SOUTH AFRICAN NATIONAL SURVEY OF RESEARCH AND EXPERIMENTAL DEVELOPMENT

STATISTICAL REPORT 2018/19

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DISSEMINATION

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User feedback

A User Satisfaction Survey (USS) questionnaire is included as **Annexure G** of this report. It would be very much appreciated if users could complete the questionnaire and return it by e-mail to CeSTIIData@hsrc.ac.za. The feedback is analysed following each survey cycle to ensure the continued improvement of the R&D Survey.

Revisions

The Department of Science and Innovation (DSI), Statistics South Africa (Stats SA) and the Human Sciences Research Council's Centre for Science, Technology and Innovation Indicators (HSRC-CeSTII) jointly reserve the right to revise the data, indicators and analysis contained in this report. Such revisions may result from revisions by Stats SA of socio-economic indicators such as the gross domestic product (GDP), or population or employment numbers, or amendments in response to internal and external data quality and consistency monitoring such as that carried out by the Organisation for Economic Co-operation and Development (OECD), which conducts quality checks through global comparative analysis, time series analyses and other methods. Explanations of any revisions will be made available and accessible on the DSI and HSRC websites.

FOREWORD

South Africa's R&D statistics are key to monitor the R&D investment and human resource profile of the country and to inform Science, Technology and Innovation (STI) policy implementation by government. These statistics are also of use as a source of evidence to the private sector, the international community, media, and researchers.

The National Survey of Research and Experimental Development (R&D Survey), which forms a part of the National Statistics System, is published annually by the Department of Science and Innovation (OSI) in partnership with Statistics South Africa, and in alignment with the Statistics Act (No. 6 of 1999).

The R&D Survey is conducted by the Human Sciences Research Council's Centre for Science, Technology and Innovation Indicators (CeSTII), in accordance with the international guidelines published by the Organisation for Economic Co-operation and Development (OECD), known as the Frascati Manual. The resulting statistics provide important evidence on the size, growth and composition of R&D expenditure and human resources devoted to R&D.

During the second quarter of 2018, the South African economy slipped into recession to the extent that GDP decreased by 0.6 of a percentage point, from 1.4% to 0.8% (Stats SA, 2020).

Gross domestic expenditure on research and development (GERD) for 2018/19 amounted to R36.784 billion in current values, a decline of 5% (R1.941 billion) from the R38.725 billion recorded in 2017/18. This represents the first such decline since the contraction of GERD recorded between 2009 and 2010.

R&D intensity, measured as GERD as a percentage of gross domestic product (GDP) at current prices, has therefore also declined by eight basis points, from 0.83% in 2017/18 to 0.75% in 2018/19.

In terms of Survey performance, the R&D Survey project's plan is cast according to the phases of the Statistical Value Chain (SVC) promoted by South African Statistical Quality Assessment Framework (SASQAF) requirements. SASQAF is the instrument used for assessing the quality of the statistical reports for accreditation as official statistics. Each year the R&D Survey is subjected to a stringent quality assessment process, which is undertaken by a Clearance Committee comprising experts from various sectors. This report is the ninth in the series of R&D Survey statistical reports since the inception of a clearance process prior to the release of the annual data. To validate the quality of the survey, independent verification by the technical clearance committee was initiated in this survey round.

The assessment revealed that the 2018/19 R&D Survey was conducted following good practice and was found to meet most of the quality requirement of the R&D Survey Assessment Tool. Notably, the current survey was negatively impacted by COVID-19 lockdowns and restrictions, particularly during the final stages of the data collection phase. To mitigate against the likelihood of a lower response rate, the fieldwork period was extended, the top 200 R&D performing business companies were targeted for additional effort, and where possible, data were imputed and signed-off by respondents.

Based on my assessment of the Clearance Committee recommendations, I endorse the 2018/19 R&D Survey, with the caveat that time series analysis of the data using the 2018/19 R&D Survey estimates need to be done with caution, taking into consideration the relatively low response rate due to the advent of COVID-19.

Risenga Maluleke
Statistician-General
REPUBLIC OF SOUTH AFRICA
18 February 2021

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The South African National Survey of Research and Experimental Development is conducted annually by HSRC-CeSTII on behalf of the DSI.

The project team extends its appreciation to Dr Phil Mjwara, Director-General of the DSI, Risenga Maluleke, Statistician-General, Prof. Crain Soudien, CEO of the HSRC, and Prof. Leickness Simbayi, Deputy CEO: Research of the HSRC, for their support of the R&D Survey.

The support and contributions of Dr Glenda Kruss, Executive Head of CeSTII, Imraan Patel, Godfrey Mashamba, Tshidi Lekala, Kgomotso Matlapeng-Matjila and Thabo Manyaka of the DSI are much appreciated.

Technical inputs and advice by the DSI and Statistics South Africa teams as well as the Clearance Committee for Science, Technology and Innovation Statistical Reports have helped improve the quality of this publication and are appreciated. Interactions with the OECD Working Party of National Experts on Science and Technology Indicators (NESTI) have provided invaluable assistance in maintaining the quality and standard of the South African R&D surveys and analysis of the results.

The HSRC-CeSTII project team for the 2018/19 South African National Survey of Research and Experimental Development comprised: Curtis Bailey, Lindiwe Binda, Yasser Buchana, Mario Clayford, Amy Kahn, Atoko Kasongo, Nhlanhla Malaza, Precious Mudavanhu, Jerry Mathekga, Neo Molotja, Audrey Mahlaela, Sintu Mavi, Nazeem Mustapha, Gerard Ralphs, Janine Senekal, Theodore Sass, Natasha Saunders, Kgabo Ramoroka, Viwe Sigenu, Moses Sithole, Anele Slater, Natalie Vlotman, Luthando Zondi, and Sibusiso Ziqubu.

