



Centre for Science, Technology and Innovation
Indicators

Human Sciences Research Council

for

Department of Science and Technology

NATIONAL SURVEY OF RESEARCH & DEVELOPMENT 2003/2004

Provisional
Report on the Sectors

1 September 2005

Table of Contents

	Page
Executive summary	3
Acknowledgements	7
Glossary of abbreviations	8
Chapter 1. Introduction to the Survey	9
Chapter 2. Business sector	19
Chapter 3. Government sector	31
Chapter 4. Higher Education sector	39
Chapter 5. Not-for-profit sector	48
Chapter 6. Science Council sector	55
Chapter 7. Concluding remarks and observations	62

Executive Summary

1. On 28 January 2004, the Centre for Science, Technology and Innovation Indicators (CeSTII) was launched within the Knowledge Management research programme of the HSRC, with a mandate from the Department of Science and Technology to carry out future surveys on both Research and Experimental Development and Innovation.
2. CeSTII is envisaged as a national resource to perform such surveys according to international best practice and to form the hub of a network of excellence involving local, regional and international peers.
3. This Report presents the second survey that CeSTII has conducted, namely the 2003/04 Survey of Inputs into Research and Experimental Development, abbreviated as the 2003/04 R&D Survey.
4. The 2003/04 R&D Survey built on the firm basis provided through the experience of conducting the 2001/02 R&D Survey.
5. As previously the 2003/04 questionnaire followed the OECD Frascati Manual guidelines. In order to improve the response rate the questionnaire comprised only the core questions needed to address the major indicators. The respondent burden of this questionnaire was thus reduced compared with the first survey.
6. The universe of R&D performers was divided into the following five sectors:
 - i. **The Business Enterprise Sector:** The business sector of large, medium and small enterprises, including state-owned companies.
 - ii. **The Government Sector:** All government departments with an R&D component, government research institutions and museums.
 - iii. **The Higher Education Sector:** All public Higher Education institutions and some private higher education institutions with an R&D component 35 Higher Education institutions (18 Universities, 8 Technikons, 3 Universities of Science and Technology, 1 Institute of Technology and 5 private higher education institutions.
 - iv. **The Not-for-Profit Sector:** Non-governmental and other organisations formally registered as not-for-profit institutions.
 - v. **The Science Council Sector:** the 8 science research councils plus the Africa Institute, all established through Acts of Parliament
7. In earlier surveys these five sectors have sometimes been contracted into three: Higher Education, Business and Government. With Government including the Science Councils, and the NPOs sometimes being with Government or Business.
8. The indicators provided in this Report are the main subset of the S&T indicators specified for R&D surveys by the OECD.
9. In Table E1 we present the breakdown of the national total of R10, 1 billion of intra-mural R&D Expenditure by sector.

Table E1: Total In-house R&D expenditure* per sector, 2003/04 and 2001/02

Sector	2003/4		2001/2	
	R 000s	%	R 000s	%
Business enterprise (BERD)	5,591,325	55.5	4,023,576	53.7
Government	465,367	4.6	203,110	2.7
Higher education	2,071,351	20.5	1,896,156	25.3
Not-for-profit	209,023	2.1	70,778	0.9
Science Councils	1,745,493	17.3	1,294,454	17.3
Grand Total	10,082,559	100.0	7,488,074	100.0

*Rounding error sums to 99,9%

10. The Business Sector at 55,5% of the spend was the largest performer; Government combined with the Science Councils accounts for 21,9%; Higher Education comprises 20,5%. The Business Sector response rate rose to 69%. No response rates are relevant to the Higher Education, Science Council and Government sectors.

11. Table E2 depicts the main information on human resources by sector.

Table E2: Headcount of R&D personnel by sector, 2003/04

	Researchers	Technicians Directly Supporting R&D	Other Personnel Directly Supporting R&D	Grand Total	%
Business enterprise	5058	3430	3120	11608	28.6
Government	929	322	1032	2283	5.6
Higher Education*	14054.54	2594	2728.5	19377.04	47.7
Science Councils	2414	1612	2496	6522	16.1
Not-for-profit	305	235	275	815	2.0
Grand Total	22760.54	8193	9651.5	40605.04	100.0

*Excluding postgraduate students

17. Deployment of Researchers varies considerably by sector. For example, in the Business Sector the time spent by R&D personnel on research is up to three times that of the time Higher Education personnel spend. The large difference is accounted for by teaching and other duties.
18. 19406 Researchers and a grand total of 32501 personnel support the country's R&D effort. The latter translates into 0,73 R&D personnel per 1000 population.
19. The implementation of the 2003/04 R&D Survey demonstrated that considerable learning by both the survey team and respondents has occurred. The survey fieldwork was completed by mid February 2005, and the launch of the Key High-Level Results of the survey occurred almost one year after the launch of the survey.
20. A close working relationship was maintained with Statistics Canada who provided valuable guidance in the finalization of the survey results.
21. The Science and Industry Directorate of the OECD also gave valuable advice toward submission of the 2001/02 R&D Survey results for inclusion in the *OECD Main S&T Indicators* and the accompanying *OECD S&T Scoreboard*.
22. Statistics South Africa declared the 2001/02 Survey of Inputs to Research and Development as a component of Official Statistics on 13 June 2005.
23. The Higher Education sector and the Business sector questionnaires are provided in a separate Annex as Appendices 1 and 2 respectively. Also included is the User Guide (Appendix 3).
24. A public web site www.hsrc.ac.za/RnDSurvey was commissioned in June 2004 via which portal users may down load the various Surveys reports and tables. The web

documents are provided in both .pdf and .xls format for the convenience of users. Onward interpretation of the data rests with the party that downloads the data.

25. All data extractions that CeSTII performs for users are governed by the Access Protocol, and are generally provided free of charge unless they require fairly substantial analytical work.
26. The full 2003/04 Research and Development Survey will be followed by the 2004/05 survey thereby marking the transition to annual rather than biennial surveys.
27. The knowledge and expertise developed through the two surveys will be codified in the CeSTII Survey Operations Manual that is currently being drafted.
28. The recurring advice from various participants in this sector continues to be that the feedback process following each survey will affect the success of future surveys. There exists a real interest in the findings of any analysis of the data, especially where these indicate the competitive standing of organizations.

Disclaimer

Survey data may be freely used, subject to the acknowledgment of its source.
Any interpretation or further analysis is the responsibility of the third party

Acknowledgements

The 2003/04 R&D Survey was launched even before the full reporting on the 2001/02 survey was completed. The second survey was conducted in new custom-designed premises that the enlarged staff occupied in December 2003. In addition the database server went on-line and this enabled more rapid compilation of the data. An ongoing process of staff development began with an international workshop in January 2004 that also served to launch the new premises of the Knowledge Management research programme. This enabling environment laid the basis for a more rapid execution of the second survey.

We again extend appreciation to the Dr. Rob Adam, Director-General of the Department of Science and Technology and his staff; to Dr. Mark Orkin, President of the HSRC, and to the members of Corporate Services.

We also acknowledge support and advice from Statistics Canada, through numerous discussions with the Dr Fred Gault, Director of the Science Innovation and Electronic Information Division and his staff.

To Icomtek (now known as the African Advanced Institute for ICT) of CSIR, our appreciation for the rapid development of version 2 of the Survey Management and Results System database in which regard we recognise the commitment of Hina Patel, Ronell Alberts and Dr Louis Coetzee.

The project team comprised Michael Kahn, William Blankley, Sagren Moodley, Sulochini Pather, Carly Steyn, Neo Molotja, Nkosikho Batatu, Iona Gutuza, Yolisa Nogenga, Natalie Vlotman, Simone Esau, and Stanley Ntukumba. All their efforts are appreciated. We also note the work of our external consultants Alanta Lachmann (Higher Education) and Julien Rumbelow (Business) and Anthony Burns (Data Analyst). The team was joined by Monique Ritter, the CeSTII Survey Manager, in May 2005 who contributed to the completion of the 2003/04 Survey.

The process of moving from the first survey team to the second went smoothly and it is clear that significant capability has been developed in a short space of time. As previously we acknowledge the cooperation of the respondents, especially those who attended to the questionnaire under pressure and even outside work hours.

Finally our appreciation to our own administration staff, especially Valda West, Fredericka Davies and Shiraaj Gamiieldien.

The R&D Survey will now be conducted annually. The steady increase in the number of requests for data extractions attests to its value to the policy community. CeSTII continues to learn and is now able further to contribute to measuring the national system of innovation.

Prof. Michael Kahn, Executive Director, Knowledge Management

Glossary of Abbreviations

AISA	Africa Institute of South Africa
ARC	Agricultural Research Council
BERD	Business Expenditure on R&D
BUS	Business
CGS	Council for Geosciences
CSIR	Council for Scientific and Industrial Research
DST	Department of Science and Technology
DTI	Department of Trade and Industry
ICT	Information and Communication Technology
FTE	Full Time Equivalent
GERD	Gross Expenditure on Research and Development
GDP	Gross Domestic Product
GOV	Government
GOVERD	Government Expenditure on Research and Development
HEI	Higher Education Institution
HERD	Higher Education Expenditure on R&D
HSRC	Human Sciences Research Council
Mintek	Council for Mineral Technology
MRC	Medical Research Council
NGO	Non-Governmental Organisation
NIF	National Innovation Fund
NPO	Not-for-Profit Organisation
NRF	National Research Foundation
OECD	Organisation for Economic Co-operation and Development
R&D	Research and Development
SABS	South African Bureau of Standards
SAIAB	South African Institute for Aquatic Biodiversity
SCI	Science Councils
SIC	Standard Industrial Classification
SMRS	Survey Management and Results System
THRIP	Technology for Human Resources and Industry Programme
UOM	Unit of Measure

Chapter 1: Introduction to the Survey

1.1 Background

In order to ensure the sustainable production of the R&D Surveys and in anticipation of the Innovation Survey, the Department of Science and Technology award a ring-fenced grant to the Knowledge Management research programme of the Human Sciences Research Council (HSRC). It was agreed that the surveys and associated work would fall within the ambit of a new Centre for Science, Technology and Innovation Indicators (CeSTII). Accordingly a new project was declared in CeSTII to carry out the National Research and Development Survey for 2003/04 following the OECD Frascati Manual of 2004.

Following the Frascati Manual, the Survey covered:

- 1. The Business Enterprise Sector:** The business sector comprises large, medium and small enterprises, including state-owned companies. Purposive sampling was undertaken using the Technology Top100 and JSE 100 and other lists including the DTI SPII, THRIP and SIP programmes, and the National Innovation Fund.
- 2. The Government Sector:** All government departments with an R&D component, government research institutions and museums
- 3. The Higher Education Sector:** 35 Higher Education Institutions (18 Universities, 8 Technikons, 3 Universities of Science and technology, 1 Institute of Technology and 5 private institutions.)
- 4. The Not-for-Profit Sector:** Non-governmental and other organisations formally registered as not-for-profit institutions.
- 5. The Science Council Sector:** the 8 science research councils plus the Africa Institute, all established through Acts of Parliament

The survey data was captured through a questionnaire that was largely common across the five sectors. The work of the Survey entailed development of appropriate sector sampling methodologies and sector specific questionnaires, development of capacity, and modification of the Survey Management and Results System (SMRS).

These sectors were surveyed over the period April 2004 to February 2005 to gather data on their R&D inputs for the 'financial year' ending 28 February 2004. For Higher Education this was the academic year 2003 viz. the calendar year. For Government departments this would be equivalent to the government financial year that ends 31 March 2004, while for Business it would be the nearest financial year to that coinciding with the tax year ending 28 February 2004.

Questionnaires were administered by post, face-to-face, electronically and telephonically. Returns were similarly gathered and augmented with telephonic completion. The bulk of

data was received by late November 2004, with final returns accepted up to the end of February 2005.

