, 2005 to 2009)

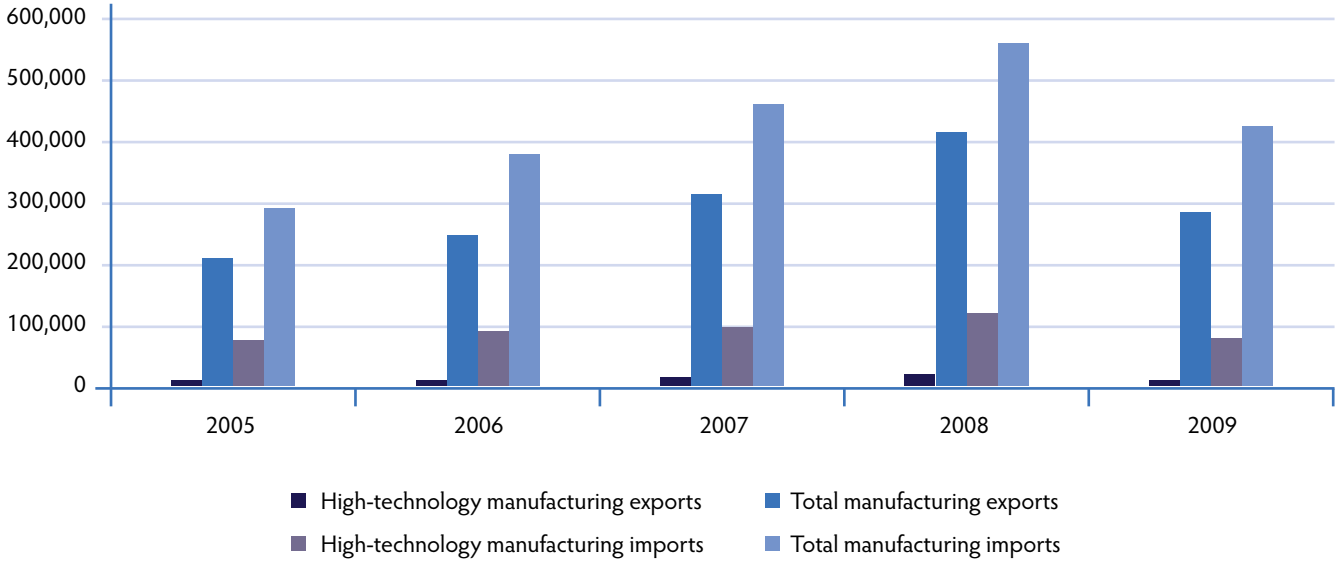


Table 26: SA trade deficit for high technology manufacturing industries (million rands, 2002 and 2007)

Industry	Deficit 2002	Deficit 2007
Television, radio and communication equipment	16,477	26,735
Office, Accounting and computing machinery	10,010	14,426
Pharmaceuticals	6,418	10,438
Aircraft	7,998	8,561
Scientific instruments	8,260	12,806
Total	**49 163**	**72 966**

Source: Global Insight, Inc., World Industry Service database, special tabulations for NSF Science and Engineering Indicators 2008

Explanatory note: The selection of industries is based on the OECD classification of high technology. All high technology manufacturing industries have trade deficits, and these are growing.

7. SET HUMAN CAPITAL

7.1. Researchers

Table 27: Researchers per 1000 employed (FTE, 2001 - 2008)

	2001	2002	2003	2004	2005	2006	2007	2008
OECD Total	6.9	7.0	7.3	7.3	7.5	7.6		
Brazil	1.5	1.5	1.7	1.7	2.0	2.1	2.2	
China	1.0	1.1	1.2	1.2	1.5	1.6	1.8	
Russian Federation	7.9	7.5	7.4	7.1	6.8	6.7	6.7	6.4
Slovenia	4.9	5.1	4.2	4.3	5.5	6.1	6.3	7.1
South Africa	1.3	..	1.2	1.5	1.5	1.5	1.5	1.4

Source OECD Factbook 2008: Economic, Environmental and Social Statistics - ISBN 92-64-04054-4 - © OECD 2009

7.2. Availability of graduates

Table 28: Availability of graduates in all fields per population group and gender (1994, 1999 and 2004)

Population Group	1994	1999	2004
African	72,475	222,647	392,982
Coloured	19,792	38,396	56,440
Indian	29,678	54,275	77,650
White	390,216	519,081	611,411
Unknown	30,235	37,556	38,014
Total	**542,396**	**871,955**	**1,176,497**

Gender	1994	1999	2004
Female	222,563	395,094	569,544
Male	319,832	476,859	606,951
Total	**542,395**	**871,953**	**1,176,495**

Source: Trends in Public Higher Education in South Africa: 1995 to 2004. SAQA, 2007

Explanatory note: Availability refers to the number of individuals with qualifications in a particular field as recorded in the National Learners' Records Database (NLRD) managed by the South African Qualifications Authority (SAQA).

Figure 18: Availability of graduates in all fields per population group (1994, 1999 and 2004)

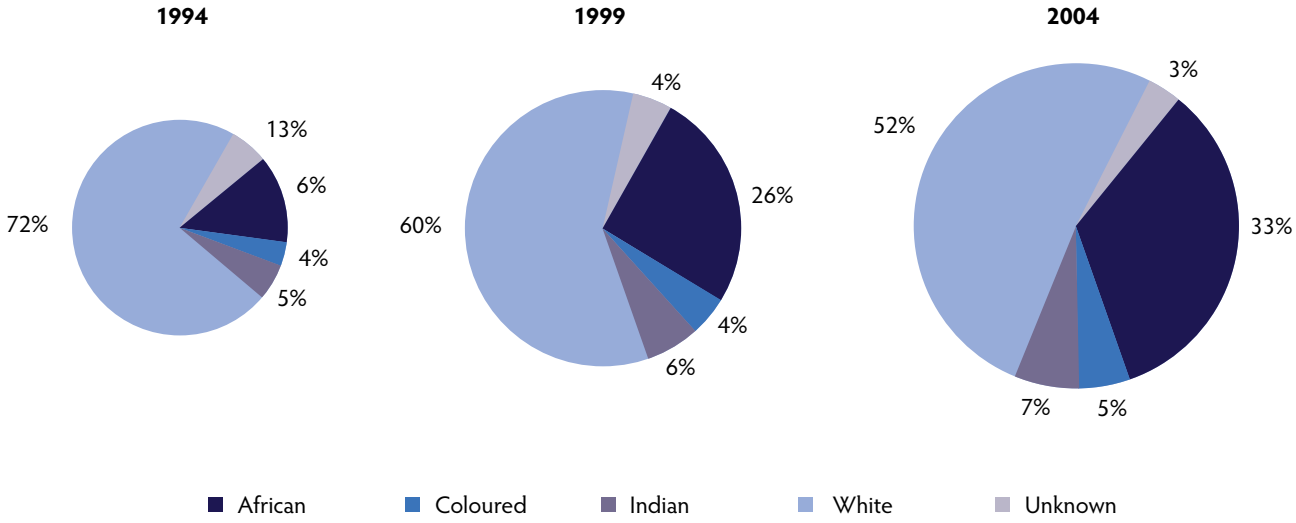


Figure 19: Availability of graduates in all fields per gender (1994, 1999 and 2004)