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We are most grateful for and acknowledge the cooperation of the respondents to the questionnaire.

ABBREVIATIONS

ABS	Australian Bureau of Statistics
AIDS	Acquired Immune Deficiency Syndrome
BERD	Business expenditure on R&D
CeSTII	Centre for Science, Technology and Innovation Indicators
DSI	Department of Science and Innovation
DST	Department of Science and Technology
FTE	Full-time equivalent
GDP	Gross domestic product
GERD	Gross domestic expenditure on R&D
GOVERD	Government intramural expenditure on R&D
HEMIS	Higher Education Management Information System
HERD	Expenditure on R&D in the higher education sector
HIV	Human Immunodeficiency Virus
HSRC	Human Sciences Research Council
ICT	Information and communication technologies
JSE	Johannesburg Stock Exchange
NABS	Nomenclature for the Analysis and Comparison of Scientific Programs
NESTI	National Experts on Science and Technology Indicators
NIFU	Nordic Institute for Studies in Innovation, Research and Education
NPO	Not-for-profit organisation
NSI	National system of innovation
NSO	National statistical organisation
OECD	Organisation for Economic Co-operation and Development
R&D	Research and experimental development
RDSMS	Research and Development Survey Management System
SA	South Africa
SANBI	South African National Biodiversity Institute
SARAO	South African Radio Astronomical Observatory
SASQAF	South African Statistical Quality Assessment Framework
SOE	State-owned enterprise
SEO	Socio-economic objective
SIC	Standard Industrial Classification
SNA	System of National Accounts
SPII	Support Programme for Industrial Innovation
Stats SA	Statistics South Africa
SVC	Statistical value chain
TB	Tuberculosis
VAT	Value Added Tax

DEFINITIONS AND DESCRIPTIONS

Applied research is original investigation undertaken in order to acquire new knowledge. It is, however, directed primarily towards a specific practical aim or objective.

Basic research is experimental or theoretical work undertaken primarily to acquire new knowledge of the underlying foundation of phenomena and observable facts, without any particular application or use in view.

Biotechnology is an application of science and technology to living organisms as well as parts, products and models thereof, to alter living or non-living materials for the production of knowledge, goods and services.

Capital expenditures are the annual gross expenditures on fixed assets used in the R&D programmes of statistical units. These are reported in full for the period when they took place and are not registered as an element of depreciation. Capital expenditures on R&D consist of buildings, vehicles, plant machinery and equipment.

Civil gross expenditure on research and development (Civil GERD) is the sum of all expenditure by socio-economic objective (SEO), minus expenditure on defence R&D.

Constant 2010 Rands is the value of goods and services of a given year using the prices of a determined base reference year, which is 2010 in this case. These values were obtained by deflating with the GDP deflator using data published in the Statistics South Africa GDP survey P0441, 4th Quarter 2019 (Stats SA, 2019a).

Current expenditure is expenditure on items that generally reoccur after a short period. Current expenditure on R&D activities consists of labour costs and other current expenditures.

Experimental development is systematic work, drawing on existing knowledge gained from research and/or practical experience, which is directed to producing new materials, products or devices, to installing new processes, systems and services, or to improving substantially those already produced or installed.

Full-time equivalent (FTE) is an estimate of the time spent on R&D activities. It is the proportion of time spent on R&D activities out of all time spent at work.

Gross domestic product (GDP) is the total market value of all final goods and services produced in a country in a given year, equal to total consumer, investment and government spending, plus the value of exports, minus the value of imports. This statistic is obtained from the Statistics South Africa GDP survey P0441, 4th Quarter 2019 (Stats SA, 2019a).

Gross expenditure on research and development (GERD) covers all expenditures for R&D performed on national territory in a given year. It thus includes domestically performed R&D, which is financed from abroad but excludes R&D funds paid abroad, notably to international agencies.

Headcounts refers to the number of people directly involved in or supporting R&D (i.e. the total number of R&D personnel within a category).

In-house or intramural R&D refers to R&D performed by the unit or entity itself (i.e. by the personnel of the unit or entity). This is R&D performed within the borders of South Africa, even if funded by foreign sources.

Labour costs comprise annual wages and salaries and all associated costs or fringe benefits, such as bonus payments, holiday pay, contributions to pension funds and other social security payments, payroll taxes, etc. The labour costs of persons providing indirect services which are not included in the personnel data (such as security and maintenance personnel or the staff of central libraries, computer departments or head offices) are excluded and included in other current costs.

Master's students refer to students doing a full research master's as well as those doing coursework plus thesis with a research component.

New materials pertain to the technology and R&D activities of high-tech companies particularly in the aerospace, construction, electronic, biomedical, renewable energy, environmental remediation, food and packaging, manufacturing and motorcar industries. New materials include multi-functional materials, advanced materials, nano-materials, nano-composites and nanotechnology.

Nanotechnology is the understanding and control of matter at dimensions of roughly 1 to 100 nanometres, where unique phenomena enable novel applications.

Open-source software is computer software that is available in source code form under an open-source licence. The source code and certain other rights normally reserved for copyright holders are provided under a software licence that permits anyone to study, change, improve and at times also to distribute the software.