As with the case of the 2001/02 survey information system weaknesses and the merger process in the higher education sector also affected the survey timeline. As necessary institutions were assisted in compiling and furnishing their returns.

The strategy of capacity development included investment in people and systems and a number of junior staff were recruited and progressively trained in survey execution.

The Survey Management and Results System serves as the final repository for the electronic data, survey by survey. In addition a hard copy record is maintained of all respondent data. The final tabulations were effected using standard office suite database software.

That the second survey was completed in almost half the time of the first, and by a largely new team is a tribute to hard work and experiential learning. Great care was taken to ensure that the questionnaire data items were clean and consistent before any capture occurred. This painstaking work shows its value in the speed with which the final compilation occurred.

Close cooperation was maintained with the indicators Unit of the National Advisory Council on Innovation throughout the survey project life cycle. At the time of compilation of this report Statistics South Africa announced that the R&D Survey has been accorded the status of Official Statistics. The results of the 2001/03 R&D Survey will appear in the OECD publications on country R&D indicators. This dual recognition is appreciated.

1.2 Interpretation

The second survey adhered to the Frascati Manual definition of R&D:

Research and Experimental Development (R&D) is creative work undertaken on a systematic basis in order to increase the stock of knowledge, including knowledge of humanity, culture and society, and the use of this stock of knowledge to devise new applications.

The boundaries of this definition are constantly shifting, particularly as industrialized societies move further into becoming 'knowledge economies' in which the service sector dominates employment.

Two areas of R&D require careful appraisal, namely software development and medical clinical trials phases 1 through 3. Both cases constitute R&D, but are easily overlooked. Accordingly the business sector coverage was deliberately extended into the financial services sub-sector, and a special effort was made to capture the work conducted by the major pharmaceutical houses.

The 2001/02 survey aimed at a transparent interpretation of the Frascati Manual in the design of the master questionnaire and in its approach to survey methodology with the aim of establishing a solid baseline through the 2001/02 survey on which future surveys could build. The 2003/04 R&D Survey confirms the findings of the first survey concerning the resources devoted to R&D as well as its major areas of focus.

For continuity we note the following from the Frascati Manual:

“ The Frascati manual provides the conceptual framework for R&D surveys in terms of the key concepts and information requirements, it does not prescribe the specific format of the measurement tools (questionnaires). Likewise, while it provides the framework for the sectors of investigation, it does not prescribe the actual sampling design.”

As previously the lists of Research Fields and Socio-Economic Objectives were based on the system used by OECD countries, based on the Malaysian approach and similar to that used by Australia. The Standard Industrial Classification codes are those provided by Statistics SA in consultation with the DTI.

In the South African National Survey of R&D Inputs each Frascati-sector has its own questionnaire that is a version of a *master* questionnaire. The primary sources of the data from which the indicators are generated are the five sector questionnaires. In addition to this primary data, the Frascati guidelines permit the use and inclusion of other data sources such as existing government databases that might be employed either to crosscheck primary data or to fill data gaps. As appropriate such secondary sources were accessed in the course of the Survey.

Each of the sector reports contains:

- An introduction to the sector
- Key results
- Brief comments on how the survey methodology was implemented
- Basic descriptive data compiled from data in the questionnaire returns. Where data from secondary sources were used this is documented.

1.3 The Report and Dissemination

The five Sector reports are presented in Chapters 2 through Chapter 6. This is followed with a set of concluding remarks in Chapter 7.

A separate, concise overview report for wider distribution is available at www.hsrc.ac.za/RnDSurvey alongside this internal document.

For illustrative purposes the full Higher Education questionnaire and the Business sector questionnaire are provided in a separate Annex as Appendices 1 and 2 respectively. Also included are the lists of Research Fields, Socio-economic Objectives, and Standard

Industrial Classifications (Appendix 3). For completeness the Access Protocol is attached as Appendix 4.

1.4 The Indicators

The indicators provided in this document are the main subset of the S&T indicators specified for R&D surveys by the OECD. Some of the indicators have been excluded as they are not derivative of the R&D survey itself, such as those relating to government budget appropriations or outlays for R&D (GBAORD) and that relate to patent information.

However, and importantly, the list of indicators provided covers the core R&D indicators as required for endorsement by the OECD and publication in the OECD *Main Science and Technology Indicators*.

Economic and other indicators (Table I 1) for year 2003 were obtained from the following sources:

- South African Reserve Bank Quarterly and Annual Bulletins and Economic Reports
- Statistics South Africa Quarterly and Annual Releases and Labour Surveys and Census
- OECD extractions from databases as supplied to CeSTII.

Table I 1: Economic indicators 2003/04

Indicator	Value
GDP - Current Prices (Millions of Rands)	1 251 469
<i>GDP – 2000 Constant Prices (Millions of Rands)</i>	1 008 649
<i>Purchasing Power Parity (Rands per US\$)</i>	2.55
Value Added in Industry (millions of Rands)	897 316 576
Implicit GDP Price Index (Base year 2000 = 1.00)	1.241
National Population (thousands)	45 026
Labour Force (Non-primary formal sector - thousands)	6 448

Any trend analysis should be undertaken and viewed with caution, and such analysis is consequently not provided in this Report.

The five sector reports now follow. They may be read in any order as they stand independent one to another.

1.5 Summary Data

The summary data for all sectors are presented below.

All tables are subject to rounding error and in some cases do not total to precisely 100 percent.

More detailed data are presented for each sector in the individual chapters.

FINANCIAL INPUTS

Table 1.1: R&D Expenditure by Sector

	Business enterprise	Government	Higher education	Not-for-profit	Science Councils	GERD
Expenditure (R 000s)	5591325	465367	2071351	209023	1745493	10082559
Percent	55.5	4.6	20.5	2.1	17.3	100.0

Table 1.2: R&D Expenditure by Accounting category

Type of Expenditure	Business enterprise		Government		Higher education		Not-for-profit		Science Councils		Total	
	Amount		Amount		Amount		Amount		Amount		Amount	
	R 000s	%	R 000s	%	R 000s	%	R 000s	%	R 000s	%	R 000s	%
Capital Expenditure on R and D	7758490	13.9	664420	14.3	1623800	7.8	123080	5.9	1174390	6.7	11344180	11.3
<i>Land: Buildings and Other Structures</i>	1368920	2.4	263300	5.7	88250	0.4	51730	2.5	131920	0.8	1904120	1.9
<i>Vehicles, Plant, Machinery, Equipment</i>	6389570	11.4	401120	8.6	1535550	7.4	71350	3.4	1042470	6.0	9440060	9.4
Current Expenditure	48154760	86.1	3989250	85.7	19089710	92.2	1967150	94.1	16280540	93.3	89481410	88.7
<i>Labour Costs</i>	24884580	44.5	1883150	40.5	9252550	44.7	1065210	51.0	9003970	51.6	46089460	45.7
<i>Total cost of R&D postgraduate students</i>	0	0.0	0	0.0	1908920	9.2	0	0.0	0	0.0	1908920	1.9
<i>Other Current Expenditure</i>	23270180	41.6	2106100	45.3	7928240	38.3	901940	43.2	7276570	41.7	41483030	41.1
Total	55913250	100.0	4653670	100.0	20713510	100.0	2090230	100.0	17454930	100.0	100825590	100.0

Table 1.3: R&D Expenditure by Sources of Funds

Funder	Other Business	Government	Higher Education	Domestic	Foreign	Organisation	Total
Performer	R 000s	R 000s	R 000s	R 000s	R 000s	R 000s	R 000s
Business enterprise	535549	345504	5133	206396	534636	3964107	5591325
Government	3758	208904	52	12276	45065	195312	465367
Higher education	478734	848554	0	173900	224031	346132	2071351
Not-for-profit	19547	34817	1184	13360	120933	19182	209023
Science Councils	254668	950130	2664	133357	171076	233598	1745493
Total	1292256	2387909	9033	539289	1095741	4758331	10082559

Table 1.4: R&D Expenditure by Research Field

Main Research Field	Business enterprise		Government		Higher education		Not-for-profit		Science Councils		Total	
	Amount		Amount		Amount		Amount		Amount		Amount	
	R 000s	%	R 000s	%	R 000s	%	R 000s	%	R 000s	%	R 000s	%
Division 1: Natural Sciences, Technology and Engineering	5456725	97.6	372373	80.0	1424560	68.8	100388	48.0	1538663	88.2	8892708	88.2
Mathematical Sciences	43823	0.8	5782	1.2	127344	6.1	0	0.0	15492	0.9	192441	1.9
Physical Sciences	208386	3.7	0	0.0	52552	2.5	0	0.0	87967	5.0	348905	3.5
Chemical Sciences	410939	7.3	493	0.1	71479	3.5	0	0.0	50159	2.9	533070	5.3
Earth Sciences	36788	0.7	38378	8.2	94833	4.6	0	0.0	84880	4.9	254879	2.5
Information, Computer and Communication	944070	16.9	3494	0.8	58014	2.8	0	0.0	55045	3.2	1060623	10.5
Applied Sciences and Technologies	857404	15.3	16758	3.6	54238	2.6	0	0.0	101620	5.8	1030020	10.2
Engineering Sciences	1980965	35.4	116	0.0	198163	9.6	0	0.0	321668	18.4	2500912	24.8
Biological Sciences	52867	0.9	64611	13.9	159708	7.7	907	0.4	226256	13.0	504349	5.0
Agricultural Sciences	200856	3.6	141460	30.4	97996	4.7	13646	6.5	287632	16.5	741589	7.4
Medical and Health Sciences	571171	10.2	66893	14.4	433504	20.9	79775	38.2	206749	11.8	1358092	13.5
Environmental Sciences	56473	1.0	13037	2.8	37358	1.8	4940	2.4	34615	2.0	146423	1.5
Material Sciences	86627	1.5	0	0.0	31685	1.5	0	0.0	47011	2.7	165323	1.6
Marine Sciences	6355	0.1	21352	4.6	7685	0.4	1120	0.5	19570	1.1	56083	0.6
Division 2: Social Sciences and Humanities	134600	2.4	92994	20.0	646791	31.2	108635	52.0	206830	11.8	1189851	11.8
Social Sciences	134600	2.4	81866	17.6	445031	21.5	108155	51.7	198138	11.4	967790	9.6
Humanities	0	0.0	11128	2.4	201761	9.7	480	0.2	8692	0.5	222061	2.2
Total	5591325	100.0	465367	100.0	2071351	100.0	209023	100.0	1745493	100.0	10082559	100.0