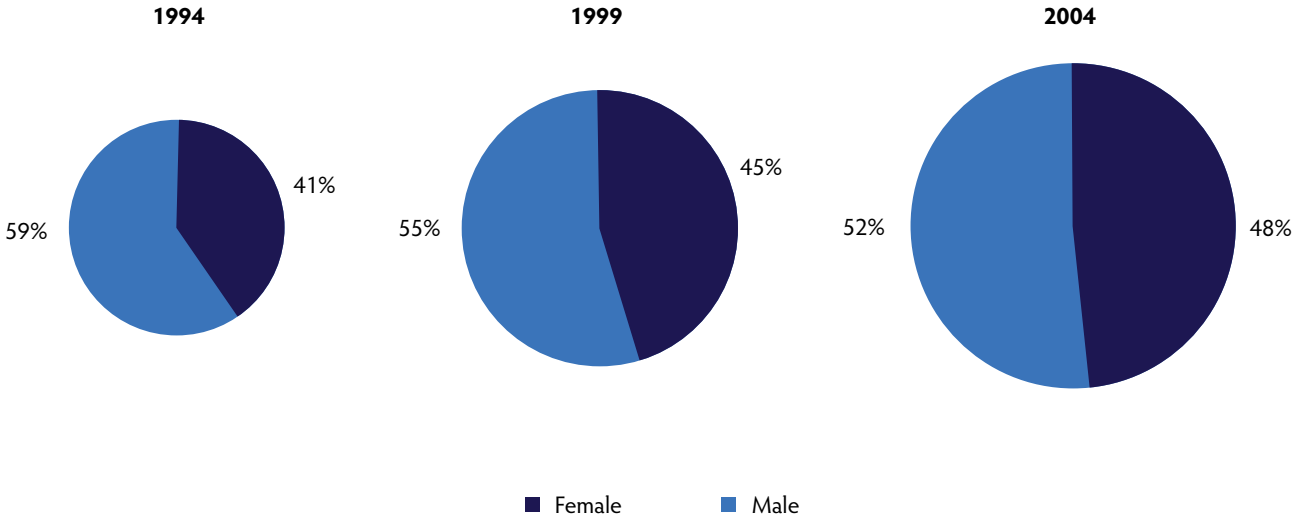


Table 29: Availability of graduates above NQF level 8 (doctoral) in all fields by population group and gender (1994, 1999 and 2004)

Population Group	1994	1999	2004
African	204	699	1,754
Coloured	84	223	429
Indian	214	406	754
White	9,792	11,810	13,499
Unknown	175	240	246
Total	**10,469**	**13,378**	**16,682**

Gender	1994	1999	2004
Female	1,997	3,343	4,948
Male	8,472	10,035	11,734
Total	**10,469**	**13,378**	**16,682**

Source: Trends in Public Higher Education in South Africa: 1995 to 2004. SAQA, 2007

Figure 20: Availability of graduates above NQF level 8 (doctoral) in all fields by population group (1994, 1999 and 2004)

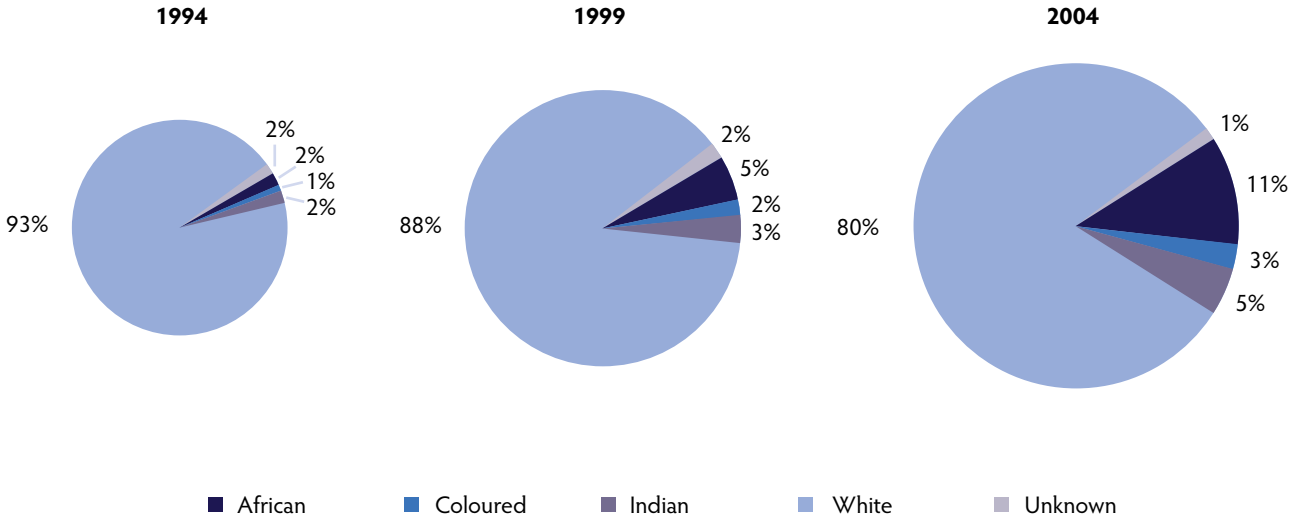


Figure 21: Availability of graduates above NQF level 8 (doctoral) in all fields per gender

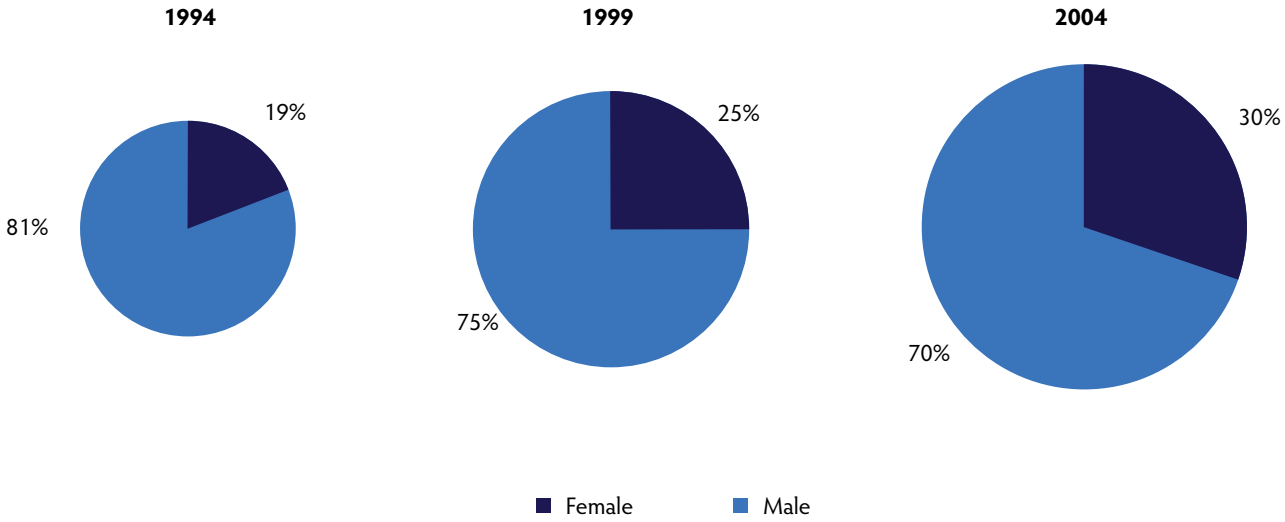


Table 30: Availability of engineers per population group and gender (1994, 1999 and 2004)

Population Group	1994	1999	2004
African	3,133	11,525	29,002
Coloured	2,014	4,196	6,857
Indian	3,132	6,341	9,952
White	68,582	90,684	104,095
Unknown	1,914	2,053	2,056
Total	**78,775**	**114,799**	**151,962**

Gender	1994	1999	2004
Female	7,944	14,357	24,137
Male	70,830	100,441	127,824
Total	**78,774**	**114,798**	**151,961**

Source: Trends in Public Higher Education in South Africa: 1995 to 2004. SAQA, 2007

Figure 22: Availability of engineers per population group (1994, 1999 and 2004)