Other current expenditure comprise non-capital purchases of materials, supplies and equipment to support R&D performed by the statistical unit in a given year. These include, but are not limited to running costs, overhead expenses, repairs and maintenance, payments to outside organisations for use of specialised testing facilities, payments to outside organisations for specialised services and on-site consultant expenses in support of R&D projects carried out by the R&D performer.

Outsourced R&D refers to R&D done by another entity on behalf of the reporting unit and paid for by the reporting unit.

R&D intensity estimated by GERD as a proportion of GDP is the total intramural expenditures on R&D performed in the country in a given year relative to GDP.

R&D personnel refers to all persons (irrespective of nationality) employed directly on R&D, as well as those providing direct services such as R&D managers, administrators, and clerical staff. These include emeritus professors, honorary fellows and research fellows[1].

Researchers are R&D personnel engaged in the conception or creation of new knowledge, products, processes, methods and systems and in the management of the projects concerned.

Research and experimental development (R&D) comprise creative and systematic work undertaken in order to increase the stock of knowledge — including knowledge of humankind, culture and society — and to devise new applications of available knowledge.

Socio-economic objective (SEO) classification provides an indication of the R&D activities by main purpose. The SEO classification used in this survey is consistent with the Nomenclature for the Analysis and Comparison of Scientific programs and Budgets (NABS) that was published by Eurostat in 2007.

Statistical unit is an entity for which statistical data are collected or derived.

Standard Industrial Classification (SIC) codes are used by Statistics South Africa for describing the economic activities of industries.

State-owned enterprises (SOEs) are public corporations owned by government units mainly engaged in market production and sale of the kind of goods and services often produced by private enterprises.

Total employment is the total employed labour force in the South African economy. This statistic is obtained from Stats SA Labour Force Survey series P0211 (Stats SA, 2019b) where employed persons were defined as those aged 15–64 years who, during the reference week, did any work for at least one hour, or had a job or business but were not at work (temporarily absent).

[1] Prior to 2016/17, R&D personnel were comprised of only South African researchers, technicians and other R&D personnel. Also, emeritus professors, honorary fellows and research fellows were not explicitly included in the estimates of R&D personnel.

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A. INTRODUCTION

This Statistical Report presents data tables from the 2018/19 South African National Survey of Research and Experimental Development (R&D Survey). The report provides the key findings of the survey with commentary, standard summary tables of the overall findings from 2018/19, along with time series data from previous instances of the survey. The Statistical Report is published annually, along with the Main Report, which provides selected analysis of the survey data.

The survey covers the sectors that perform R&D in South Africa.

- **The business enterprise sector**, comprising large, medium and small enterprises, including state-owned enterprises.
- **The government sector**, comprising national, provincial and local government with an R&D component, government research institutions and museums.
- **The higher education sector**, comprising all public and private higher education institutions with an R&D component.
- **The not-for-profit sector**, comprising non-governmental and other organisations formally registered as not-for-profit institutions.
- **The science council sector**, comprising the seven science councils established through Acts of Parliament.

This approach is followed in order to maintain consistency with the institutional sector categorisation recommended by the Organisation for Economic Co-operation and Development (OECD) in *The Measurement of Scientific and Technological Activities: Proposed Standard Practice for Surveys on Research and Experimental Development*, known as the Frascati Manual (OECD, 2002, 2015). The split of government into two sectors — a government sector and a science councils sector — is an adjustment to the South African situation.

This report presents R&D statistics in tables according to the following categories:

- Gross domestic expenditure on research and development (GERD), and R&D expenditure by R&D-performing sectors.
- Local and international sources of funding for R&D sectors.
- R&D expenditure by field of research and socio-economic objective, and by industrial sector in the business sector.
- R&D expenditure in selected areas of policy interest, namely: biotechnology, nanotechnology, space science, environment-related, open-source software, new materials and tuberculosis (TB), HIV/AIDS and malaria research.
- R&D personnel.

GDP values were obtained from the Stats SA GDP statistical release P0441 (Stats SA, 2019a), and the total employment level was taken from the Stats SA Quarterly Labour Force Survey statistical release P0211 (Stats SA, 2019b).

All financial quantities presented in this report are in current values, unless otherwise indicated. Constant 2010 Rand values were calculated using the GDP deflator.

The headline indicator of GERD/GDP has been recalculated to adjust for ongoing revisions in the Stats SA GDP series.[2]

The classification of main institutional sectors recommended in the System of National Accounts (EC, IMF, OECD, UN and World Bank, 2009) is indicated in terms of those used in the Frascati Manual (OECD, 2002, 2015). This is only used indicatively in this report to assist users of data for R&D capitalisation purposes. Full implementation of the main institutional sectors will be done once the changes published in the seventh edition of the Frascati Manual have been finalised.

Since the 2014/15 R&D Survey, tables have been included to assess the R&D activities of SOEs, to address user needs for this type of data.

[2] The R&D Survey has historically used the GDP series calculated according to the production method.

From the 2016/17 survey onwards, the master's students category was split into two types: students doing a research master's degree and students doing a master's degree with coursework and a dissertation component. Furthermore, non-SA R&D staff were included in headcount estimates since 2016/17.

Section B provides the main findings of the survey, including commentary on key developments. Section C contains a detailed set of tables describing the survey results for 2018/19 and the preceding nine years. The description of the survey methodology is contained in section D, section E contains references cited, and the higher education sector questionnaire for the 2018/19 survey is reproduced in section F.

Please note: Readers are cautioned that time series analysis of the data using the 2018/19 R&D Survey's estimates need to be undertaken with caution, taking into consideration the relatively low response rate due to the advent of COVID-19.