Table 1.5: R&D Expenditure by socio-economic objective

Main Research Field	Business enterprise		Government		Higher education		Not-for-profit		Science Councils		Total	
	Amount		Amount		Amount		Amount		Amount		Amount	
	R 000s	%	R 000s	%	R 000s	%	R 000s	%	R 000s	%	R 000s	%
Socio-Economic Objective												
Division 1: Defence	849574	15.2	0	0.0	1679	0.1	1564	0.7	153196	8.8	1006013	10.0
Defence	849574	15.2	0	0.0	1679	0.1	1564	0.7	153196	8.8	1006013	10.0
Division 2: Economic Development	3935136	70.4	274374	59.0	628565	30.3	47946	22.9	879229	50.4	5765250	57.2
Economic Development Unclassified	0	0.0	0	0.0	93498	4.5	0	0.0	0	0.0	93498	0.9
Plant Production And Plant Primary Products	153202	2.7	44609	9.6	69061	3.3	13023	6.2	188451	10.8	468345	4.6
Animal Production and Animal Primary Products	21967	0.4	48052	10.3	58674	2.8	1376	0.7	141996	8.1	272065	2.7
Mineral Resources (Excluding Energy)	469983	8.4	0	0.0	67831	3.3	0	0.0	150228	8.6	688042	6.8
Energy Resources	277337	5.0	0	0.0	17402	0.8	920	0.4	16961	1.0	312619	3.1
Energy Supply	279093	5.0	4755	1.0	30186	1.5	718	0.3	3125	0.2	317876	3.2
Manufacturing	1023487	18.3	0	0.0	78679	3.8	0	0.0	128057	7.3	1230223	12.2
Construction	385179	6.9	1501	0.3	19548	0.9	0	0.0	36433	2.1	442661	4.4
Transport	351443	6.3	0	0.0	12109	0.6	0	0.0	54906	3.1	418458	4.2
Information and Communication Services	355231	6.4	5195	1.1	26125	1.3	0	0.0	7176	0.4	393727	3.9
Commercial Services	486682	8.7	1942	0.4	27868	1.3	3729	1.8	7234	0.4	527456	5.2
Economic Framework	14803	0.3	54990	11.8	65539	3.2	22604	10.8	35116	2.0	193052	1.9
Natural Resources	116730	2.1	113331	24.4	62045	3.0	5577	2.7	109546	6.3	407227	4.0
Division 3: Society	502865	9.0	96430	20.7	634216	30.6	144673	69.2	205207	11.8	1583390	15.7
Society Unclassified	0	0.0	0	0.0	93498	4.5	0	0.0	0	0.0	93498	0.9
Health	475478	8.5	66844	14.4	292029	14.1	76295	36.5	134099	7.7	1044744	10.4
Education and Training	16672	0.3	11853	2.5	110531	5.3	30217	14.5	31227	1.8	200500	2.0
Social Development and Community Services	10715	0.2	17732	3.8	138158	6.7	38162	18.3	39881	2.3	244648	2.4
Division 4: Environment	151043	2.7	62698	13.5	197632	9.5	6418	3.1	137520	7.9	555312	5.5
Environment Unclassified	0	0.0	0	0.0	31166	1.5	0	0.0	0	0.0	31166	0.3
Environmental Knowledge	43489	0.8	49295	10.6	68443	3.3	3883	1.9	83067	4.8	248177	2.5
Environmental Aspects of Development	56246	1.0	4679	1.0	43021	2.1	1395	0.7	17175	1.0	122517	1.2
Environmental and Other Aspects	51307	0.9	8724	1.9	55002	2.7	1140	0.5	37279	2.1	153452	1.5
Division 5: Advancement of Knowledge	152708	2.7	31865	6.8	609259	29.4	8423	4.0	370340	21.2	1172594	11.6
Advancement of Knowledge Unclassified	0	0.0	0	0.0	93498	4.5	0	0.0	0	0.0	93498	0.9
Natural Sciences, Technologies and Engineering	147486	2.6	16619	3.6	311137	15.0	5514	2.6	274691	15.7	755448	7.5
Social Sciences and Humanities	5222	0.1	15245	3.3	204623	9.9	2909	1.4	95649	5.5	323648	3.2
Total	5591325	100.0	465367	100.0	2071351	100.0	209023	100.0	1745493	100.0	10082559	100.0

Table 1.6: R&D personnel headcount by sector

	Business enterprise	Government	Higher education	Not-for-profit	Science Councils	Total
Occupation						
Researchers	5058	929	14054.54	305	2414	22760.54
Technicians	3430	322	2594	235	1612	8193
Other personnel	3120	1032	2728.5	275	2496	9651.5
Total	11608	2283	19377.04	815	6522	40605.04
%	28.6	5.6	47.7	2.0	16.1	100.0

Table 1.7: R&D personnel full-time equivalent (FTE)

	Business enterprise	Government	Higher education	Not-for-profit	Science Councils	Total	%
Occupation							
Researchers	4152.92	443.31	3373.78	257.98	1899.5	10127.49	47.8
Technicians directly	2605.03	244.61	763.33	226.05	1303.73	5142.75	24.3
Other personnel directly	2373.7	740.23	416.88	199.49	2186.18	5916.48	27.9
Total FTE	9131.65	1428.15	4553.99	683.52	5389.41	21186.72	100.0

Chapter 2: The Business Sector

2.1 Introduction

The Business Sector survey was built on the foundations of the 2001/2 survey and has benefited considerably from the accumulation of knowledge occasioned by this second survey.

The survey expanded upon its predecessor in several ways. Most notably, completed questionnaires containing non-nil BERD (business expenditure on R&D) figures increased to 366, up from 139 in 2001/2. Increased knowledge of South Africa's business sector R&D environment has led to an expanded register of R&D performers. Simultaneously the quality of information on the register has improved and survey response rates have increased. These factors have combined to enable a resultant data set that exhibits greater resolution in its aggregate picture of Business Sector R&D, while also displaying greater depth and clarity in its subsets.

Complexities in company structures and names (including trade names & brands) remain challenging and demanding as the register of known R&D performers expands. The size, dynamic nature and diverse character of the business sector contribute to the ongoing challenge to ensure greater coverage while ensuring no double counting or significant under-counting.

Historically the business sector is known to contribute the major part of R&D activity in the South African Economy. The current survey measured this contribution at 55.5%, up from the 53.7% recorded in 2001/2.

Table B1: In-house R&D expenditure by sector

Sector	2003/4		2001/2	
	R 000s	%	R 000s	*%
Business enterprise (BERD)	5,591,325	55.5	4,023,576	53.7
Government	465,367	4.6	203,110	2.7
Higher education	2,071,351	20.5	1,896,156	25.3
Not-for-profit	209,023	2.1	70,778	0.9
Science Councils	1,745,493	17.3	1,294,454	17.3
Grand Total	10,082,559	100.0	7,488,074	100.0

*Sums to 99,9%

2.2 Key Results

Table B2: Main Characteristics of the Business sector

	2003/4	2001/2
BERD	R 5,591bn	R 4, 023bn
BERD as a percentage of GDP	0.45%	0.41%
Percentage of BERD financed by industry	80.5%	81.4%
Percentage of BERD financed by government	6.2%	8.9%
Percentage of BERD financed by other national sources	3.8%	5.2%
Percentage of BERD financed from abroad	9.6%	4.5%
Total Business sector R&D personnel (FTE)	9131.7	6210.3
Total Business sector Researchers (FTE)	4152.9	2952.0

The business sector R&D community, while performing 55% of GERD, employs about a quarter (28.6%) of R&D personnel.

Table B 3: Headcount of R&D personnel by sector

	Researchers		Technicians Directly Supporting R&D		Other Personnel Directly Supporting R&D		Grand Total		%	
	2003/4	2001/2	2003/4	2001/2	2003/4	2001/2	2003/4	2001/2	2003/4	2001/2
Business enterprise	5058	3753	3430	2488	3120	2043	11608	8284	28.6	25.5
Government	929	560	322	427	1032	1151	2283	2138	5.6	6.6
Higher education *	14055	12626	2594	827	2728.5	2314	19377	15767	47.7	48.5
Not-for-profit	305	253	235	62	275	123	815	438	2.0	1.3
Science Councils	2414	2214	1612	1335	2496	2325	6522	5874	16.1	18.1
Grand Total	22761	19406	8193	5139	9652	7956	40605	32501	100.0	100.0

*Excluding Post-graduate students

The growth in R&D Personnel across all categories in the Business Sector is a combination of improved coverage and response rate as well as organic growth.

2.3 Survey Methodology

The OECD Frascati Method guides the survey and as such all definitions, standards, guidelines and methods are derived from the Frascati Manual. The manual is not prescriptive: indigenous application of method in pursuit of universally comparable indicators is encouraged in recognition that field conditions vary across the globe.

2.3.1. Measuring Instrument (Questionnaire) Design & Pilot:

The 2003/4 was in effect an expanded version of the 2001/2 business 'lite' questionnaire. It also requested direct data on FTE's whereas the 2001/2 questionnaire used a percentage of time applied to headcount.

No separate user guide was issued; rather the survey relied on an 'embedded' user guide' that took the form of text boxes dispersed throughout the body of the questionnaire.

The questionnaire was piloted at 5 companies that were deliberately varied in their size, industry and BERD. Minor improvements were made following the pilot and prior to fieldwork.

2.3.2. Sample

The Business Sector survey sample took the previous survey register as a base. This data was then verified and updated as required, while also being supplemented and processed for field correspondence.

The sample is made up of two essential parts:

- The Previous Survey's Register (containing certain surveyed results)
- Referrals (obtained through systematic intelligence gathering)

We conduct a survey based on a purposive sample with special effort made to capture all the data that most affect the unknowable total.

Essentially, large known R&D Performers are surveyed and are also interviewed to obtain information on where other large concentrations of private sector R&D may occur in the economy.

This strategy is realistic in that it leverages known knowledge resources (the existing R&D Survey register & experts in various sectors of the economy) and applies fieldwork resources to this data. It purposefully seeks all the major contributing R&D amounts and as such is likely to uncover useful and pertinent lower bounds for the total business on R&D.

Sampling beyond this initial base is described below. It is desirable to have as extensive a sampling frame as possible to achieve defensible coverage of the enterprises most likely R&D Performers.

Technology Top 100 Companies (Business Day)
Johannesburg Stock Exchange (JSE) Top 100 Companies
SPII (Support Programme for Industrial Innovation)
Expert Referrals
Business Intelligence Gathering

2.3.3 Fieldwork Methods

As mentioned above a purposive sample method was followed and a purposive sample frame was set up and iteratively extended and refined.

The fieldwork methodology recognizes the concentration of most business R&D expenditure in a relatively small proportion of enterprises. Thus, the methodology first seeks to ensure that all large known R&D performers are surveyed while also to ensuring that the survey effort is spread across all industry sectors.

Fieldwork is conducted according to Fieldwork Sectors with a specific individual(s) taking responsibility for each defined Fieldwork Sector. In conjunction with the desired objective to survey the maximum BERD without any data quality compromise, the Fieldwork Sector grouping process also aims to assimilate the following indigenous factors:

- Known concentrations of economic activity (e.g. Mining)
- Known R&D intensive clusters (e.g. Biotech)
- National Priority Areas (e.g. Health)
- Available survey resources

The ownership, control and management structures of many large enterprises are complex and thus require in-depth inquiry and research to correctly identify and measure R&D and thus ensure correctly target fieldwork. Care in such identification reduces the chance of double counting and omissions.

It is important that any notional R&D site should be specified uniquely and only once in the purposive sample frame. Duplicate entries such as those arising from inclusion of a parent and subsidiary will induce errors in BERD if undetected.

In addition, complications for contact arise from the changing nature of business. Differences in registered company names and trade names also need to be established on the register. Once contacted, the existence or otherwise within an enterprise of R&D activities consistent with the survey definitions has to be established and confirmed.

Enterprises were systematically interrogated with varying degrees of emphasis according to their notional R&D spends. This variable effort is justifiable in order to have the larger R&D amounts specified as precisely as resources permit.

The preferred respondent for the business sector is the Chief Financial Officer or equivalent. The CFO is usually the person empowered to release company financial information and has access through the other corporate components to human resources data.

Table B 4. Business Sector Fieldwork

	Sample	UOM's Identified	UOM "no R&D"	Qnres sent	Qnres returned	Nil Returns
Initial Sample (previous register)	589	433	69	310	196	33
Additional Referrals	512	370	81	177	140	17
Total	1101	803	150	487	*336	50

*not including 71 SPII nearest neighbour imputations & 9 supplementary questionnaires.

The initial sample for this survey consisted of the previous survey's register of 'probable performers' of R&D. An internal quality control process led to a purge of a significant portion of the 2001/2 Business Sector register. This portion was known contain sufficiently unreliable data and was referred to as the 'other enterprises' within the survey team.

Through the survey process, the sample frame was complimented by an additional 512 new entities. These were obtained through interviews, expert referrals and intelligence gathering on R&D performance in the business sector. The entire frame ultimately contained 1101 entities.