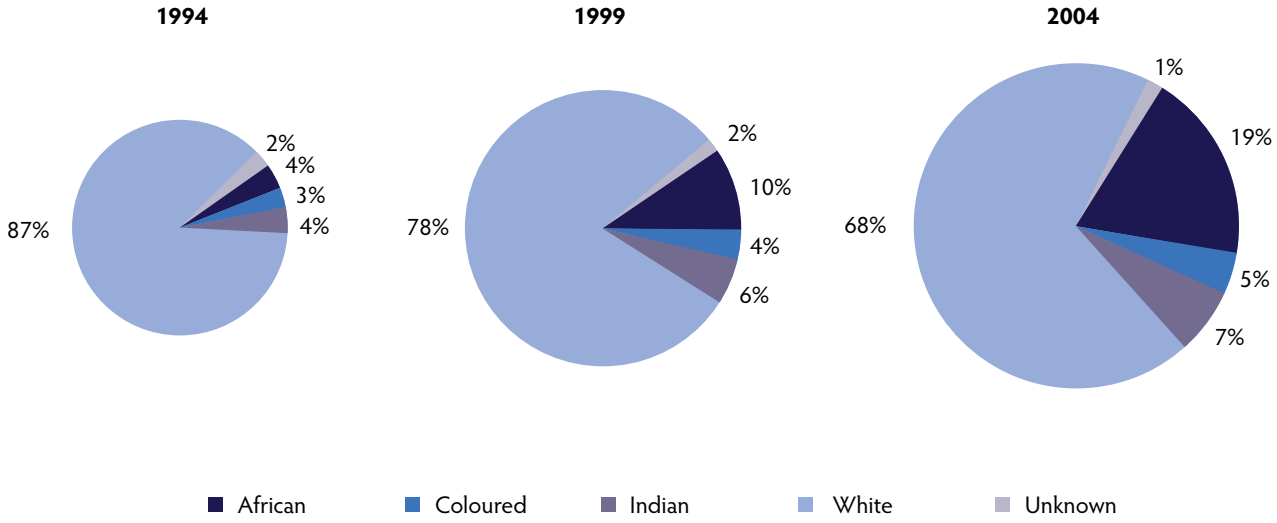
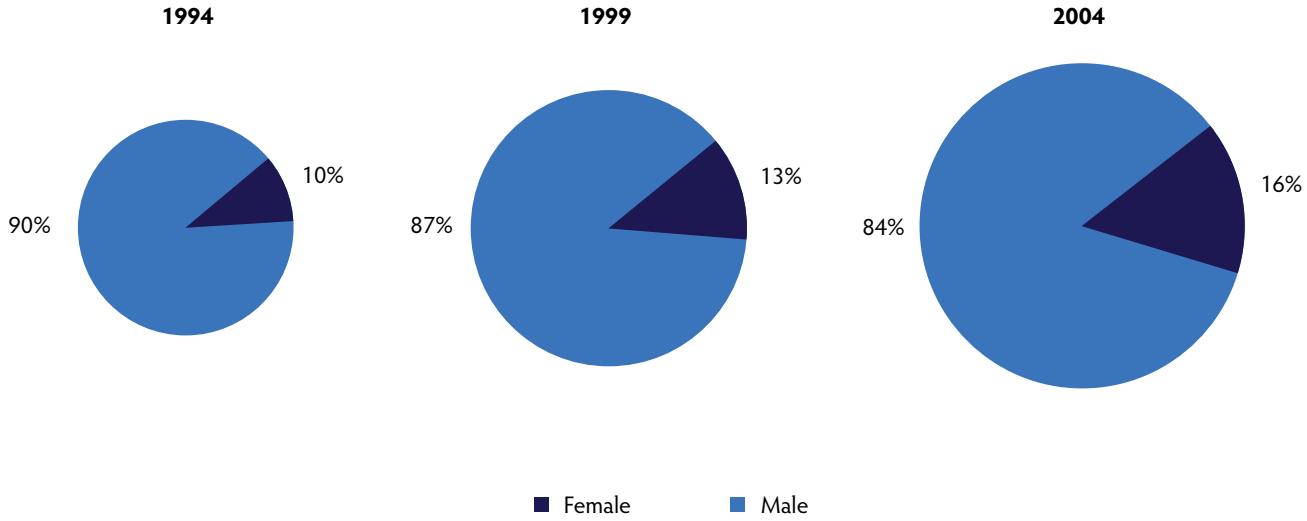


Figure 23: Availability of engineers per gender (1994, 1999 and 2004)



8. TECHNICAL PROGRESS (IMPROVEMENT AND INNOVATION)

8.1. Patents

Table 31: SA patents and world share by USPTO (1995-2008)

Year	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
No of patents	123	111	101	115	110	111	120	113	112	100	87	109	82	91	93
SA patents as % of world	0.121	0.101	0.09	0.078	0.072	0.07	0.072	0.068	0.066	0.061	0.06	0.063	0.052	0.058	0.023

Source: http://www.uspto.gov/web/offices/ac/ido/oeip/taf/h_at.htm#PartA1_1a

Figure 24: SA patents and world share by USPTO (1995 – 2009)

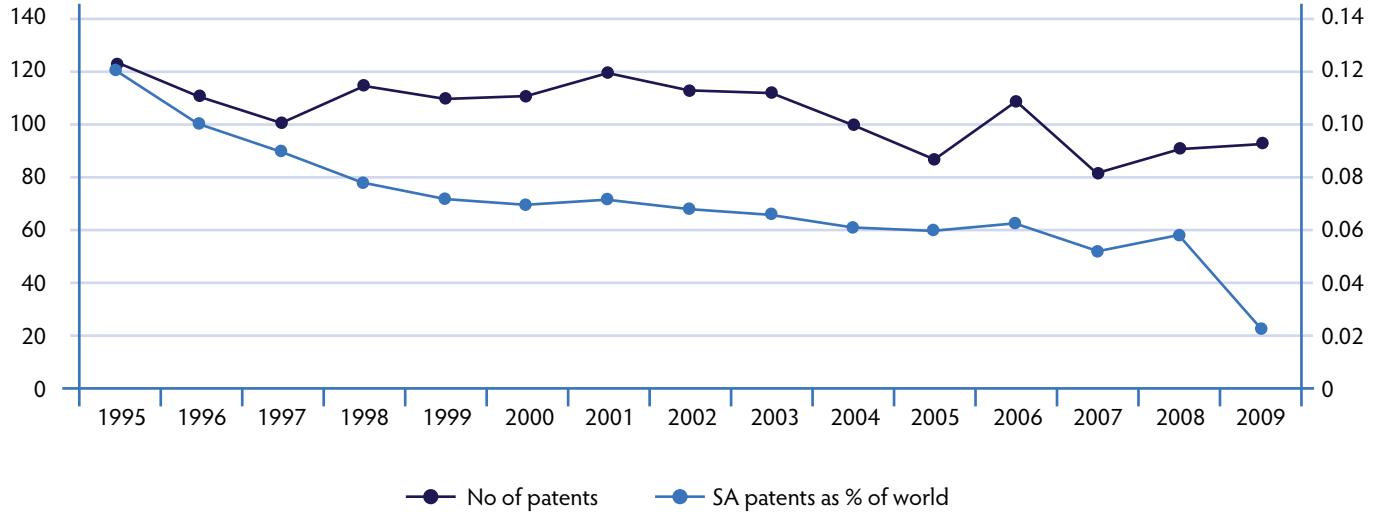


Table 32: SA patents granted by other patent offices (2002-2008)

Patent Office	2002	2003	2004	2005	2006	2007	2008	Total
United States of America	114	112	100	87	109	82	91	695
Australia	52	64	59	55	34	44	31	339
European Patent Office	35	35	56	55	59	58	53	351
China	8	32	21	37	28	37	38	201
Canada	11	11	18	22	21	23	34	140
United Kingdom	19	16	24	15	8	7	10	99
New Zealand	8	18	13	13	4	10	6	72
Singapore	10	12	7	6	10	9	6	60
Russian Federation	5	9	8	13	7	11	10	63
Mexico	5	10	7	7	6	9	12	56
Republic of Korea	1	6	0	10	12	12	17	58
Japan	8	9	0	2	8	10	18	55