B. KEY FINDINGS FOR 2018/19

Gross domestic expenditure on R&D declined in real terms after seven years of consecutive increases

Gross domestic expenditure on research and development (GERD) for 2018/19 was R36.784 billion. GERD in constant 2010 prices fell from R25.963 billion in 2017/18 to R23 732 in 2018/19, which represents a year-on-year change of -8.6%. Whilst it has been growing for seven consecutive years, the growth in GERD has been slowing down since the peak growth rate of 8.3% reached in 2014/15.

GERD as a percentage of gross domestic product (GDP) at current prices was 0.75% in 2018/19, which is eight basis points lower than the 0.83% recorded in 2017/18.

Due to challenges in the field brought about by the response to the COVID-19 epidemic, an unusually high number of imputations were used in the estimates of business sector statistics. The methodology chapter provides more detail on the challenges encountered and how these were addressed. Trend analysis of indicators that use business sector statistics need to be treated with caution. Table B.1 shows the key R&D indicators for the 2016/17, 2017/18 and 2018/19 reference periods.

Table B.1: Summary of key statistics and indicators (2016/17 to 2018/19)

KEY INDICATOR	2016/17	2017/18	2018/19
Expenditure on R&D			
Gross domestic expenditure on R&D (GERD) (Rm)	35 693	38 725	36 784
Business enterprise expenditure on R&D (BERD) (Rm)	*14 781*	*15 859*	*14 448*
Not-for-profit (NPO) expenditure on R&D (Rm)	*1 018*	*1 216*	*1 486*
Government expenditure on R&D (GOVERD) (Rm)	*2 099*	*2 326*	*2 223*
Science council (SCI) expenditure on R&D (Rm)	*6 136*	*6 313*	*5 444*
Higher education (HE) expenditure on R&D (HERD) (Rm)	*11 659*	*13 010*	*13 183*
Gross domestic expenditure on R&D in constant 2010 prices (Rm)	25 191	25 963	23 732
Funding sources			
Government-funded* R&D (Rm)	16 428	18 082	17 475
Business-funded R&D (Rm)	14 046	16 067	14 534
Foreign funding of R&D (Rm)	4 172	3 937	3 999
Foreign funding of BERD (Rm)	*1 339*	*475*	*400*
Foreign funding of NPO R&D (Rm)	*640*	*866*	*899*
Foreign funding of GOVERD (Rm)	*512*	*472*	*297*
Foreign funding of SCI R&D (Rm)	*538*	*618*	*550*
Foreign funding of HERD (Rm)	*1 143*	*1 506*	*1 852*
R&D personnel			
Total R&D personnel (FTE**)	42 533.0	44 259.3	43 774.3
Total researchers# (FTE**)	27 56.2	29 515.2	29 110.8
Total researchers# (headcount)	56 761	61 840	62 166
Female researchers# (headcounts)	25 591	27 774	28 401
Indicators computed from R&D Survey			
GERD as a percentage of GDP (%)	0.82	0.83	0.75
Civil GERD as a percentage of GDP (%)	0.78	0.79	0.72
Basic research (R millions)	9 543	10 224	10 364
Total R&D personnel (FTE**) per 1 000 in total employment	2.6	2.7	2.7
Total researchers# (FTE**) per 1 000 in total employment	1.7	1.8	1.8
Female researcher# headcounts as a percentage of total researcher headcounts (%)	45.1	44.9	45.7
Indicators obtained from external data sources			
Gross domestic product (GDP) level at current prices (Rm)	4 359 060	4 653 579	4 873 899
GDP (%)	0.4	1.4	0.8
SA employment ('000)	16 212	16 378	16 420

*Government-funded R&D includes science council and university own funds.
**FTE: Full-time equivalent.
#Includes doctoral students and post-doctoral fellows. Also includes emeritus professors, research fellows and honorary research fellows (2016/17 onwards). These categories do not incur salary, but there are time and costs (included in "Other current costs") associated with them.
Note: Headcounts include non-SA R&D personnel in 2016/17. Non-South African personnel are classified as those personnel that are not citizens of South Africa but are undertaking research in South Africa for a period exceeding six months.

Notable developments reflected in key indicators

Economic environment and recession

During the second quarter of 2018, the South African economy slipped into recession (Stats SA, 2019a). Annually, GDP decreased by 0.6 of a percentage point to 0.8% in 2018 (Stats SA, 2020). Also, during the 2018/19 fiscal year, 'overall reductions were effected to planned spending across all government departments' (National Treasury, 2018, p. iii).

Large decreases recorded in business and science council sector expenditure and personnel

The business sector R&D expenditure (BERD) decreased by a relatively large amount of R1.411 billion in nominal terms (Table C.1). The business sector also shed 678 R&D personnel, of which 200 were researchers, and 369 were R&D technicians (Table C.53). These numbers are indicative of a general trend of stagnation in the business sector evident since at least 2014/15, reflecting the poor economic environment culminating in the recession in 2018/19. The science council sector bore the brunt of the public sector budget cuts across government departments by registering a decrease in R&D expenditure of R869 million (Table C.1). This was accompanied by a loss in R&D personnel of 352 headcounts (Table C.31), of which 102 were researchers (Table C.33). Government departments, which includes research centres, also registered a decrease of R102 million in R&D expenditure (Table C.1). Government departments decreased the number of R&D personnel in their employ by 117 in 2018/19, 101 of which were technicians directly supporting R&D (Table C.110).

The higher education sector recorded a slight increase in nominal R&D expenditure of R173 million (Table C.1) and R&D personnel of 725 (Table C.33). The not-for-profit sector increased R&D expenditure by R269 million (Table C.1) and increased R&D personnel by 196, of which 165 were technicians directly supporting R&D (Table C.92).