In all, 803 unique desired units of measure (UOM's) were identified after careful field research to determine company name and organizational structure information that would preclude any duplication. 150 of this number advised of 'no R&D' in terms of the survey definitions.

A reliable contact person was successfully engaged at 487 companies and Questionnaires were dispatched to these contacts. Successful contacts were established throughout the survey process as new referrals were processed.

Ultimately 336 Completed Survey questionnaires were obtained from the field. Of these, 85 were obtained telephonically.

In addition a further 6 supplementary questionnaires were added to the database. In such cases sufficient info about the organization had been obtained from the organization itself (but not through a completed questionnaire) & the public domain for a supplementary questionnaire to be completed by the fieldworkers.

Another three companies had their data from 2001/2 imputed pro rata to the current survey based on their known turnover and/or staff numbers.

A substantial additional 71 Questionnaires were completed using known R&D expenditure obtained through the Support Program for Industrial Innovation (SPII) annual report. Detail on the exact method agreed for imputations, commutations & supplementary questionnaire completion can be viewed in the National R&D Survey Operations Manual.

In all, data from 366 non-nil questionnaires was entered on the survey results database. Where obvious anomalies existed prior to data entry to the results system, data was cleaned through an iterative process with the field. An automated checking and cleaning process followed whereby programmed discrepancy checks were run on the data. Fieldworkers were then required to assist in cleaning data as applicable.

The Business Sector survey achieved a 69.0% response rate compared with the 23% achieved in 2001/2. This figure is inflated by the fact that fewer questionnaires were dispatched (750 in 2001/2, 487 in 2003/4) through the current survey fieldwork strategy. However, the number of completed questionnaires received from the field almost doubled the number from the previous survey (173 in 2001/2, 336 in 2003/4).

11 Companies declined participation in the survey and many more did not reply after the initial contact, questionnaire dispatch (by post or email) and subsequent follow up calls. Notwithstanding these factors there was a tremendously positive attitude to the survey from the field and a 69.0% response rate was achieved.

2.4 Detailed Results

Table B 5: BERD by accounting category 2003/4

	R 000s	R 000s	%
Capital Expenditure	775,849		13.9
Vehicles, Plant, Machinery, Equipment		638,957	11.4
Land: Buildings and Other Structures		136,892	2.4
Current Expenditure	4,815,476		86.1
Labour Costs		2,488,458	44.5
Other Current Expenditure		2,327,018	41.6
Total	5,591,325	5,591,325	100.0

Table B5 shows that labour costs (44.5%) and other current expenditure (41.6%) continue to account for a substantial part of BERD. There has been an increase in total current expenditure and in the land & buildings purchased for R&D purposes.

Table B 6: BERD by type of research 2003/4

Type of Research	R 000s	%
Pure Basic Research	239,763	4.3
Strategic Basic Research	519,582	9.3
Applied Research	1,883,082	33.7
Experimental Research	2,948,898	52.7
Total	5,591,325	100.0

The Business Sector shows a continued focus on experimental development (52.7%), up from 44.8% in 2001/2. Applied Research has fallen to 33.7 % from 37.4% in 2001/2.

It may be that the phenomena observed could be a result from an increased survey response rate and the new emphasis on financial services and the pharmaceutical industry. There has been a slight increase in Basic Research (4.3%), up from 3.8% in 2001/2.

Table B7. BERD by sources of funds 2003/04

Source	Amount		
	R 000s	R 000s	%
Funds from Own/Internal Sources	3,964,107		70.9
Internal Resources		3,964,107	70.9
Business	535,549		9.6
Locally based (domestic) business		535,549	9.6
Government and Science Councils	345,504		6.2
National & Provincial Government		246,650	4.4
Science Councils & Agency Funding		98,854	1.8
Higher Education	5,133		0.1
University/Technikon/College		5,133	0.1
Other South African Sources	206,396	206,396	3.7
Other International Sources	534,636	534,636	9.6
Total	5,591,325	5,591,325	100.0

Business sector R&D funding from own internal sources has dropped to 70.9% from 74.9% in 2001/2. Less R&D is being performed for other businesses at 9.6% down from 11.8 in 2001/2.

Most significantly, international sources of funding for business sector R&D have grown to 9.6% from 4.5% in 2001/02.

Table B 8: BERD by Research Fields 2003/4 and 2001/02

	2003/4		2001/2	
	R 000s	%	R 000s	%
Division 1: Natural Sciences, Technology and Engineering	5,456,725	97.6	3,974,369	98.8
Mathematical Sciences	43,823	0.8	11,336	0.3
Physical Sciences	208,386	3.7	16,099	0.4
Chemical Sciences	410,939	7.3	306,074	7.6
Earth Sciences	36,788	0.7	43,722	1.1
Information, Computer and Communication	944,070	16.9	717,747	17.8
Applied Sciences and Technologies	857,404	15.3	1,046,037	26.0
Engineering Sciences	1,980,965	35.4	1,367,752	34.4
Biological Sciences	52,867	0.9	34,156	0.8
Agricultural Sciences	200,856	3.6	112,158	2.8
Medical and Health Sciences	571,171	10.2	156,868	3.9
Environmental Sciences	56,473	1.0	31,161	0.8
Material Sciences	86,627	1.5	131,260	3.3
Marine Sciences	6,355	0.1	0	0.0
Division 2: Social Sciences and Humanities	134,600	2.4	49,207	1.2
Social Sciences	134,600	2.4	49,207	1.2
Humanities	0	0.0	0	0.0
Total	5,591,325	100.0	4,023,576	100.0

Regarding research fields, there was a strong emphasis (97.6%) on the natural sciences, technology & engineering. Social Sciences and Humanities were small (2.4%) but growing, up from 1.5% in 2001/2.

Engineering Sciences (35.4%) absorbed more expenditure than any other research field.

There was a significant drop in Applied Sciences and Technologies from 26.0% in 2001/2 to 15.3% in 2003/4. This could be attributed to increased respondent education occasioned by this second survey by CeSTII, with many respondents now assigning their R&D to more specific Research Fields rather than the more general Applied Sciences and Technologies.

Table B 9: BERD by Socio-Economic Objective (SEO) 2003/4 & 2001/2

	2003/4	2003/4	2001/2	2001/2
Socio-Economic Objective	R 000s	%	R 000s	%
Division 1:Defence	849,574	15.2	466,542	14.8
Defence	849,574	15.2	466,542	14.8
Division 2:Economic Development	3,935,136	70.4	1,818,874	73.2
Economic Development unclassified	0	0.0	0	0
Plant Production & Plant Primary Products	153,202	2.7	101,526	3.0
Animal Production & Animal Primary Products	21,967	0.4	0	0
Mineral Resources (Excluding energy)	469,983	8.4	468,382	19.3
Energy Resources	277,337	5.0	30,481	0.8
Energy Supply	279,093	5.0	47,864	6.0
Manufacturing	1,023,487	18.3	535,271	20.4
Construction	385,179	6.9	17,789	0.4
Transport	351,443	6.3	133,950	6.9
Information & Communication Services	355,231	6.4	163,513	8.1
Commercial Services	486,682	8.7	216,366	5.6
Economic Framework	14,803	0.3	0	0.1
Natural Resources	116,730	2.1	103,733	2.6
Division 3:Society	502,865	9.0	29,639	1.0
Society unclassified	0	0.0	0	0
Health	475,478	8.5	20,315	0.8
Education and Training	16,672	0.3	4,033	0.1
Social Development & Community Services	10,715	0.2	5,291	0.1
Division 4:Environment	151,043	2.7	75,574	1.9
Environment unclassified	0	0.0	0	0
Environmental Knowledge	43,489	0.8	26,183	0.7
Environmental Aspects Of Development	56,246	1.0	16,625	0.4
Environmental Management & Other Aspects	51,307	0.9	32,767	0.8
Division 5:Advancement of Knowledge	152,708	2.7	369,451	9.2
Advancement of Knowledge unclassified	0	0.0	0	0
Natural Sciences, Technologies & Engineering	147,486	2.6	369,451	9.2
Social Science & Humanities	5,222	0.1	0	0
Total	5,591,325	100.0	2,760,080	100.0

Research in the business community evidenced three strong socio-economic objectives: Manufacturing (18.3%) and Defence (15.2%). Notably Mineral Resources was down to 8.4% from 17.0% in 2001/2; the Society Division has accelerated from 1.0% in 2001/2 to 9.0% in 2003/4. In SEO Division 5 (Advancement of Knowledge), Natural Sciences, Technology & Engineering has dropped to 2.6% down from 9.2% in 2003/4. R&D ICT has dropped to 6.5% from 8.1%.

Table B 10: BERD by Standard Industrial Classification (SIC) 2003/4

SIC Classification	Amount		Amount	
	R 000s	%	R 000s	%
10000 Agriculture, Hunting, Forestry and Fishing			98,659	1.8
20000 Mining and Quarrying			721,503	12.9
30000 Manufacturing			2,478,200	44.3
<i>Manufacture of Food Products, Beverages and Tobacco Products</i>	128,017	2.3		
<i>Manufacture of Textiles, Clothing and Leather Goods</i>	3,376	0.1		
<i>Manufacture of Wood and Products of Wood and Cork, except furniture</i>	91,107	1.6		
<i>Manufacture of Articles of Straw and Plaiting Materials</i>				
<i>Manufacture of Paper & Paper Products</i>				
<i>Manufacture of Publishing, Printing and Reproduction of Recorded Material</i>				
<i>Manufacture of Refined Petroleum, Coke and Nuclear Fuel</i>	921,065	16.5		
<i>Manufacture of Chemicals and Chemical Products (incl. Pharmaceuticals)</i>				
<i>Manufacture of Rubber and Plastic Products</i>				
<i>Manufacture of Non-Metallic Mineral Products</i>	108,379	1.9		
<i>Manufacture of Basic Metals, Fabricated Metal Products, Machinery & Equipment</i>	342,799	6.1		
<i>Manufacture of Office, Accounting and Computing Machinery</i>				
<i>Manufacture of Electrical Machinery and Apparatus</i>	65,838	1.2		
<i>Manufacture of Radio, Television and Communication Equipment and Apparatus</i>	348,015	6.2		
<i>Manufacture of Medical, Precision and Optical Instruments, Watches and Clocks</i>				
<i>Manufacture of Transport Equipment</i>	463,272	8.3		
<i>Manufacture of Furniture, Recycling, Manufacturing not elsewhere classified</i>	6,333	0.1		
40000 Electricity, Gas and Water Supply			227,956	4.1
50000 Construction			537,300	9.6
60000 Wholesale and Retail			6,458	0.1
70000 Transport, Storage and Communication			289,070	5.2
80000 Financial Intermediation, Real Estate and Business Services			1,095,482	19.6
90000 Community, Social and Personal Services			136,697	2.4
Total			5,591,325	100.0

Manufacturing industry accounted for 44.3% of all BERD, made up dominantly of:

- SIC Division 33000 (fuels, chemicals & related products) (16.5%)
- SIC Division 38000 (transport equipment) (8.3%)
- SIC Division 37000 (radio, TV & precision equipment (6.2%)
- SIC Division 35000 (basic &fabricated metals) (6.1%)

The above four Divisions account for 83.7% of Manufacturing expenditure on R&D or 37.1% of BERD).

After Manufacturing, the next largest R&D sector, moving strongly up to second position was Financial Intermediation and Business Services (19.6%), up from 13.7% in 2001/2. This was followed by Mining and Quarrying (12.9%), down from 23.5% in 2001/2.

Other significant industries contributing to BERD for the period included Construction (9.6%) up from 0.1%, Transportation, Storage & Communication (5.2%) and Electricity, Gas & Water Supply (4.1%).

Agriculture, Forestry & Fishing was down to 1.8% from 3.0% in 2001/2.