Note: Twelve of a total of 56 patent offices data are given, in descending order of total number of patents granted during 2002 to 2008

Source: http://www.wipo.int/ipstats/en/statistics/patents/index.html

Table 33: Number of South African patent applications (EPO): Total, ICT and biotechnology (1997-2005)

Year	1997	1998	1999	2000	2001	2002	2003	2004	2005
Total	138	146	140	148	118	130	139	139	125
ICT	30	27	36	35	15	27	32	21	N/A
Biotechnology	4	3	1	4	4	5	0	7	N/A

Source: OECD.stat (beta version) database at http://stats.oecd.org

Table 34: Number of patent applications to EPO: Selected countries (2005)

	Country								
	USA	Germany	Japan	Korea	Canada	Australia	Turkey	New Zealand	South Africa
Patents	33,035	22,887	21,920	5,031	2,267	1,102	201	180	125

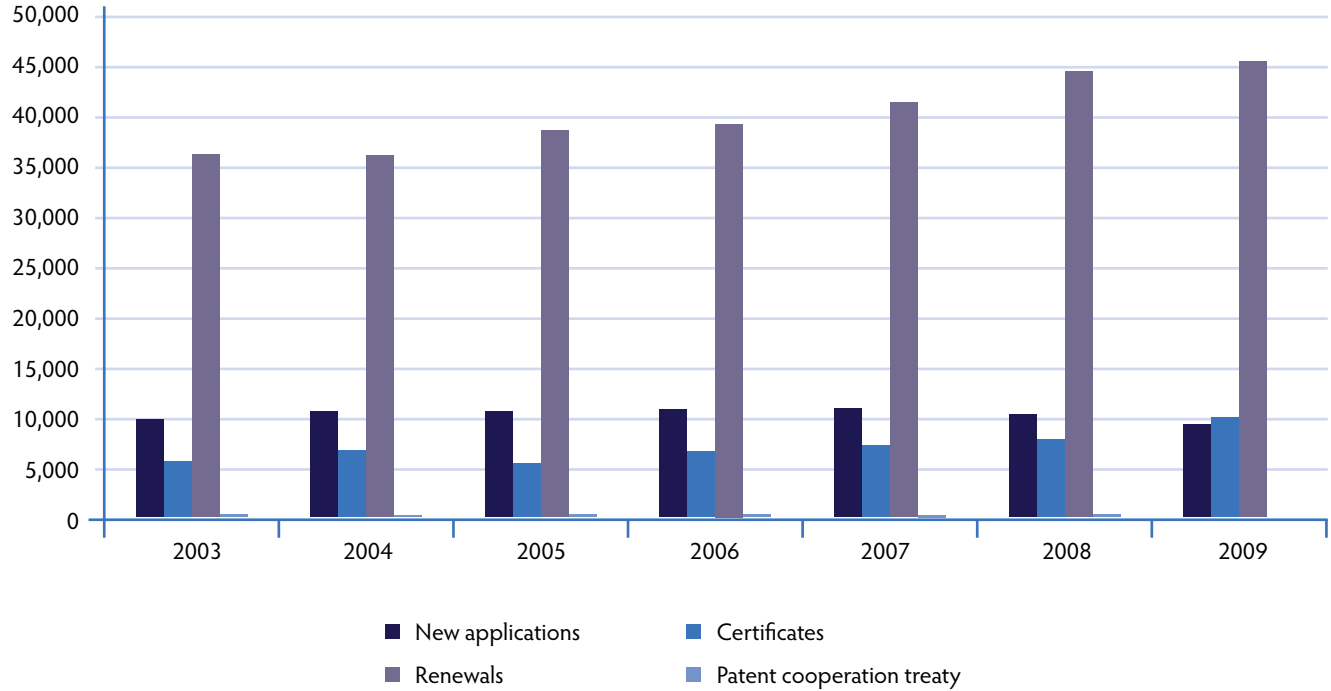
Source: OECD.stat (beta version) database at http://stats.oecd.org

Table 35: SA patent office statistics (2003/04-2008/09)

	2003	2004	2005	2006	2007	2008	2009
New Applications	10,029	10,493	10,464	10,753	10,830	10,191	9,271
Certificates	5,806	6,709	5,432	6,513	7,205	7,740	10,042
Renewals	36,194	35,942	38,395	39,194	41,379	44,310	45,296
Patent Cooperation Treaty	186	179	168	124	96	126	N/A

Source: Companies and Intellectual Property Registration Office (CIPRO)

Figure 25: SA patent office statistics (2003/04-2008/09)

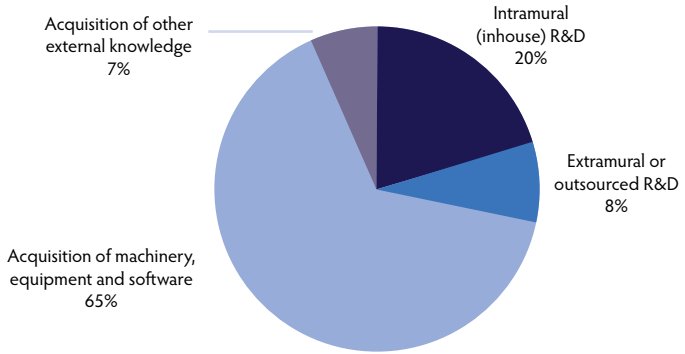


9. BUSINESS PERFORMANCE AND KEY INDUSTRIAL SECTORS

9.1. South African innovation survey 2005

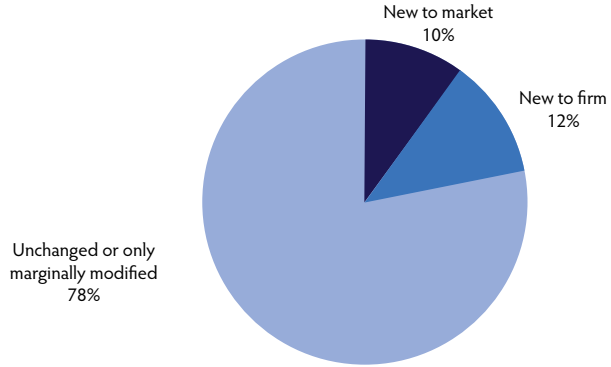
The results given in this section are based on the SA Innovation Survey, which covered the period 2002 to 2004. A total of 979 enterprises, representative of economic sector and size of enterprise, responded out of the 2 627 surveyed from a target business population of ±31 500 enterprises on the business registry database of Statistics South Africa. The graphs in this section are mainly based on the 51.7% of the enterprises (n=506) that reported innovation activities. Sixty three percent of the innovating companies had both product and process innovations, while some only had product or process innovations (25% and 12% respectively).

Figure 26: Proportional distribution of expenditure by business enterprises on innovation activities



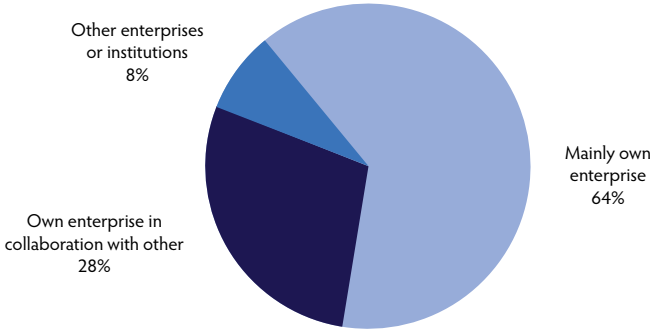
Source SA Innovation Survey 2005

Figure 27: Proportion of turnover in 2004 attributed by business enterprises to different types of products