Both the government sector and business sector decreased their funding of R&D activity

The main sources of funding for R&D in South Africa are the government and business sectors. The government sector (including science councils and university own funds) funded 47.5% and the business sector 39.5% of R&D undertaken in 2018/19 (Table C.20). The government sector decreased their funding of R&D activity by R607 million, and the business sector decreased their funding of R&D by R1.533 billion, in current prices (Table C.19).

R&D funding by foreign sources fluctuated by sector

The funding of R&D by foreign sources received an additional R62 million in 2018/19. The higher education sector benefited the most from a boost of foreign funding to the tune of R246 million, whilst the government and science councils together received R242 million less in 2018/19 (Table C.26).

Financial and manufacturing sectors recorded large decreases in R&D expenditure

Within the business sector, the two industries with the largest R&D expenditure have been the financial intermediation, real estate and business services industry and the manufacturing sector (Table C.51). The financial sector decreased R&D expenditure from R7.744 billion in 2017/18 to R6.402 billion, and the manufacturing sector decreased R&D expenditure from R4.473 billion to R3.166 billion. Mining and quarrying increased R&D expenditure from R1.101 billion in 2017/18 to R1.748 billion in 2018/19.

The contribution of state-owned enterprises (SOEs) to R&D activity in the business sector increased by 1.3 percentage points to 17.3% in 2018/19, even though the amount of R&D expenditure that SOEs contributed to the business sector decreased by R44 million (Table C.57).

National R&D continued to tend towards applied research

Applied research accounted for 52.5% of GERD in 2018/19 (Table C.6). There is a long-term trend towards applied research, coming at the cost of experimental development, which continued to trend downwards in 2018/19 (Table C.6).

The proportion of R&D performed in Gauteng reflected a decreasing trend

While most R&D activity is still performed in Gauteng, the proportion of R&D in that province decreased from 49.5% in 2009/10 to 42.9% in 2018/19. Over the same ten-year period, the Western Cape and North West provinces both saw a 2.0 percentage points increase in their contribution to R&D expenditure, while the Northern Cape increased its contribution by 1.4 percentage points (Table C.18). The Eastern Cape and KwaZulu-Natal provinces increased their contribution by 0.7 percentage points each.

The social sciences and medical and health sciences dominated R&D expenditure

The 2018/19 results show that the majority of R&D activity was undertaken in social sciences research fields (22.4%) followed closely by medical and health sciences research fields (21.2%) (Table C.14). The engineering sciences, at 12.9%, is the field of research with the third highest R&D expenditure in South Africa. Over the ten-year period from 2009/10 to 2018/19, the social sciences and engineering sciences have switched positions in the ranking of research field R&D expenditure.

Researcher FTEs as a proportion of employed persons was unchanged at 1.8 per 1 000 employed

R&D personnel (inclusive of doctoral students and postdoctoral fellows at universities) decreased by 485.0 FTEs to 43 774.3 in 2018/19 (Table C.28). Researcher FTEs (including post-doctoral fellows and doctoral students) decreased by 404.4 FTE from 29 515.2 FTE to 29 110.8 FTE in 2018/19 (Table C.28). The number of FTE researchers per 1000 in total employment is still 1.8 in 2018/19 (Table C.28). The proportion of female researchers increased by 0.8 of a percentage point from 44.9% to 45.7% in 2018/19 (Table C.28).

R&D in most priority policy areas increased

The largest amount of R&D expenditure, amounting to R5.106 billion (Table C.11) is still spent on communicable diseases (TB, HIV/AIDS and malaria). This area recorded R484 million more on R&D in 2018/19. However, space science expenditure registered the largest increase of R588 million, reaching a total of R888 million in 2018/19. Environment-related R&D has shown sustained growth since 2010/11 and increased by R268 million to reach a level of R3.083 billion in 2018/19 (Table C.11).

R&D in biotechnology increased by R66 million and contributed 5.1% of GERD, and R&D in nanotechnology increased by R106 million and contributed 2.2% of GERD in 2018/19 (Table C.10).

C. TABLES

Notes:

- Totals in the tables may not add up to the sum of their constituent items due to rounding effects.
- Data from 2001/02 onwards may be downloaded from
  - http://www.hsrc.ac.za/en/departments/CeSTii/reports-cestii

C.1. General survey results

C.1.1. Expenditure on research and experimental development

Table C.1: R&D expenditure by sector (2009/10 to 2018/19)

YEAR	GERD	GOVERNMENT	SCIENCE COUNCILS	HIGHER EDUCATION	BUSINESS	NOT-FOR-PROFIT
	R'000	R'000	R'000	R'000	R'000	R'000
2009/10	**20 954 677**	1 067 302	3 458 074	5 101 224	11 139 237	188 840
2010/11	**20 253 805**	1 011 340	3 596 023	5 424 602	10 059 010	162 830
2011/12	**22 209 192**	1 235 669	3 729 680	6 609 216	10 464 022	170 605
2012/13	**23 871 219**	1 437 509	4 025 998	7 333 153	10 570 726	503 833
2013/14	**25 660 573**	1 697 151	4 304 556	7 292 853	11 782 848	583 165
2014/15	**29 344 977**	1 893 010	5 004 669	8 377 575	13 290 951	778 772
2015/16	**32 336 679**	2 013 021	5 740 897	9 876 623	13 814 995	891 142
2016/17	**35 692 973**	2 098 646	6 136 183	11 659 258	14 781 270	1 017 616
2017/18	**38 724 590**	2 325 875	6 313 344	13 009 876	15 859 185	1 216 310
2018/19	**36 783 968**	2 223 426	5 443 885	13 183 119	14 447 833	1 485 704

The NPO sector in 2012/13 improved coverage by R281 509 000 contributing 1.2% of GERD. In 2015/16 the NPO sector improved coverage by R185 302 000 contributing 0.6% of GERD.