Table B 11: Business R&D personnel Headcount and Full-time equivalent (FTE) 2003/04

	Male	Female	Total	FTE	FTE as % of Headcount
Occupation					
Researchers	3758	1300	5058	4153	82.1
Technicians directly	2491	939	3430	2605	75.9
Other personnel directly	1923	1197	3120	2374	76.1
Total	8172	3436	11608	9132	78.7

Table B11 shows the 9132 Full-Time Equivalent (FTE) R&D personnel recorded in the business sector for the survey period. This is 47 % higher than the 6210 FTE's recorded in 2001/2.

The table also shows the 11608 R&D personnel recorded in the business sector for the survey period. This is 40% higher than the 8284 R&D personnel recorded in 2001/2.

The above data show significant growth in the number of female R&D workers in the business sector. The proportion of all categories of female R&D workers appears to have grown.

Chapter 3: The Government Sector

3.1 Introduction

For the purpose of the 2003/2004 Survey, this sector was divided into National Departments, Provincial Departments, Research Institutes and Museums.

Because the sector consisted of a clearly defined universe a census approach was followed. As previously the sector was surveyed at the level of department whether national or provincial, and at the institutional level. The basic information required for the survey was in most cases only available at these levels.

The 2003/2004 survey used a core questionnaire, which did not require as much information as the previous questionnaire. A pilot survey of four suitably representative institutions was undertaken to ensure the validity of the survey instrument. Valuable feedback from the pilot led to the improvement of the final questionnaire.

3.2 Key results

Table G1: In-house R&D expenditure by sector

Sector	Subtotal	Amount	
	R 000s	R 000s	%
Business enterprise		5,591,325	55.5
Government		465,367	4.6
<i>National departments</i>	189,738		1.9
<i>Provincial departments</i>	87,015		0.9
<i>Government research institutes</i>	155,026		1.5
<i>Museums</i>	33,588		0.3
Higher education		2,071,351	20.5
Not-for-profit		209,023	2.1
Science Councils		1,745,493	17.3
GERD		10,082,559	100.0

The total government in-house R&D expenditure (GOVERD) was R 465.3 million in the 2003/2004 survey, or 4.6 % of gross national expenditure on R&D. In this sector 40.8 % of R&D expenditure went to national departments, followed by 33.3 % to research institutes, 18.7 % to provincial departments and 7.2% to museums.

Table G2: R&D personnel headcount by sector

Sector	Researchers	Technicians directly supporting R&D	Other personnel directly supporting R&D	Sector Total	Grand Total	%
Business enterprise	5058	3430	3120		11608	
Government	929	322	1032		2283	5.6
<i>National departments</i>	488	43	89	620		1.5
<i>Provincial departments</i>	97	109	555	761		1.9
<i>Government research institutes</i>	239	87	272	598		1.5
<i>Museums</i>	105	83	116	304		0.7
Higher education*	14054.54	2594	2728.5		19377.04	47.7
Science Councils	2414	1612	2496		6522	16.1
Not-for-profit	305	235	275		815	2.0
Grand Total	22760.54	8193	9651.5		40605.04	100.0

*Excluding Post-graduate students

Some 33 % of R&D personnel were located in the provincial departments, followed by national departments with 27 %, research institutes 26 % and museums with 14 %. Support staff represent 45 % of R&D personnel within this sector, followed by 41 % researchers and 14 % technicians.

3.3 Survey Methodology & Fieldwork Methods

National Departments

It was decided to post the questionnaire to respondents of the previous survey while e-mail was used to reach potential new respondents identified from the Government Directory. Although all 37 national departments and entities received questionnaires only 19 questionnaires returns were received. The low return rate may be attributed to the lack of buy-in by national departments, unfamiliarity with the purpose of the R&D Survey and to the fact that the Frascati definition of R&D excludes policy-related research. Extensive and exhaustive telephone support was employed to encourage departments to submit complete questionnaires.

The new Treasury policy in respect of budget line items for S&T (and R&D) together with the new oversight and coordination role of the Department suggests that the R&D

Survey may play a useful role in contributing to the planning framework and might itself benefit from the new budgeting environment in which R&D has enhanced status.

Provincial Departments

It was decided to survey all provincial departments at the level of Head of Department (HOD). The nine provinces were contacted for details of their HOD's and a registry with their details was created. In total 93 departments were identified in the nine provinces. This sector of government had a low response rate and could be attributed to the fact that provincial administrations are mainly involved in service delivery and the provision of scientific services both of which fall outside the scope of the Frascati guidelines. Similar fieldwork method was used as in national departments.

Museums

For the 2003/4 National R&D survey, 117 museums were surveyed. Respondents were contacted to verify their postal addresses, and to request their participation in the survey. Once all the entities postal details were verified, the museums were sent the questionnaire. By the closing date of the questionnaire, a total of 36 questionnaires were returned. The low response rate is due to the fact, that many of the museums surveyed are small in size and do not have the capacity or funds to undertake research. All the major museums returned a complete questionnaire. Any research required is sent to the central Museum Scientific Services office, which then performs the research on behalf of the museums.

Research Institutes

Fifty research institutes were surveyed in the 2003/4 National R&D survey. In the same manner as the museums respondents were contacted to verify their postal addresses and contact persons were identified to answer the questionnaire. Of the 50 entities that were surveyed 21 entities (including all major institutes) returned their questionnaires.

3.4 Detailed results

Table G3: GERD by Accounting Category

	R 000s	R 000s	%
<i>National Departments</i>			
Capital Expenditure	7,092		3.7
Vehicles, Plant, Machinery, Equipment		7,092	3.7
Land: Buildings and Other Structures		0	0.0
Current Expenditure	182,646		96.3
Labour Costs		44,053	23.2
Other Current Expenditure		138,593	73.0
Total	189,738	189,738	100.0
<i>Provincial Departments</i>			
Capital Expenditure	33,190		38.1
Vehicles, Plant, Machinery, Equipment		22,894	26.3
Land: Buildings and Other Structures		10,296	11.8
Current Expenditure	53,825		61.9
Labour Costs		37,335	42.9
Other Current Expenditure		16,490	19.0
Total	87,015	87,015	100.0
<i>Government research institutes</i>			
Capital Expenditure	18,631		12.0
Vehicles, Plant, Machinery, Equipment		5,557	3.6
Land: Buildings and Other Structures		13,074	8.4
Current Expenditure	136,395		88.0
Labour Costs		86,932	56.1
Other Current Expenditure		49,463	31.9
Total	155,026	155,026	100.0
<i>Museums</i>			
Capital Expenditure	7,529		22.4
Vehicles, Plant, Machinery, Equipment		4,569	13.6
Land: Buildings and Other Structures		2,960	8.8
Current Expenditure	26,059		77.6
Labour Costs		19,995	59.5
Other Current Expenditure		6,064	18.1
Total	33,588	33,588	100.0
<i>All Government Sectors</i>			
Capital Expenditure	66,442		14.3
Vehicles, Plant, Machinery, Equipment		40,112	8.6
Land: Buildings and Other Structures		26,330	5.7
Current Expenditure	398,925		85.7
Labour Costs		188,315	40.5
Other Current Expenditure		210,610	45.3
Total	465,367	465,367	100.0

Table G3 shows the in-house expenditure by type of expenditure (i.e. capital and current expenditure) for each component of government. The current expenditure for all the government sectors runs at 85.7% compared to a capital expenditure of 14.3%. Most of the current expenditure comprised of other current expenditure (45.3%), while capital expenditure was mostly comprised of vehicles, plant, machinery and equipment (8.6%).

Table G4: GERD by type of research

Type of Research	Amount	
	R 000s	%
Pure Basic Research	68,596	14.7
Strategic Basic Research	50,557	10.9
Applied Research	283,958	61.0
Experimental Research	62,256	13.4
Total	465,367	100.0

Table G4 illustrates R&D expenditure by the type of research undertaken by government. In this sector 61% of R&D is spent on applied research with only 14% spent on pure basic research.

Table G5: GERD by Sources of Funds

Source	Amount	Amount	
	R 000s	R 000s	%
Funds from Own/Internal Sources	195,312		42.0
Internal Resources		195,312	42.0
Business	3,758		0.8
Locally based (domestic) business		3,758	0.8
Government and Science Councils	208,904		44.9
National & Provincial Government		181,376	39.0
Science Councils & Agency Funding		27,528	5.9
Higher Education	52		0.0
University/Technikon/College		52	0.0
Other South African Sources	12,276	12,276	2.6
Other International Sources	45,065	45,065	9.7
Total	465,367	465,367	100.0

The largest component (86.9%) of government R&D expenditure was funded by government itself, through internal resources, national and provincial government as well as science councils and agency funding. The total international funding for government's R&D expenditure was R45, 065 million, or 9.7% of the specified total of in-house R&D expenditure.

Table G6: GERD by Research Field

Main Research Field	Amount	%
	R 000s	
Division 1: Natural Sciences, Technology and Engineering	372,373	80.0
Mathematical Sciences	5,782	1.2
Physical Sciences	0	0.0
Chemical Sciences	493	0.1
Earth Sciences	38,378	8.2
Information, Computer and Communication	3,494	0.8
Applied Sciences and Technologies	16,758	3.6
Engineering Sciences	116	0.0
Biological Sciences	64,611	13.9
Agricultural Sciences	141,460	30.4
Medical and Health Sciences	66,893	14.4
Environmental Sciences	13,037	2.8
Material Sciences	0	0.0
Marine Sciences	21,352	4.6
Division 2: Social Sciences and Humanities	92,994	20.0
Social Sciences	81,866	17.6
Humanities	11,128	2.4
Total	465,367	100.0

The main component, 80%, of government expenditure was spent in the division Natural Sciences, Technology and Engineering, the largest contributors to this division are Agricultural with 30% and Medical and Health Sciences with 14%. The division Social Sciences and Humanities spent 20% of government expenditure.

Table G7: GERD by Socio-Economic Objective (SEO)

	Amount	%
	R 000s	
Socio-Economic Objective		
Division 1: Defence	0	0.0
Defence	0	0.0
Division 2: Economic Development	274,374	59.0
Economic Development Unclassified	0	0.0
Plant Production And Plant Primary Products	44,609	9.6
Animal Production and Animal Primary Products	48,052	10.3
Mineral Resources (Excluding Energy)	0	0.0
Energy Resources	0	0.0
Energy Supply	4,755	1.0
Manufacturing	0	0.0
Construction	1,501	0.3
Transport	0	0.0
Information and Communication Services	5,195	1.1
Commercial Services	1,942	0.4
Economic Framework	54,990	11.8
Natural Resources	113,331	24.4
Division 3: Society	96,430	20.7
Society Unclassified	0	0.0
Health	66,844	14.4
Education and Training	11,853	2.5
Social Development and Community Services	17,732	3.8
Division 4: Environment	62,698	13.5
Environment Unclassified	0	0.0
Environmental Knowledge	49,295	10.6
Environmental Aspects of Development	4,679	1.0
Environmental and Other Aspects	8,724	1.9
Division 5: Advancement of Knowledge	31,865	6.8
Advancement of Knowledge Unclassified	0	0.0
Natural Sciences, Technologies and Engineering	16,619	3.6
Social Sciences and Humanities	15,245	3.3
Total	465,367	100.0

The major portion of government research is on Division 2: Economic Development (59%) and the least Division 5: Advancement of knowledge with 6.8%. The Advancement of Knowledge had a major drop of 16.7% when compared with the 2001/02 data. Significant increases were measured in Division 3:Society (11.4%) and Division 4:Environment (4.8%).