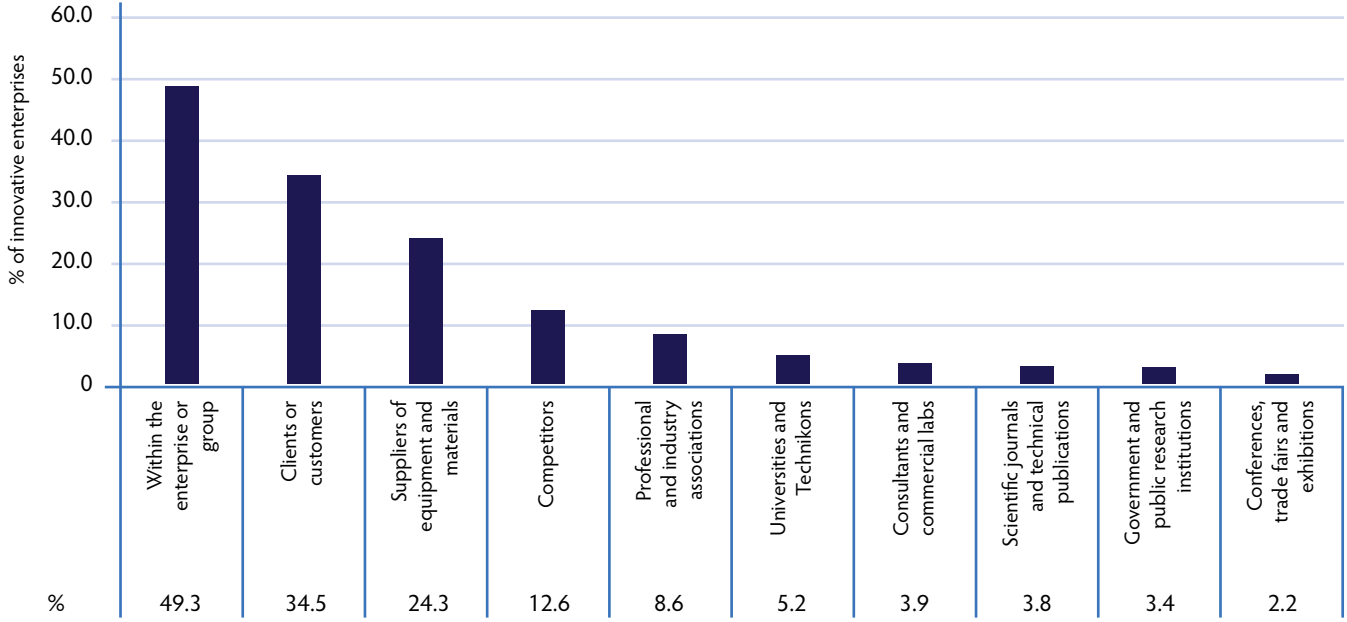
Source SA Innovation Survey 2005

Figure 28: Responsibility for the development of product innovations



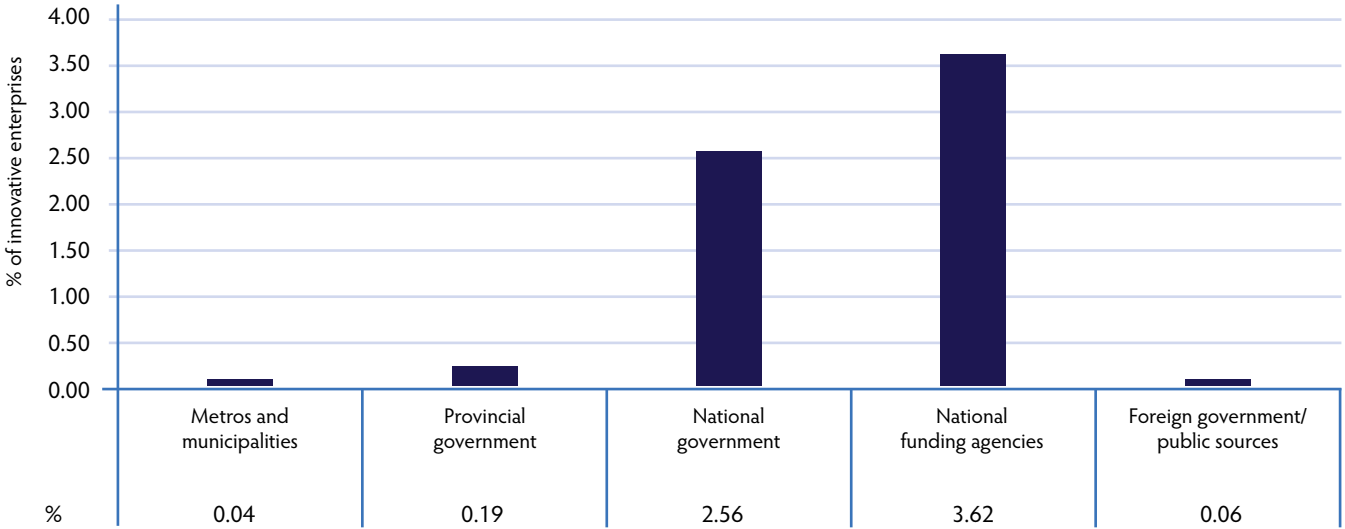
Source SA Innovation Survey 2005

Figure 29: Sources of information for innovation



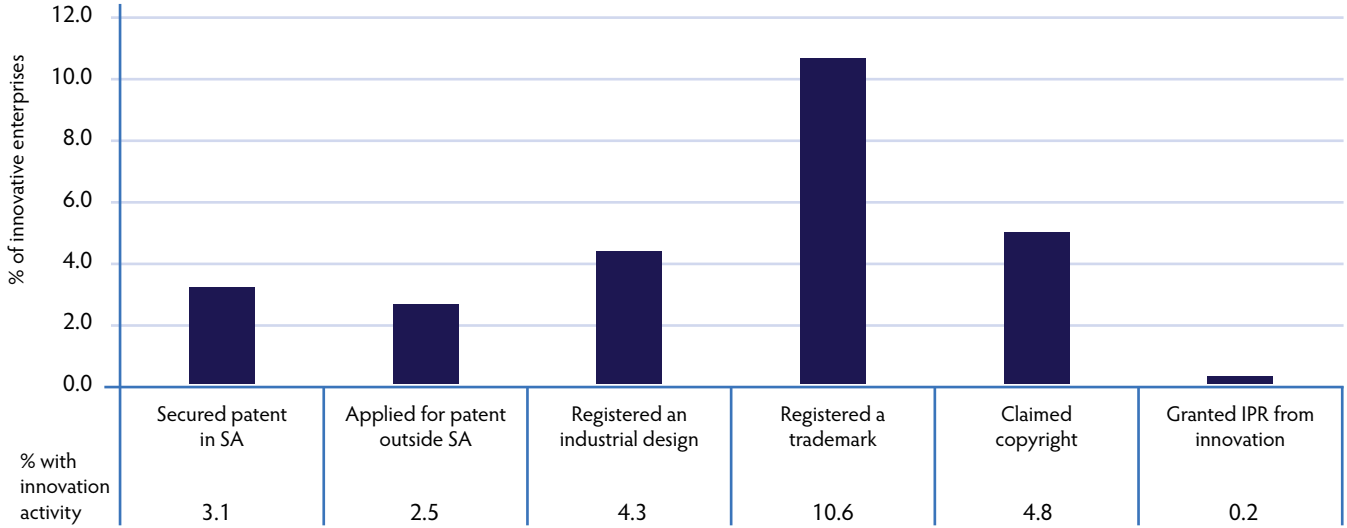
Source SA Innovation Survey 2005

Figure 30: Financial support for innovation activities from government sources



Source SA Innovation Survey 2005

Figure 31: Intellectual property rights utilised by business enterprises



Source SA Innovation Survey 2005

10. QUALITY OF LIFE

Table 36: Comparative analysis of quality of life indicators

Indicator	Year	Value	Relative to world[1]
HIV/AIDS population	2007	5.7 million	Highest in world
HIV/AIDS prevalence rate	2007	10%	5th highest in world
Life expectancy at birth: Female	2010	52 years	Bottom 15%
Life expectancy at birth: Male	2010	51 years	Bottom 15%
Crime: homicides	2008	36.5 per 100 000 inhabitants	Top 10%
Income inequality (UN Gini coefficient[2])	2000	0.578	Top 10%
Unemployment rate	2008	22.9%	Top 15%
Poverty: living below national poverty line	2000	26.2%	Top 40%
Adult literacy rate	2010	89.3%	Bottom 50%
GDP per capita (PPP dollar)	2010	10,139.99 US$	Top 45%