Table C.2: R&D expenditure by sector, constant 2010 Rand values (2009/10 to 2018/19)

YEAR	GERD	GOVERNMENT	SCIENCE COUNCILS	HIGHER EDUCATION	BUSINESS	NOT-FOR-PROFIT
	R'000	R'000	R'000	R'000	R'000	R'000
2009/10	**22 285 515**	1 135 087	3 677 697	5 425 204	11 846 693	200 833
2010/11	**20 253 802**	1 011 340	3 596 022	5 424 601	10 059 009	162 830
2011/12	**20 847 389**	1 159 901	3 500 987	6 203 958	9 822 399	160 144
2012/13	**21 283 167**	1 281 658	3 589 510	6 538 113	9 424 677	449 209
2013/14	**21 551 944**	1 425 413	3 615 334	6 125 162	9 896 243	489 792
2014/15	**23 351 132**	1 506 354	3 982 443	6 666 417	10 576 214	619 704
2015/16	**24 466 688**	1 523 099	4 343 697	7 472 884	10 452 748	674 259
2016/17	**25 190 793**	1 481 148	4 330 693	8 228 677	10 432 079	718 196
2017/18	**25 962 839**	1 559 379	4 232 771	8 722 451	10 632 765	815 473
2018/19	**23 732 257**	1 434 509	3 512 283	8 505 476	9 321 444	958 546

The NPO sector in 2012/13 improved coverage by R281 509 000 contributing 1.2% of GERD. In 2015/16 the NPO sector improved coverage by R185 302 contributing 0.6% of GERD.

Table C.3: R&D expenditure composition by sector (2009/10 to 2018/19)

YEAR	GOVERNMENT	SCIENCE COUNCILS	HIGHER EDUCATION	BUSINESS	NOT-FOR-PROFIT
	%	%	%	%	%
2009/10	5.1	16.5	24.3	53.2	0.9
2010/11	5.0	17.8	26.8	49.7	0.8
2011/12	5.6	16.8	29.8	47.1	0.8
2012/13	6.0	16.9	30.7	44.3	2.1
2013/14	6.6	16.8	28.4	45.9	2.3
2014/15	6.5	17.1	28.5	45.3	2.7
2015/16	6.2	17.8	30.5	42.7	2.8
2016/17	5.9	17.2	32.7	41.4	2.9
2017/18	6.0	16.3	33.6	41.0	3.1
2018/19	6.0	14.8	35.8	39.3	4.0

Table C.4: R&D expenditure as a percentage of GDP by sector (2009/10 to 2018/19)

YEAR	GERD/GDP	GOVERNMENT	SCIENCE COUNCILS	HIGHER EDUCATION	BUSINESS	NOT-FOR-PROFIT
	%	%	%	%	%	%
2009/10	**0.84**	0.04	0.14	0.20	0.44	0.01
2010/11	**0.74**	0.04	0.13	0.20	0.37	0.01
2011/12	**0.73**	0.04	0.12	0.22	0.35	0.01
2012/13	**0.73**	0.04	0.12	0.23	0.32	0.02
2013/14	**0.72**	0.05	0.12	0.21	0.33	0.02
2014/15	**0.77**	0.05	0.13	0.22	0.35	0.02
2015/16	**0.80**	0.05	0.14	0.24	0.34	0.02
2016/17	**0.82**	0.05	0.14	0.27	0.34	0.02
2017/18	**0.83**	0.05	0.14	0.28	0.34	0.03
2018/19	**0.75**	0.05	0.11	0.27	0.30	0.03

The NPO sector in 2012/13 experienced improved coverage contributing 0.01 percentage points to NPO expenditure as a percentage of GDP. In 2015/16 the NPO improved coverage by R185 302 contributing a little less than 1 basis point to NPO expenditure as a percentage of GDP.

Table C.5: R&D expenditure by type of research (2009/10 to 2018/19)

YEAR	GERD	BASIC RESEARCH	APPLIED RESEARCH	EXPERIMENTAL DEVELOPMENT
	R'000	R'000	R'000	R'000
2009/10	**20 954 676**	5 553 399	6 578 902	8 822 375
2010/11	**20 253 804**	4 848 283	8 058 799	7 346 722
2011/12	**22 209 192**	5 439 561	9 388 273	7 381 358
2012/13	**23 871 219**	6 030 827	11 064 247	6 776 146
2013/14	**25 660 573**	6 102 085	12 132 211	7 426 277
2014/15	**29 344 977**	7 133 213	14 331 016	7 880 748
2015/16	**32 336 679**	8 209 662	15 349 070	8 777 948
2016/17	**35 692 973**	9 542 644	17 061 167	9 089 162
2017/18	**38 724 590**	10 223 956	20 623 856	7 876 778
2018/19	**36 783 968**	10 364 091	19 316 433	7 103 444

Table C.6: Proportional R&D expenditure by type of research (2009/10 to 2018/19)