Table G8: Government R&D personnel Headcount and Full-time equivalent (FTE)

	Male	Female	Total	FTE	FTE as % of Headcount
Occupation					
Researchers	599	330	929	443.31	47.7
Technicians directly	170	152	322	244.61	76.0
Other personnel directly	673	359	1032	740.23	71.7
Total	1442	841	2283	1428.15	62.6

This table indicates that there are at present 443 FTE researchers in government, who spend an average of 48% of their time on research. The headcount of researcher has significantly increased from 560 in 2001/02 to 929 in 2003/04. Technicians and support staff spent relatively more time on research than researchers, which is 76% and 72% respectively.

Chapter 4: The Higher Education Sector

4.1 Introduction

As a sector, higher education is well defined in size and scope, and it was therefore surveyed as a census. The Frascati Manual (OECD, 2002)¹ describes the Higher Education Sector as composed of

- “All universities, colleges of technology and other institutions of post-secondary education, whatever their source of finance or legal status.
- It also includes all research institutes, experimental stations and clinics operating under the direct control of or administered by or associated with higher education institutions.”

The core of the sector in all countries surveyed is largely made up of universities and colleges of technology. Countries differ however, with the treatment of other post-secondary education institutions and institutes linked to universities and colleges. These include other post-secondary teaching institutions, university hospitals and clinics and “borderline” research institutions. University hospitals and clinics are generally included in the Higher Education Sector (HES) because they are both post-secondary educational institutions and because they are research units associated with higher educational institutions. If all or nearly all activities in the university hospital or clinic have a teaching or training component, the entire institution should be included as part of the HES. When only a few of the departments within the university hospital or clinic have a higher education component, only those should be classified within HES.

As far as “borderline” research institutions are concerned, those that have been set up through the use of special funds and managed by agencies that award grants to universities and have their own research institutions, are included in the higher education sector. If, however, the research conducted serves predominantly governments needs, the country may decide to classify the institution as a government sector. As far as the statistical unit is concerned, the Frascati manual recommends the research institute, centre, department, faculty and hospital or college (OECD, 2002). University owned or affiliated companies that are naturally recorded on the Companies Register are surveyed in the business sector.

The universe of Higher Education R&D performers in the 2003/04 survey differed slightly from the 2001 survey in that privately funded higher education institutions, though a small R&D component in Higher Education, were included in the survey for the first time. The 2003/04 survey was once again conducted at saturation level, although the previous classification of institutions into low, growing and high research intensity was abandoned due to the mergers that had taken place as of January 2004.

4.2 Results

Table H1: In-house R&D expenditure per sector

Sector	Sub total	Amount	
	R 000s	R 000s	%
Business enterprise		5,591,325	55.5
Government		465,367	4.6
Higher education		2,071,351	20.5
<i>Technikons</i>	65,566		0.7
<i>Universities of Technology</i>	113,137		1.1
<i>Universities</i>	1,888,727		18.7
<i>Private Higher Education</i>	3,921		0.0
Not-for-profit		209,023	2.1
Science Councils		1,745,493	17.3
Grand Total		10,082,559	100.0

The Higher Education sector accounts for 20.5% of GERD and comprises its second largest component. Universities account for just over 91% of higher education expenditure on R&D (HERD).

Table H2: R&D personnel headcount per sector

Sector	Researchers	Technicians directly supporting R&D	Other personnel directly supporting R&D	Grand Total	Grand Total	%
Business enterprise	5058	3430	3120		11608	28.6
Government	929	322	1032		2283	5.6
Higher education*	14054.54	2594	2728.5		19377	47.7
<i>Technikons</i>	644	81	82	807		2.0
<i>Universities of Technology</i>	1319	161	80	1560		3.8
<i>Universities</i>	12050.54	2352	2562.5	16965		41.8
<i>Private Higher Education</i>	41		4	45		0.1
Not-for-profit	305	235	275		815	2.0
Science Councils	2414	1612	2496		6522	16.1
Grand Total	22760.54	8193	9651.5		40605	100.0

* Excludes postgraduate students

The higher education sector accounts for 47.7% of R&D human resources and 61.7% of all researchers in the country.

4.3 Survey Methodology and fieldwork methods

In considering the variation in organisational structures and the location of what might be termed 'Frascati capable accounting capacity', the UOM during the 2001 survey comprised the Research Institute, Research Centre, Department or equivalent. The 2003/04 project team decided, however, to designate only faculties or entire institutions as units of measure due to the complexity created by using departments as the UOM and the subsequent low response rates from some departments in the 2001 survey. Many faculties did, however, fill the questionnaire at either faculty level, so-called 'Focus Area' or CESM category. As previously the 2003/04 financial year is taken as the 2003 academic year.

In total, 35 Higher Education institutions were surveyed of which 18 were universities, 8 technikons, 3 Universities of (Science) and Technology, one Institute of Technology and 5 private higher education institutions. In total, returns were received from 24 institutions, of which, one was a nil return and three private institutions declined to participate in the survey. Seven institutions had to be surveyed using supplementary data sources. A total of 146 UOM's were entered into the database.

Where a sufficiently complete questionnaire was not forthcoming, a process of obtaining trusted information from other sources was set in motion. Data were requested from the Department of Education (HEMIS data for student and staff numbers; CESM field and time spent on research), NRF, NIF, THRIP and the Medical Research Council (MRC) (in terms of research grants and postgraduate bursaries awarded to institutions). Academic staff salary scales were obtained from a number of HEIs.

As a check on the validity of these calculations, the calculations referred to above were performed for some of the other HEIs as appropriate. The results were then compared to compiled information per institution. In most cases, there were very good correlations between the data received from the institutions and the calculated data sets.

4.4 Detailed results

Table H3: HERD by accounting category

<u>Technikons</u>			
	R 000s	R 000s	%
Capital Expenditure	14,445		22.0
Vehicles, Plant, Machinery, Equipment		11,775	18.0
Land: Buildings and Other Structures		2,670	4.1
Current Expenditure	51,121		78.0
Labour Costs		35,988	54.9
Total cost of postgraduate students		7,283	11.1
Other Current Expenditure		7,850	12.0
Total	65,566	65,566	100.0
<u>Universities of Technology</u>			
Capital Expenditure	7,770		6.9
Vehicles, Plant, Machinery, Equipment		7,180	6.3
Land: Buildings and Other Structures		590	0.5
Current Expenditure	105,367		93.1
Labour Costs		70,330	62.2
Total cost of postgraduate students		5,472	4.8
Other Current Expenditure		29,565	26.1
Total	113,137	113,137	100.0

Universities			
Capital Expenditure	140,015		7.4
Vehicles, Plant, Machinery, Equipment		134,450	7.1
Land: Buildings and Other Structures		5,565	0.3
Current Expenditure	1,748,712		92.6
Labour Costs		815,166	43.2
Total cost of postgraduate students		178,137	9.4
Other Current Expenditure		755,409	40.0
Total	1,888,727	1,888,727	100.0
Private Higher Education			
Capital Expenditure	150		3.8
Vehicles, Plant, Machinery, Equipment		150	3.8
Land: Buildings and Other Structures		0	0.0
Current Expenditure	3,771		96.2
Labour Costs		3,771	96.2
Total cost of postgraduate students		0	0.0
Other Current Expenditure		0	0.0
Total	3,921	3,921	100.0
Entire Sector			
Capital Expenditure	162,380		7.8
Vehicles, Plant, Machinery, Equipment		153,555	7.4
Land: Buildings and Other Structures		8,825	0.4
Current Expenditure	1,908,971		92.2
Labour Costs		925,255	44.7
Total cost of postgraduate students		190,892	9.2
Other Current Expenditure		792,824	38.3
Total	2,071,351	2,071,351	100.0

In 2003, 92.2% of in-house R&D expenditure within the Higher Education Sector consisted of current expenditure, of which labour costs comprise over 50%.

Table H4: HERD by type of research

Type of Research	Amount	
	R 000s	%
Pure Basic Research	619,086	29.9
Strategic Basic Research	296,885	14.3
Applied Research	827,209	39.9
Experimental Research	328,170	15.8
Total	2,071,351	100.0

The Higher Education sector spent the largest portion of its R&D expenditure on basic research (44.2%) of which 29.9% was devoted to pure basic research and 14.3% to strategic basic research. Applied research (39.9%) comprised the second largest component of R&D expenditure within the sector, followed by experimental development (15.8%). Although basic research still accounts for the largest portion of R&D expenditure, the current survey shows a slight decline in expenditure devoted to that of 2002 (47.8%). Expenditure on experimental research increased slightly for the period.

Table H5: HERD by sources of funding

Source	Amount		%
	R 000s	R 000s	
Funds from Own/Internal Sources	346,132		16.7
Internal Resources		346,132	16.7
Business	478,734		23.1
Locally based (domestic) business		478,734	23.1
Government and Science Councils	848,554		41.0
National & Provincial Government		23,217	1.1
Science Councils & Agency Funding		372,061	18.0
Higher Education Vote allocated to research		453,276	21.9
Other South African Sources	173,900	173,900	8.4
Other International Sources	224,031	224,031	10.8
Total	2,071,351	2,071,351	100.0

The largest portion of funding for Higher Education R&D was derived from General University Funds (38.6%). Other important sources of funds are from local businesses (23.1%) and Science Council and Agency Funding (18%)

Table H6: HERD by Research Field

Main Research Field	Amount	
	R 000s	%
Division 1: Natural Sciences, Technology and Engineering	1,424,560	68.8
Mathematical Sciences	127,344	6.1
Physical Sciences	52,552	2.5
Chemical Sciences	71,479	3.5
Earth Sciences	94,833	4.6
Information, Computer and Communication	58,014	2.8
Applied Sciences and Technologies	54,238	2.6
Engineering Sciences	198,163	9.6
Biological Sciences	159,708	7.7
Agricultural Sciences	97,996	4.7
Medical and Health Sciences	433,504	20.9
Environmental Sciences	37,358	1.8
Material Sciences	31,685	1.5
Marine Sciences	7,685	0.4
Division 2: Social Sciences and Humanities	646,791	31.2
Social Sciences	445,031	21.5
Humanities	201,761	9.7
Total	2,071,351	100.0

According to the data presented in Table H9, Natural Sciences, Technology and Engineering together account for 68.8% of higher education expenditure on R&D, while Social Sciences and Humanities account for 31.2% of R&D expenditure. Within Division 1, Medical and Health Sciences constitute the largest component of expenditure (20.9%) followed by Engineering Sciences (9.6%) and Biological Sciences (7.7%). The same pattern was observed in 2001-2002 results.

Table H7: HERD by socio-economic objective (SEO)

	Amount	
	R 000s	%
Socio-Economic Objective		
Division 1: Defence	1,679	0.1
Defence	1,679	0.1
Division 2: Economic Development	628,565	30.3
Economic Development Unclassified	93,498	4.5
Plant Production And Plant Primary Products	69,061	3.3
Animal Production and Animal Primary Products	58,674	2.8
Mineral Resources (Excluding Energy)	67,831	3.3
Energy Resources	17,402	0.8
Energy Supply	30,186	1.5
Manufacturing	78,679	3.8
Construction	19,548	0.9
Transport	12,109	0.6
Information and Communication Services	26,125	1.3
Commercial Services	27,868	1.3
Economic Framework	65,539	3.2
Natural Resources	62,045	3.0
Division 3: Society	634,216	30.6
Society Unclassified	93,498	4.5
Health	292,029	14.1
Education and Training	110,531	5.3
Social Development and Community Services	138,158	6.7
Division 4: Environment	197,632	9.5
Environment Unclassified	31,166	1.5
Environmental Knowledge	68,443	3.3
Environmental Aspects of Development	43,021	2.1
Environmental and Other Aspects	55,002	2.7
Division 5: Advancement of Knowledge	609,259	29.4
Advancement of Knowledge Unclassified	93,498	4.5
Natural Sciences, Technologies and Engineering	311,137	15.0
Social Sciences and Humanities	204,623	9.9
Total	2,071,351	100.0

Research and Development within the Higher Education Sector is largely concentrated within the Socio-Economic Objective categories of Economic Development (30.3),

Society (30.6) and the Advancement of Knowledge (29.4). Consistent with 2001, health constitutes almost 50 percent of research within Division.