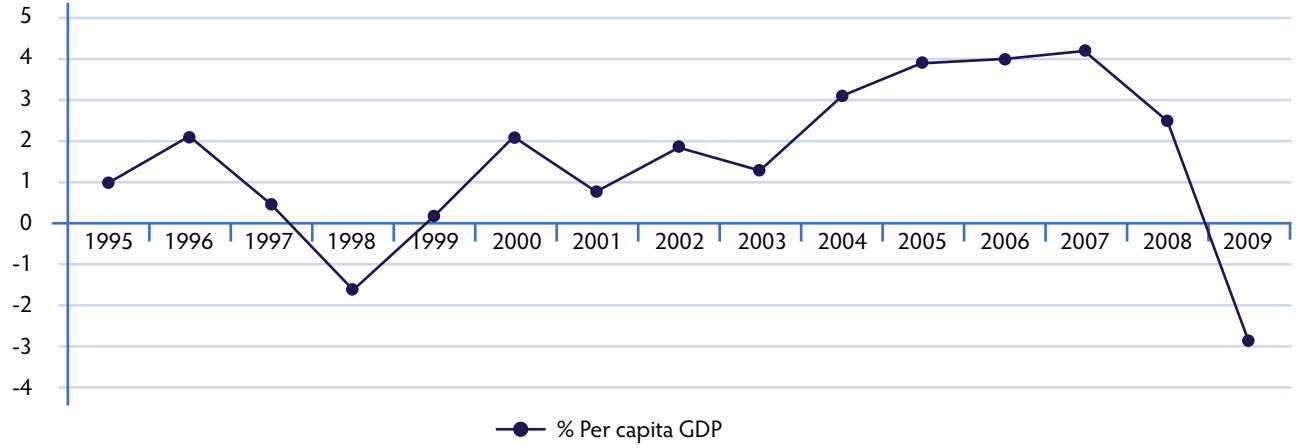
Notes:
1. Comparisons included between 111 and 193 countries (depending on the availability of information). Sources included CIA World Factbook, United Nations Development Programme Human Development Report, etc.)
2. Gini coefficient ranges from 0 to 1 where 0 indicates income is evenly distributed while 1 indicates highly unequal income distribution. More recent values are provided in Table 1.

Table 37: Real per capita GDP growth (1994 – 2009)

Year	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
% Per capita GDP	1.0	2.1	0.5	-1.6	0.2	2.1	0.8	1.9	1.3	3.1	3.9	4.0	4.2	2.5	-2.8

Source: Development Indicators 2009, the Presidency, Republic of South Africa

Figure 32: Real per capita GDP growth (2000 constant prices, 1994 - 2009)



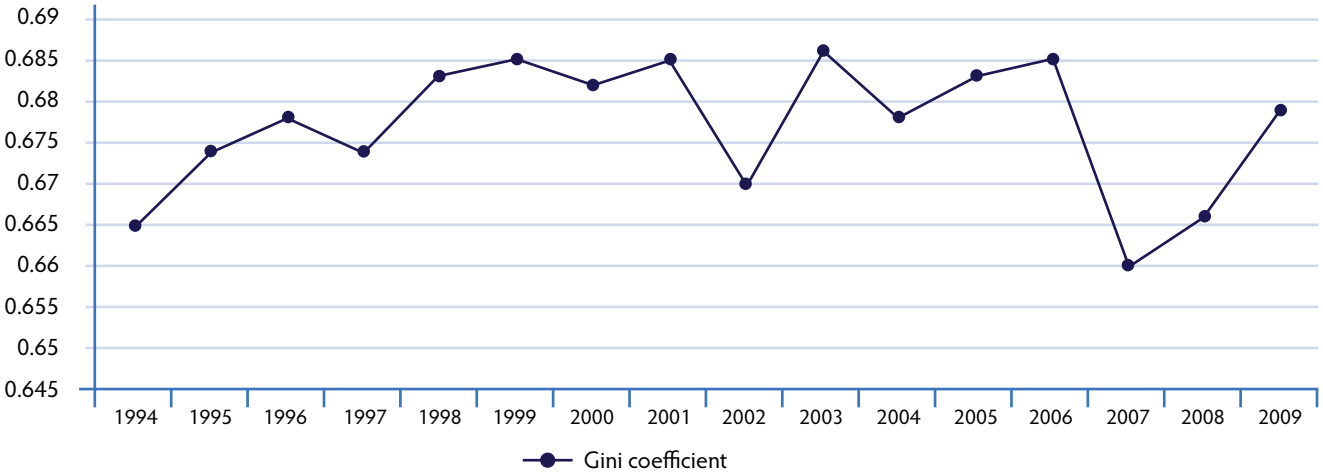
Explanatory note: Real GDP per capita growth is the annual growth of the size of the economy divided by the size of the population adjusted for price changes and inflation.

Table 38: Income inequality: SA Gini Coefficient (1993 – 2009)

Year	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Gini Coefficient	0.665	0.674	0.678	0.674	0.683	0.685	0.682	0.685	0.670	0.686	0.678	0.683	0.685	0.660	0.666	0.679

Source: Development Indicators 2009, The Presidency, Republic of South Africa

Figure 33: Income inequality as measured by the Gini Coefficient (1993 – 2009)



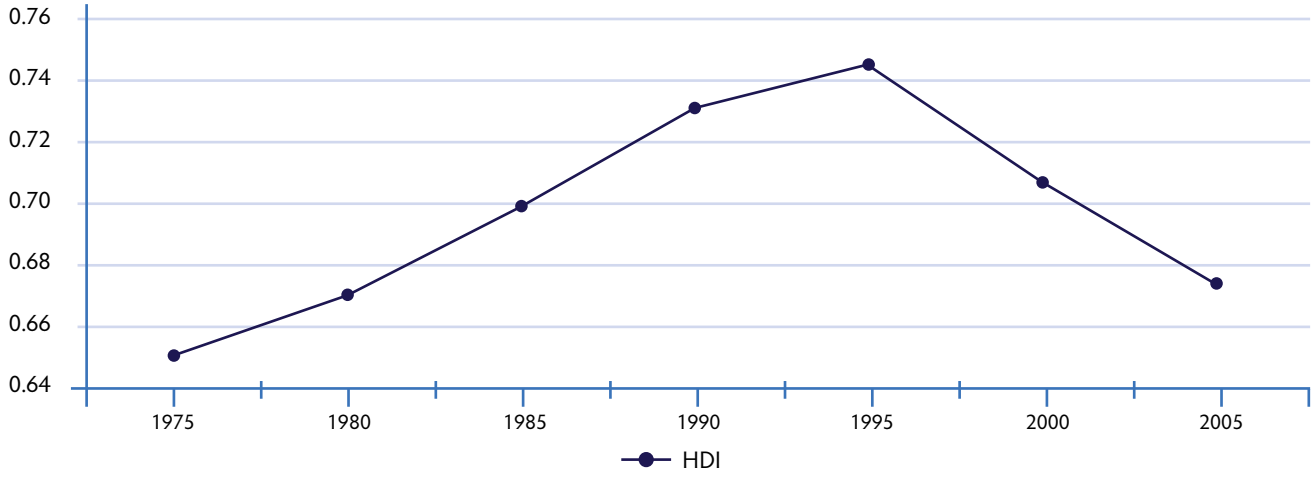
Explanatory note: Income inequality refers to the extent of disparity between high income and low income households. The Gini coefficient measures the inequality as a proportion of its theoretical maximum. It can range from 0 (no inequality) to 1 (complete inequality).