YEAR	BASIC RESEARCH	APPLIED RESEARCH	EXPERIMENTAL DEVELOPMENT
	%	%	%
2009/10	26.5	31.4	42.1
2010/11	23.9	39.8	36.3
2011/12	24.5	42.3	33.2
2012/13	25.3	46.3	28.4
2013/14	23.8	47.3	28.9
2014/15	24.3	48.8	26.9
2015/16	25.4	47.5	27.1
2016/17	26.7	47.8	25.5
2017/18	26.4	53.3	20.3
2018/19	28.2	52.5	19.3

Table C.7: R&D expenditure by accounting category (2009/10 to 2018/19)

YEAR		CAPITAL EXPENDITURE ON R&D			CURRENT EXPENDITURE ON R&D			
	GERD	LAND: BUILDINGS AND OTHER STRUCTURES	VEHICLES, PLANT, MACHINERY, EQUIPMENT	SUBTOTAL: CAPITAL EXPENDITURE	LABOUR COSTS	TOTAL COST OF R&D POST-GRADUATE STUDENTS	OTHER CURRENT EXPENDITURE*	SUBTOTAL: CURRENT EXPENDITURE
	R'000	R'000	R'000	R'000	R'000	R'000	R'000	R'000
2009/10	**20 954 677**	623 089	2 067 728	2 690 817	8 909 301	581 140	8 773 419	18 263 860
2010/11	**20 253 805**	472 205	1 714 845	2 187 050	8 353 254	756 930	8 956 571	18 066 755
2011/12	**22 209 192**	454 321	2 215 416	2 669 737	9 534 138	1 074 207	8 931 110	19 539 455
2012/13	**23 871 219**	495 842	1 747 183	2 243 025	11 922 169	1 186 653	8 519 372	21 628 194
2013/14	**25 660 573**	529 575	1 857 913	2 387 488	13 304 413	1 224 611	8 744 061	23 273 085
2014/15	**29 344 977**	805 961	2 311 181	3 117 142	14 443 903	1 579 088	10 204 844	26 227 835
2015/16	**32 336 679**	711 631	3 008 992	3 720 622	14 781 549	1 926 301	11 908 207	28 616 057
2016/17	**35 692 973**	1 274 737	2 822 229	4 096 967	16 505 080	1 928 108	13 162 819	31 596 007
2017/18	**38 724 590**	1 715 060	2 385 032	4 100 092	18 757 628	1 889 065	13 977 805	34 624 498
2018/19	**36 783 968**	879 489	2 393 110	3 272 599	18 112 670	1 938 984	13 459 715	33 511 369

*Includes specific categories of R&D personnel costs (from 2016/17).

Table C.8: Proportional R&D expenditure by accounting category (2009/10 to 2018/19)

YEAR	CAPITAL EXPENDITURE ON R&D			CURRENT EXPENDITURE ON R&D			
	LAND: BUILDINGS AND OTHER STRUCTURES	VEHICLES, PLANT, MACHINERY, EQUIPMENT	SUBTOTAL: CAPITAL EXPENDITURE	LABOUR COSTS	TOTAL COST OF R&D POST-GRADUATE STUDENTS	OTHER CURRENT EXPENDITURE*	SUBTOTAL: CURRENT EXPENDITURE
	%	%	%	%	%	%	%
2009/10	3.0	9.9	12.8	42.5	2.8	41.9	87.2
2010/11	2.3	8.5	10.8	41.2	3.7	44.2	89.2
2011/12	2.0	10.0	12.0	42.9	4.8	40.2	88.0
2012/13	2.1	7.3	9.4	49.9	5.0	35.7	90.6
2013/14	2.1	7.2	9.3	51.8	4.8	34.1	90.7
2014/15	2.7	7.9	10.6	49.2	5.4	34.8	89.4
2015/16	2.2	9.3	11.5	45.7	6.0	36.8	88.5
2016/17	3.6	7.9	11.5	46.2	5.4	36.9	88.5
2017/18	4.4	6.2	10.6	48.4	4.9	36.1	89.4
2018/19	2.4	6.5	8.9	49.2	5.3	36.6	91.1

*Includes specific categories of R&D personnel costs (from 2016/17).

Table C.9: Expenditure on multidisciplinary areas of R&D (2009/10 to 2018/19)

YEAR	GERD	BIOTECHNOLOGY	NANOTECHNOLOGY
	R'000	R'000	R'000
2009/10	**20 954 677**	917 917	423 865
2010/11	**20 253 805**	1 142 337	414 529
2011/12	**22 209 192**	1 065 286	596 072
2012/13	**23 871 219**	1 179 478	662 634
2013/14	**25 660 573**	1 266 325	664 139
2014/15	**29 344 977**	1 576 727	818 919
2015/16	**32 336 679**	1 843 363	871 426
2016/17	**35 692 973**	1 788 728	853 121
2017/18	**38 724 590**	1 797 013	718 527
2018/19	**36 783 968**	1 862 865	824 420

Table C.10: Proportional expenditure on multidisciplinary areas of R&D (2009/10 to 2018/19)

YEAR	BIOTECHNOLOGY	NANOTECHNOLOGY
	%	%
2009/10	4.4	2.0
2010/11	5.6	2.0
2011/12	4.8	2.7
2012/13	4.9	2.8
2013/14	4.9	2.6
2014/15	5.4	2.8
2015/16	5.7	2.7
2016/17	5.0	2.4
2017/18	4.6	1.9
2018/19	5.1	2.2

Table C.11: R&D expenditure on selected areas of interest (2009/10 to 2018/19)