Table H8: Higher education postgraduate student headcount by gender and qualification

Qualification	Male	Female	Total
Post-doctoral fellows	225	132	357
Doctoral Degree or Equivalent	4537	3053	7590
Masters Degree or Equivalent	10422	8046	18468
Total	15184	11231	26415

Of the 26415 postgraduate students in Higher Education, 57.4% are male. Gender representation is most strongly skewed amongst post-doctoral fellows, where over 63% are male.

Table H9: Higher education R&D personnel headcount and full-time equivalent (FTE)

Occupation	Male	Female	Total	FTE	FTE as % of Headcount
Researchers	8276.38	5778.16	14055	3373.78	24.0
Technicians directly supporting R&D	1531	1063	2594	763.33	29.4
Other personnel directly supporting R&D	1170	1558.5	2728.5	416.88	15.3
Total	10977	8399.7	19377	4553.99	23.5

According to the data presented in Table H14, there are 3 374 FTE researchers in higher education, from which one may calculate that researchers in HEI's spend on average 24.0% of their time on R&D. Technicians spend an average of 29.4% of their time on R&D, and support staff spend 15.3% of their time on R&D. According to the above results FTE researchers in the higher education sector have decreased since 2001 when they spent 27% of their time of R&D.

Table H10: Higher education postgraduate student headcounts by gender and qualification

Qualification	Male	Female	Total	FTE	FTE as % of Headcount
Post-doctoral fellows	225	132	357	313.3	87.8
Doctoral Degree or Equivalent	4537	3053	7590	3690	48.6
Masters Degree or Equivalent	10422	8046	18468	6411.4	34.7
Total	15184	11231	26415	10415	39.4

According to the data above, post-doctoral fellows spend 87.7 % of their time on R&D, while doctoral students spend 48.6% of their time on R&D.

Chapter 5: The Not-for-profit Sector

5.1 Introduction

The definition of the NPO sector is taken from the Southern African Non-Governmental Organisation Network report (SANGONET, 2003). NPOs are defined in terms of five broad structural and operational criteria:

It is difficult to define R&D in the NPO sector according to definitions used in other sectors because of the differing nature of R&D in this sector. Many of the respondents also felt that the Frascati definition of R&D was biased towards natural science, whilst most NPOs specialize in social sciences.

Currently this sector accounts for the smallest proportion (2.1%) of the total R&D expenditure across all sectors in South Africa.

Not-for profit R&D personnel make up only 2.0% of the total R&D workforce. The Survey found that the NPO sector accounted for 305 researchers, which constitutes 2.0% of the national total of 22760.54 researchers.

Although an increase in R&D expenditure and R&D personnel was noted in this survey, this can mainly be ascribed to better coverage of the NPO sector. Despite a better understanding of the sector, it remains somewhat problematic to survey the NPO sector as some respondents still reported a lack of capacity to participate in surveys. The length and complexity of the survey instrument requires them to allocate significant time and resources towards completion of the questionnaire, which may not be readily available.

5.2 Key results

Table N1: In-house R&D expenditure by sector

Sector	Amount	
	R 000s	%
Business enterprise	5,591,325	55.5
Government	465,367	4.6
Higher education	2,071,351	20.5
Not-for-profit	209,023	2.1
Science Councils	1,745,493	17.3
Grand Total	10,082,559	100.0

The total R&D expenditure for the NPO sector was R209 million in 2003/04. In the NPO sector a slight increase in the amount of R&D spent was noticed, however the NPO sector

still accounts for the smallest proportion (2.1%) of the total R&D expenditure across all sectors in South Africa.

Table N2: Main Characteristics of the NPO Sector

Not for Profit domestic expenditure on R&D (thousands):	R 209,023
Not for Profit expenditure on R&D as a percentage of GDP:	0.02%
Total Not for Profit R&D personnel (FTE)	684
Total Not for Profit researchers (FTE)	258
% Of NPO expenditure on R&D financed by industry	9.40%
% Of NPO expenditure on R&D financed by government:	16.70%

Table N3: Headcount of R&D personnel by sector

Sector	Researchers	Technicians directly supporting R&D	Other personnel directly supporting R&D	Grand Total	%
Business enterprise	5058	3430	3120	11608	28.6
Government	929	322	1032	2283	5.6
Higher education*	14054.54	2594	2728.5	19377.04	47.7
Not-for-profit	305	235	275	815	2.0
Science Councils	2414	1612	2496	6522	16.1
Grand Total	22760.54	8193	9651.5	40605.04	100.0

*Excluding Postgraduate students

R&D personnel of the NPO sector make up only 2.0% of the total R&D workforce. The Survey found that the NPO sector accounted for 305 researchers, which constitutes 1.3% of the national total of 22760.54 researchers.

5.3 Survey Methodology and Fieldwork Methods

A purposive sample method was followed and only NPO's, who were considered likely to undertake R&D activities, were added to the registry. The existing registry created for the 2001/02 R&D survey was updated and further expanded using various resources.

The NPO registry has been extended to approximately 120 entities to allow for greater representation in this sector. Information about these organizations were accessed or extracted from:

- The list of NGO's produced by Sangonet for the HSRC
- Prodder Directory
- The Directory of southern African Development Organisations 2002/03 edition
- The Environmental Resource Directory
- Internet searches
- References / referrals from various colleagues that were familiar with the NPO sector

A pilot survey was conducted with three organisations. They were provided with the necessary background information on the survey and its overall objective. Interviews were conducted with these respondents and based on their feedback the relevant documents (questionnaire & codes books) were subsequently modified.

120 NPOs' were surveyed via post / email and a few questionnaires were completed telephonically. These were followed up with intensive telephonic support and reminders. Completed questionnaires were checked for completeness & accuracy of data before being uploaded into the database.

Fifty-two (43%) of the hundred-and-twenty questionnaires sent, were returned. Of these, 16 were "nil" returns. "Nil" returns refers to questionnaires where the respondent indicated that no R&D input, either financial or human, had been made in the survey year. Hence, a total of 36 (69%) of the 52 returned questionnaires reported R&D expenditures for 2003/04. There was a noticeable increase in the number of NPOs that participated in this survey despite the fact that some of the organisations which participated in the previous survey have either closed down or phased out their R&D activities.

5.4 Detailed results

Table N4: NPO R&D by accounting category

	R 000s	R 000s	%
Capital Expenditure	12,308		5.9
Vehicles, Plant, Machinery, Equipment		7,135	3.4
Land: Buildings and Other Structures		5,173	2.5
Current Expenditure	196,715		94.1
Labour Costs		106,521	51.0
Other Current Expenditure		90,194	43.2
Total	209,023	209,023	100.0

Current expenditure of R197 million on labour costs and other related expenses accounts for almost the entire portion (94.1%) of the total NPO expenditure on R&D. Only a small proportion (5.9%) accounts for the cost of infrastructure, equipment and buildings and maintenance of physical plant. The percentage breakdown of capital and current expenditure is similar to the ratio seen in the 2001/02 survey.

Table N5: NPO R&D expenditure by type of research

Type of Research	R 000s	%
Pure Basic Research	32,429	15.5
Strategic Basic Research	32,848	15.7
Applied Research	118,698	56.8
Experimental Research	25,048	12.0
Total	209,023	100.0

More than half (56.8%) of the total R&D expenditure in the NPO sector supports applied research, whilst the other 43.2% are accounted for by pure basic, strategic basic and experimental research. The amount spent on applied research in the NPO sector vastly exceeds expenditure on other types of research.

Table N6: NPO R&D expenditure by sources of funds

Source	R 000s	R 000s	%
Funds from Own/Internal Sources	19,182		9.2
Internal Resources		19,182	9.2
Business	19,547		9.4
Locally based (domestic) business		19,547	9.4
Government and Science Councils	34,817		16.7
National & Provincial Government		22,805	10.9
Science Councils & Agency Funding		12,012	5.7
Higher Education	1,184		0.6
University/Technikon/College		1,184	0.6
Other South African Sources	13,360	13,360	6.4
Other International Sources	120,933	120,933	57.9
Total	209,023	209,023	100.0

It is a characteristic of the NPO sector that the largest source of funding is derived from international development agencies.

Table N7: NPO R&D expenditure by research fields (RF)

	R 000s	%
Division 1: Natural Sciences, Technology and Engineering	100,388	48
Mathematical Sciences	0	0
Physical Sciences	0	0
Chemical Sciences	0	0
Earth Sciences	0	0
Information, Computer and Communication	0	0
Applied Sciences and Technologies	0	0
Engineering Sciences	0	0
Biological Sciences	907	0
Agricultural Sciences	13,646	7
Medical and Health Sciences	79,775	38
Environmental Sciences	4,940	2
Material Sciences	0	0
Marine Sciences	1,120	1
Division 2: Social Sciences and Humanities	108,635	52
Social Sciences	108,155	52
Humanities	480	0
Total	209,023	100

The research fields indicate that the focus of R&D spending is equally supportive of research in the Social Sciences (52%) and Natural Sciences, Technology and Engineering (48%).

Table N8: NPO R&D expenditure by socio-economic objective (SEO)

	R 000s	%
Socio-Economic Objective		
Division 1: Defence	1,564	0.7
Defence	1,564	0.7
Division 2: Economic Development	47,946	22.9
Economic Development Unclassified	0	0.0
Plant Production And Plant Primary Products	13,023	6.2
Animal Production and Animal Primary Products	1,376	0.7
Mineral Resources (Excluding Energy)	0	0.0
Energy Resources	920	0.4
Energy Supply	718	0.3
Manufacturing	0	0.0
Construction	0	0.0
Transport	0	0.0
Information and Communication Services	0	0.0
Commercial Services	3,729	1.8
Economic Framework	22,604	10.8
Natural Resources	5,577	2.7
Division 3: Society	144,673	69.2
Society Unclassified	0	0.0
Health	76,295	36.5
Education and Training	30,217	14.5
Social Development and Community Services	38,162	18.3
Division 4: Environment	6,418	3.1
Environment Unclassified	0	0.0
Environmental Knowledge	3,883	1.9
Environmental Aspects of Development	1,395	0.7
Environmental and Other Aspects	1,140	0.5
Division 5: Advancement of Knowledge	8,423	4.0
Advancement of Knowledge Unclassified	0	0.0
Natural Sciences, Technologies and Engineering	5,514	2.6
Social Sciences and Humanities	2,909	1.4
Total	209,023	100.0

The research with the strongest socio-economic objectives within this sector is Division 3 (Society 69.2%) followed by Division 2 (Economic Development 22.9%). This pattern was noted in both the 2001/02 and 2003/04 R&D surveys.

Within Division 3 the major expenditure was spent on Health (36.5%), Social Development and Community Services (18.3%) & Education and Training (14.5%).

Table N9: NPO R&D personnel Headcount and Full-time equivalent (FTE)

	Male	Female	Total	FTE	FTE as % of Headcount
Occupation					
Researchers	149	156	305	257.98	84.6
Technicians directly Supporting R&D	67	168	235	226.05	96.2
Other personnel directly supporting R&D	93	182	275	199.49	72.5
Total	309	506	815	683.52	83.9

Table N9 indicates that in the NPO sector there are 257 FTE Researchers who on average spend about 85% of their time on research.

Technicians (226 FTE) spend approximately 96% of their time on R&D while support staff (199 FTE) dedicates 72% of their time to R&D.

The NPO sector accounted for 305 researchers, 235 technicians and 275 other personnel directly supporting R&D. The ratios for researchers, technicians and other personnel directly supporting R&D are similar to that found in the 2001/02 survey. Females were well represented and accounted for 62% of the total headcounts.