Table 39: SA human development index (HDI) (1975 – 2005)

Year	1975	1980	1985	1990	1995	2000	2005
HDI	0.650	0.670	0.699	0.731	0.745	0.707	0.674

Source: Human Development Report 2007/08 Indicator tables, UNDP

Figure 34: SA human development index (1975 – 2005)



Explanatory note: The Human Development Index (HDI) is a summary measure of three dimensions of human development: health- leading a long and healthy life, measured by life expectancy at birth; education- being knowledgeable measured by literacy and school enrolment; and income- having a decent standard of living, measured by GDP per capita.

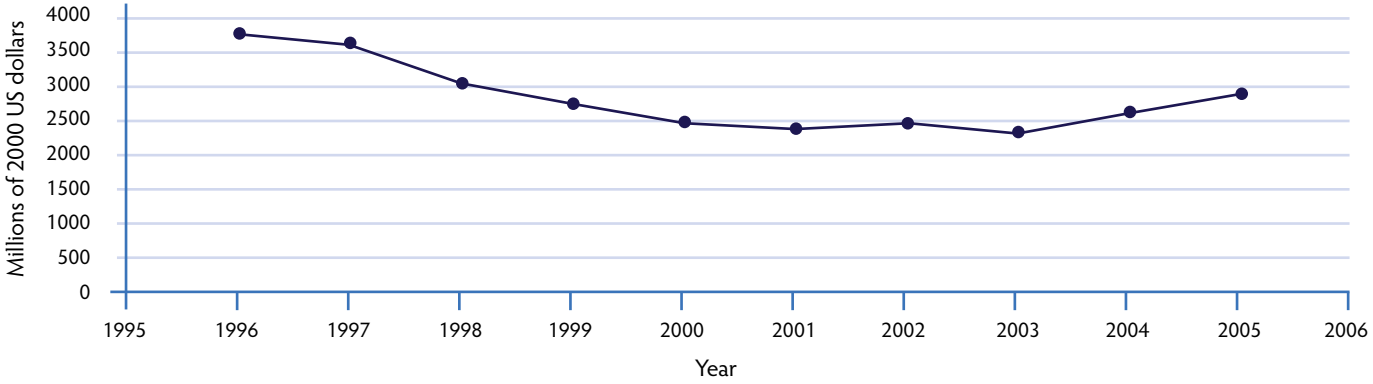
11. WEALTH CREATION

Table 40: Gross revenue of high technology manufacturing industry - South Africa (1996-2005)

	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
South Africa revenue	3,773	3,620	3,058	2,754	2,477	2,394	2,470	2,327	2,619	2,886

Source: Global Insight, Inc., World Industry Service database, special tabulations for NSF Science and Engineering Indicators 2008

Figure 35: Gross revenue of SA high technology manufacturing industry (1996 – 2005)



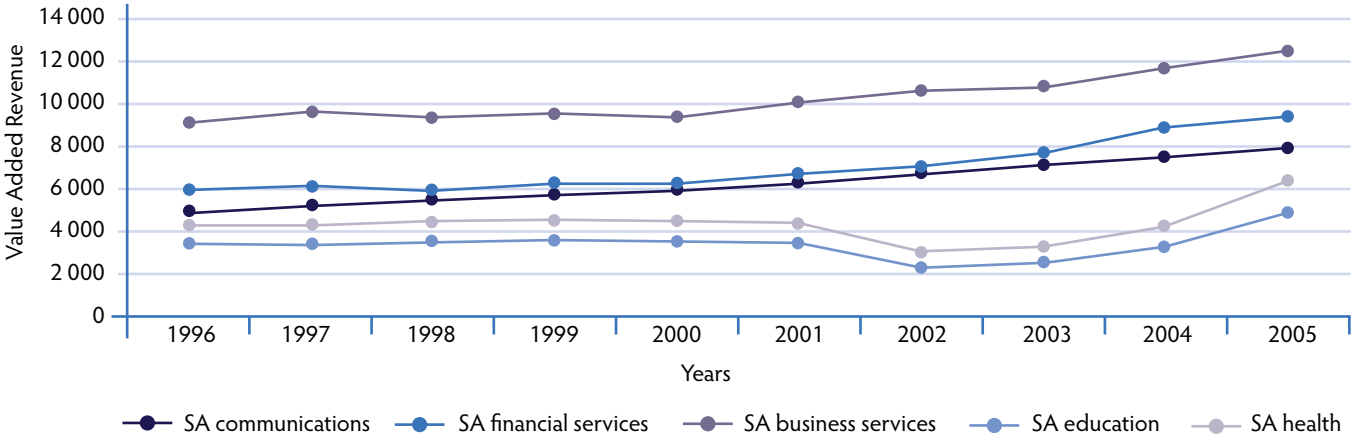
Explanatory note: Gross Revenue is the value of the particular industry's shipments or services, equivalent to the industry's sales, including domestic and imported supplies and inputs from other industries. Gross Revenue indicates the industry's impact on the national or global economy, because the industry's use of inputs boosts output in other domestic industries or countries.

Table 41: Value added revenue from knowledge intensive services (million $ US constant 2000, 1996-2005)

Year	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
South Africa	27,804	28,854	28,893	29,664	29,762	31,017	29,768	31,582	35,619	41,065

Source: Global Insight, Inc., World Industry Service database, special tabulations for NSF Science and Engineering Indicators 2008

Figure 36: Value added revenue of knowledge intensive services (specific sectors, 1996 – 2005)



Explanatory note: Value added is gross revenue sales minus purchases of domestic and imported supplies and inputs from other industries. It is an indicator of an industry's direct contribution to the national economy.

Table 42: High-technology exports as percentage of manufactured exports (1990 and 2005)

	1990	2005
South Africa	6.8	6.6
Developing countries	10.4	28.3
Medium human development	7.2	24.3
World	17.5	21.0

Source: World Development Indicators database, April 2008

12. GLOBAL COMPETITIVENESS

Table 43: World economic forum (WEF) global competitiveness index (2001-2009)

Year	2002	2003	2004	2005	2006	2007	2008	2009	2010
WEF Global Competitiveness Index (overall rank)	32	42	41	42	45	44	45	45	54
Number of Countries	80	102	104	117	125	127	134	133	139
Inverted normalised GCI rank*	60	58.8	60.6	64.1	64	65.4	66.4	66.2	61.2

*Ranks are normalised by the number of countries and inverted on a scale from 0 to 100, where 100 indicates most competitive of all countries considered.

Source: WEF (2009) "The Global Competitiveness Report 2009 – 2010", World Economic Forum

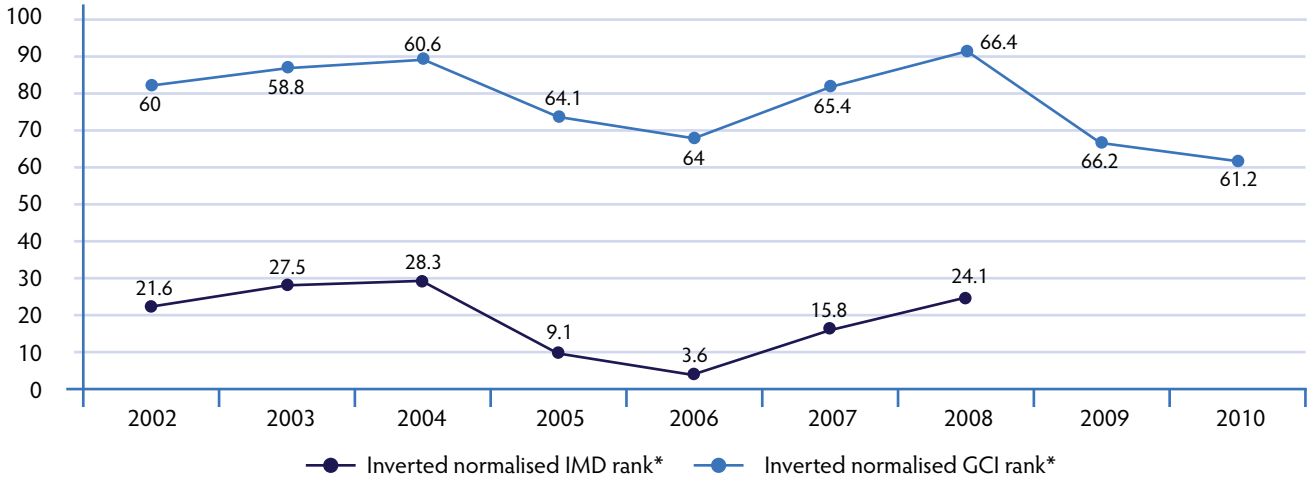
Table 44: Institute for development management (IMD) world competitiveness ranking (2004-2009)

Year	2004	2005	2006	2007	2008	2009	2010
IMD overall rank	40	37	38	50	53	48	44
Number of Countries	51	51	53	55	55	57	58
Inverted normalised IMD rank for SA*	21.6	27.5	28.3	9.1	3.6	15.8	24.1

*Ranks are normalised by the number of countries and inverted on a scale from 0 to 100, where 100 indicates most competitive of all countries considered.

Source: IMD (2009) "IMD World Competitiveness Yearbook" Institute for Development Management

Figure 37: International competitiveness indices (2004-2009)



Source: WEF (2009) "The Global Competitiveness Report 2007 – 2008", World Economic Forum and IMD (2009) "IMD World Competitiveness Yearbook" Institute for Development Management

Explanatory note:

- **World Economic Forum (WEF) Global Competitiveness Index (GCI):** The GCI provides a holistic overview of factors that are critical to driving productivity and competitiveness in industrialised and developing countries and groups these factors into twelve pillars: institutions, infrastructure, macro economic stability, health and primary education, higher education and training, goods market efficiency, financial market sophistication, technological readiness, market size, business sophistication and innovation.
- **Institute for Development Management (IMD) World Competitiveness Ranking:** The IMD World Competitiveness Yearbook (WCY) analyses and ranks the ability of nations to create and maintain an environment that sustains the competitiveness of enterprises. The WCY methodology assumes that enterprises operate in a national environment which enhances or hinders their ability to compete domestically or internationally. The WCY methodology divides the national environment into four main competitiveness factors; economic performance (79 criteria), government efficiency (72 criteria), business efficiency (71 criteria) and infrastructure (101 criteria).
- Note that both indices are comprised of a combination of objective and subjective information.

13. BIOTECHNOLOGY INDICATORS

Table 45: Benchmarking biotechnology indicators (SA and EU)

Indicators	South Africa	EU Average[1]	EU Leaders	EU Laggards
PhD Graduates (Life Sciences) per million capita (pmc)[2]	2.5	23.8	34.5 Fr	13.6 B
Government funded biotechnology R&D as % of GDP[3]	0.012	0.028	0.052 Belgium (B)	0.004 Greece (Gr)
Biotechnology publications pmc[4]	16.5	94.8	195.8 Sweden (Sw)	29 Gr
Biotechnology patents EPO pmc[5]	0.15	4.5	19.2 Netherlands	0.0 Gr
GMO field trials per billion GDP agriculture[6]	3.6	6.8	19.9 B	0.6 Austria
Dedicated biotechnology firms pmc[7]	0.8	5.4	26.5 Sw	1.1 Italy
Biotechnology venture capital as % of GDP[8]	0.007	0.0094	0.0257 B	0.0 Gr

Notes:

1. European Commission (2003) "2002 European Innovation Scorecard, Technical Paper no 7, Biotechnology Innovation Scoreboard" European Trend Chart on Innovation, Innovation Policy Unit, Brussels
2. SA data for 2006 from HEMIS database of the Department of Education (personal communication); EU data 1999
3. SA data GDP 2005 R1500 bil; Gov Funded Biotechnology R&D R182,993 million (National R&D Survey data adjusted for 50% of R&D in higher education sector coming from non government 2005/06); hence ratio 0.012; EU data 1994-98
4. Data from ISI National Science Indicators Database for 2006 (789 publications) Pop 47.6 m; hence ratio 16.5; EU data 2000
5. SA data for EPO from OECD patent databases. 7 SA patent applications during 2004; EU data 2000
6. SA data GMO field trials (2001-2005) 26 (from Department of Agriculture, Genetically Modified Organisms Act 1997, Annual Report 2004-5, Pretoria); Agriculture GDP (2005) R27.7 billions PPP$7.3 billion, hence ratio 3.6; EU data 1996-2001
7. SA data 38 core bio firms during 2006 (National Biotechnology Audit 2007 DST) Population 47.8 m; hence ratio 0.8
8. SA 2005 data: R100 million from BICs (65%) and R10 million from private VC, GDP 2005 R1,500 billion; hence ratio 0.007. The SA data utilize available capital from BIC's and not declared amounts by by bio-firms.

Source: NACI (2009), "Review of the funding environment for Biotechnology in South Africa", Research commissioned by NACI to the Institute of Technological Innovation, University of Pretoria

Table 46: Biotechnology R&D expenditures by the public sector

Country	Biotechnology R&D expenditures by the public sector Million PPP$	Public biotechnology R&D as % of total public R&D
Germany	4605	19.3
Korea	1909	18.2
Spain	1090	12.5
Poland	195	7.0
Czech Republic	88	5.9
Portugal	33	2.1
Slovenia	3	1.0
Italy	94	0.9
South Africa	63	4.5

General Note: SA data from "The South African National R&D Survey"; personal contact with HSRC; SA performer based information, Biotechnology R&D expenditures by the public sector (m PPP $ 2005) 63.4. (R245.5million). Government Expenditure on R&D (2005) 5 404 million hence ratio 4.5 Data source for PPP IBRD/WB (2008) 2005 International Comparison Program, International Bank for Reconstruction and Development; World Bank, Washington DC

Source: OECD (2009). Science Technology and Industry: Scoreboard 2009. Organisation for Economic Cooperation and Development; Paris.

14. LIST OF FIGURES

15. LIST OF TABLES

16. LIST OF ACRONYMS

CESTII	Centre for Science, Technology and Innovation Indicators
DACST	Department of Arts, Culture, Science and Technology
DST	Department of Science and Technology
EPO	European Patent Office
FRD	Foundation for Research Development
FTE	Full-Time Equivalent
GDP	Gross Domestic Product
GERD	Gross Domestic Expenditure on Research and Development
HDI	Human Development Index
HE	Higher Education
HEMIS	Higher Education Management Information System
HG	Higher Grade
ICT	Information and Communication Technology
IMD	Institute for Development Management
IPR	Intellectual Property Rights
ISI	Institute for Scientific Information
NACI	National Advisory Council on Innovation
NLRD	National Learners' Records Database

NRDS	National Research and Development Strategy
NSF	National Science Foundation
NSI	National System of Innovation
OECD	Organisation for Economic Cooperation and Development
PTMT	Patent Technology Monitoring Team
R&D	Research and Development
SAQA	South African Qualifications Authority
SG	Standard Grade
S&T	Science and Technology
SET	Science, Engineering and Technology
UNDP	United Nations Development Programme
UNESCO	United Nations Educational, Scientific and Cultural Organization
USPTO	United States Patent and Trademark Office
WCY	World Competitiveness Yearbook
WEF	World Economic Forum
WEI	World Education Indicators

Postal Address:
NACI
Private Bag X 894
Pretoria, 0001
South Africa

Physical Address:
Department of Science and Technology
Building 53, CSIR Campus
Meiring Naude Road
Brummeria, Pretoria

Contact:
T: +27 (0) 12 843 6511
Fax: +27 (0) 12 349 1060
Email: naci@dst.gov.za
Website: www.naci.org.za