Chapter 6: Science Councils Sector

6.1. Introduction

There are nine Science Councils in the country and they include; the Africa Institute of South Africa (AISA), the Council for Scientific and Industrial Research (CSIR), the Human Sciences Research Council (HSRC), the Medical Research Council (MRC), the Council for Minerals Technology (Mintek), the Agricultural Research Council (ARC), the National Research Foundation (NRF, including the national facilities), the Council for Geoscience (CGS) and the South African Bureau of Standards (SABS).

Whilst the Science Councils are government funded organizations they are surveyed as a separate sector. It is a simple matter to combine the Science Councils and Government should such aggregation be required.

In 2004, the Pretoria Zoological Gardens was declared a national facility. Its functions are now coordinated by the NRF.

6.2 Key Results

Table S1: In-house R&D expenditure by sector

Sector	R 000s	%
Business enterprise	5,591,325	55.5
Government	465,367	4.6
Higher education	2,071,351	20.5
Not-for-profit	209,023	2.1
Science Councils	1,745,493	17.3
Grand Total	10,082,559	100.0

In 2003/04, the Science Councils accounted for R1 745 493 million worth of R&D expenditure, which was equivalent to 17.3% of GERD (Table S1). The same value was recorded during the 2001/2 survey.

Table S2: Main characteristics of the Science Council sector

Expenditure on R&D (thousands)	R 1,745,493
Expenditure on R&D as a % of GDP	0.14%
R&D personnel FTE	5389
Researchers (FTE)	1899.5
Researcher Headcount	2414
% Expenditure on R&D financed by local industry	14.6%
% Expenditure on R&D financed by government	54.4%

The expenditure of the science councils as a percentage of GDP increased from 0.13% to 0.14%. The expenditure in real terms increased by about R500 million.

The researcher FTE in the science councils increased by 135 in the 2003/4 survey. The total value (1899.5) indicates that, on average, researchers spend about 78.7% (79.7% during 2001/2) of their time on research.

Table S3: R&D personnel headcount by sector

Sector	Researchers	Technicians directly supporting R&D	Other personnel directly supporting R&D	Grand Total	%
Business enterprise	5058	3430	3120	11608	28.6
Government	929	322	1032	2283	5.6
Higher education	14054.54	2594	2728.5	19377.04	47.7
Not-for-profit	305	235	275	815	2.0
Science Councils	2414	1612	2496	6522	16.1
Grand Total	22760.54	8193	9651.5	40605.04	100.0

Science councils' R&D personnel make up 16.1% of the total R&D workforce. The number has decreased by 2% (2001/2) even though the headcount total has increased from 5874 in 2001/2 to 6522 in 2003/4.

However this number is still in line with the proportion of GERD shown in Table S1.

6.3 Survey Methodology

At the beginning of the 2001/2 National R&D survey, the survey team met with the CEO or representatives of each of the science council alerting them to the forthcoming surveys. The objective of the interviews was to outline the purpose of the National R&D survey and expectations by DST from each of the council. The other issue was to determine the appropriate approach to the fieldwork and conduct persons within the science councils. The result was a 100% return rate from the science council sector. Given this background, the 2003/4 survey team thought it was not necessary to pilot each science council but to choose one or two that proved to be problematic during the 2001/2 survey. Pilot tests of the questionnaire were accordingly run at two Science Councils. Ambiguities and unclear sections were rectified in consultation with other sectors. At the same time, the CEO and contact persons of the other Science Councils were sent letters to notify them of the upcoming survey.

All but two of the Science Councils preferred to use the top organization as the unit of measure. The other two completed the questionnaire at the level of the unit or facility. Twenty-eight hardcopy questionnaires were sent to the field accompanied by e-mail versions as requested. All 28 questionnaires were returned and only three were nil returns. Although the return rate was 100% for this survey, not every questionnaire was

fully completed and it was the duty of the fieldworker to follow up with the contact persons. The questionnaires were checked for accuracy and completeness before being uploaded on the SMRS.

6.4 Detailed results

Table S4: Science council R&D expenditure by accounting category

	R 000s	R 000s	%
Capital Expenditure	117,439		6.7
Vehicles, Plant, Machinery, Equipment		104,247	6.0
Land: Buildings and Other Structures		13,192	0.7
Current Expenditure	1,628,054	0	93.3
Labour Costs		900,397	51.6
Other Current Expenditure		727,657	41.7
Total	1,745,493	1,745,493	100.0

Current expenditure still accounts for a very high proportion (93.3%) of science councils' expenditure on R&D. The table shows that only 7% of expenditure is on the investment in infrastructure and research equipment.

This low capital expenditure carries potential future risk.

Table S5: Science council R&D expenditure by type of research

Type of Research	R 000s	%
Pure Basic Research	209,178	12.0
Strategic Basic Research	366,438	21.0
Applied Research	752,489	43.1
Experimental Research	417,388	23.9
Total	1,745,493	100.0

Table S5 shows that the expenditure on basic research has increased from 27.8% during 2001/2 to 33% during 2003/4 while applied research decreased from 47.1% to 43.1% during the same period. Experimental research also decreased from 25.1% to 23.9 % during the 2003/4 period.

Table S6: Science council R&D expenditure by sources of funds

Source	R 000s	R 000s	%
Funds from Own/Internal Sources	233,598		13.4
Internal Resources		233,598	13.4
Business	254,668		14.6
Locally based (domestic) business		254,668	14.6
Government and Science Councils	950,130		54.4
National & Provincial Government		844,533	48.4
Science Councils & Agency Funding		105,597	6.0
Higher Education	2,664		0.2
University/Technikon/College		,2664	0.2
Other South African Sources	133,357	133,357	7.6
Other International Sources	171,076	171,076	9.8
Total	1,745,493	1,745,493	100.0

Overall, Government directly funded 54.5% of Science Council R&D expenditure. The total international funding for Science Councils' R&D expenditure increased from R121.6 million, or 9.4% of total expenditure during 2001/2 survey to R171.1 million during the 2003/4 period. It should also be noted that some Science Councils received funding from Higher education institutions.

Table S7: Science council R&D expenditure by research field

Main Research Field	R 000s	%
Division 1: Natural Sciences, Technology& Engineering	1,538,663	88.2
Mathematical Sciences	15,492	0.9
Physical Sciences	87,967	5.0
Chemical Sciences	50,159	2.9
Earth Sciences	84,880	4.9
Information, Computer and Communication	55,045	3.2
Applied Sciences and Technologies	101,620	5.8
Engineering Sciences	321,668	18.4
Biological Sciences	226,256	13.0
Agricultural Sciences	287,632	16.5
Medical and Health Sciences	206,749	11.8
Environmental Sciences	34,615	2.0
Material Sciences	47,011	2.7
Marine Sciences	19,570	1.1
Division 2: Social Sciences and Humanities	206,830	11.8
Social Sciences	198,138	11.4
Humanities	8,692	0.5
Total	1,745,493	100.0

One notes significant changes when comparing these figures with the data obtained during the 2001/2 survey. The expenditure on the Agricultural sciences decreased from R309 057 (23.9% of total R&D expenditure) to R287 632 or 16.5%. During the same period the expenditure on engineering sciences increased from 15.8% to 18.4% and biological sciences increased from 7.7 to 13.0 %. Although the actual spending in Rands increased in the medical and health sciences, its share of the total GERD in the Science councils has decreased from 13.8 to 11.8%. The expenditure in the social sciences also increased significantly from R82 197 (6.3%) to R198 138 (11.4%).

Table S8: Science Council R&D expenditure by socio-economic objective (SEO)

Socio-Economic Objective	R 000s	%
Division 1: Defence	153,196	8.8
Defence	153,196	8.8
Division 2: Economic Development	879,229	50.4
Economic Development Unclassified	0	0.0
Plant Production And Plant Primary Products	188,451	10.8
Animal Production and Animal Primary Products	141,996	8.1
Mineral Resources (Excluding Energy)	150,228	8.6
Energy Resources	16,961	1.0
Energy Supply	3,125	0.2
Manufacturing	128,057	7.3
Construction	36,433	2.1
Transport	54,906	3.1
Information and Communication Services	7,176	0.4
Commercial Services	7,234	0.4
Economic Framework	35,116	2.0
Natural Resources	109,546	6.3
Division 3: Society	205,207	11.8
Society Unclassified	0	0.0
Health	134,099	7.7
Education and Training	31,227	1.8
Social Development and Community Services	39,881	2.3
Division 4: Environment	137,520	7.9
Environment Unclassified	0	0.0
Environmental Knowledge	83,067	4.8
Environmental Aspects of Development	17,175	1.0
Environmental and Other Aspects	37,279	2.1
Division 5: Advancement of Knowledge	370,340	21.2
Advancement of Knowledge Unclassified	0	0.0
Natural Sciences, Technologies and Engineering	274,691	15.7
Social Sciences and Humanities	95,649	5.5
Total	1,745,493	100.0

The 2001/2 survey showed that the Science Councils conducted the major part of their research in areas with a bearing on Economic Development (55.6%). This decreased by 5.2% in the 2003/4 period. Research in activities associated with defence increased by 2.2% while research influencing environment and society decreased slightly. The R&D expenditure devoted to the

division Advancement of Knowledge increased from 15.1% to 21.2%. These results tie in well with the increase in expenditure on basic research noted on Table S5.

Nearly half (47.9%) of the R&D personnel in the sector have degrees; 25.3% have diplomas, and 26.8% have other qualifications. Amongst researchers, 56.5% have a masters or doctoral degree. The researcher component of this sector is still dominated by whites, and researchers from the three groups representing black researchers account for only 27.8% of the researchers. Women account for 38.9% of the R&D personnel in the sector and 36.7% of researchers.

Table S9: Science council R&D personnel headcount and full-time equivalent (FTE)

	Male	Female	Total	FTE	FTE as % of Headcount
Occupation					
Researchers	1505	909	2414	1899.5	78.7
Technicians directly	760	852	1612	1303.73	80.9
Other personnel directly	1626	870	2496	2186.18	87.6
Total	3891	2631	6522	5389.41	82.6

In the Science Councils the total number of researchers has increased since 2001. The same is observed for technicians. Technicians spend the most amount of time (81%) on research. This pattern is the same as in the 2001/02 survey.

Chapter 7: Concluding Remarks and Observations

The 2003/04 Survey is the second that the Centre for Science, Technology and Innovation Indicators has conducted for the Department.

The survey design and fieldwork took less than a year to perform with the publication on 13 April 2004 of the Key High-Level Results occurring exactly a year after commencement of the work.

The coverage attained in this second survey demonstrates a marked improvement on that of the 2001/02 survey. This was attributed to the experience gained in the 2001/02 survey, an improved CeSTII staff component and, equally important, the experience that CeSTII had gained the trust and confidence of many respondents from the first survey. Respondents, particularly in the business sector, felt more comfortable in cooperating knowing that they had previously submitted a completed questionnaire to CeSTII.

It is clear therefore that considerable learning in both CeSTII and the respondent community has taken place.

In parallel with performing the second survey, CeSTII staff undertook two related processes.

- The first was to compile and submit the data of the 2001/02 survey to the OECD for inclusion in the *Main S&T Indicators* publication.
- The second was to subject the 2001/02 survey data to the standards demanded of Statistics SA for declaration as Official Statistics.

At the time of release of this report both of these submissions have been successful.

In the case of OECD the full time series of R&D survey GERD/GDP data back to 1983, suitably adjusted by OECD for changes in GDP, are now included in *Main S&T Indicators*

The R&D Survey for 2004/05 is currently being launched and this marks the start of a series of regular annual R&D Surveys in South Africa. This will allow the development of a reliable and valid database of R&D data over time and a better understanding of South Africa's NSI and international standing.