YEAR	GERD	OPEN-SOURCE SOFTWARE	TUBERCULOSIS (TB), HIV/AIDS, MALARIA	ENVIRONMENT / ENVIRONMENT RELATED	NEW MATERIALS	SPACE SCIENCE
	R'000	R'000	R'000	R'000	R'000	R'000
2009/10	**20 954 677**	172 712	1 816 901	N/A	559 021	N/A
2010/11	**20 253 805**	157 790	2 052 521	N/A	722 167	N/A
2011/12	**22 209 192**	181 320	2 006 625	1 215 855	783 232	N/A
2012/13	**23 871 219**	211 264	2 478 422	1 051 035	1 327 832	N/A
2013/14	**25 660 573**	339 065	2 867 954	1 088 094	794 016	N/A
2014/15	**29 344 977**	818 735	3 008 176	1 996 195	1 053 783	N/A
2015/16	**32 336 679**	1 145 590	3 462 704	2 056 659	1 146 470	N/A
2016/17	**35 692 973**	826 648	3 947 430	2 452 367	1 008 578	633 930
2017/18	**38 724 590**	1 233 636	4 621 859	2 815 269	850 606	300 763
2018/19	**36 783 968**	465 624	5 105 952	3 083 232	965 820	888 214

N/A: Environment-related data were collected from the 2011/12 R&D Survey onwards. Space science data were collected for the first time in the 2016/17 R&D Survey.

Table C.12: Proportional R&D expenditure on selected areas of interest (2009/10 to 2018/19)

YEAR	OPEN-SOURCE SOFTWARE	TUBERCULOSIS (TB), HIV/AIDS, MALARIA	ENVIRONMENT / ENVIRONMENT RELATED	NEW MATERIALS	SPACE SCIENCE
	%	%	%	%	%
2009/10	0.8	8.7	N/A	2.7	N/A
2010/11	0.8	10.1	N/A	3.6	N/A
2011/12	0.8	9.0	5.5	3.5	N/A
2012/13	0.9	10.4	4.4	5.6	N/A
2013/14	1.3	11.2	4.2	3.1	N/A
2014/15	2.8	10.3	6.8	3.6	N/A
2015/16	3.5	10.7	6.4	3.5	N/A
2016/17	2.3	11.1	6.9	2.8	1.8
2017/18	3.2	11.9	7.3	2.2	0.8
2018/19	1.3	13.9	8.4	2.6	2.4

N/A: Environment-related data were collected from the 2011/12 R&D Survey onwards. Space science data were collected for the first time in the 2016/17 R&D Survey.

Table C.13: R&D expenditure by research field (2009/10 to 2018/19)

MAIN RESEARCH FIELD	2009/10	2010/11	2011/12	2012/13	2013/14	2014/15	2015/16	2016/17	2017/18	2018/19
	R'000	R'000	R'000	R'000	R'000	R'000	R'000	R'000	R'000	R'000
Division 1: Natural sciences, technology and engineering	18 236 046	17 274 483	18 924 485	19 384 947	20 587 093	23 687 304	25 562 694	27 253 955	28 666 760	27 582 242
Mathematical sciences	414 234	530 693	636 153	634 658	627 017	636 084	646 870	713 360	879 045	934 136
Physical sciences	648 657	305 701	338 098	370 616	379 813	582 267	769 739	876 009	1 070 851	930 033
Chemical sciences	860 745	865 345	1 273 588	1 460 180	1 305 139	1 299 969	1 491 410	1 761 693	1 668 359	1 685 031
Earth sciences	402 949	403 848	409 212	499 210	498 427	690 040	635 291	780 402	766 556	826 869
Information, computer and communication technologies	3 272 679	2 808 681	2 852 251	2 000 453	1 994 502	2 946 625	3 877 852	4 494 987	4 006 992	3 636 363
Applied sciences and technologies	1 740 755	2 151 557	2 114 322	2 252 175	2 164 025	1 555 897	1 525 646	1 585 106	1 628 489	1 537 213
Engineering sciences	4 580 166	3 600 159	3 775 247	3 903 931	4 315 051	5 485 812	5 444 740	4 611 038	5 068 338	4 735 131
Biological sciences	800 435	1 326 076	1 350 716	1 555 035	1 578 516	1 398 611	1 452 763	1 416 454	1 562 103	1 579 782
Agricultural sciences	1 445 847	1 307 191	1 710 860	1 810 114	2 196 122	2 656 038	2 573 509	2 741 962	2 999 821	3 051 678
Medical and health sciences	3 506 472	3 461 304	3 819 180	4 107 641	4 668 417	5 459 721	6 389 455	6 868 131	7 540 190	7 793 148
Environmental sciences	229 186	352 139	439 719	587 113	611 007	533 065	375 455	992 281	1 125 709	435 578
Material sciences	254 092	109 551	166 411	155 379	192 199	368 315	299 069	287 507	206 687	190 551
Marine sciences	79 830	52 238	38 726	48 442	56 857	74 858	80 897	125 024	143 621	246 728
Division 2: Social sciences and humanities	2 718 631	2 979 322	3 284 707	4 486 272	5 073 480	5 657 674	6 773 985	8 439 018	10 057 830	9 201 726
Social sciences	2 233 521	2 512 714	2 790 339	3 999 853	4 489 054	5 000 339	6 043 806	7 495 167	9 168 767	8 238 808
Humanities	485 110	466 608	494 368	486 420	584 426	657 335	730 179	943 851	889 064	962 918
Total	20 954 677	20 253 805	22 209 192	23 871 219	25 660 573	29 344 977	32 336 679	35 692 973	38 724 590	36 783 968

Table C.14: Proportional R&D expenditure by research field (2009/10 to 2018/19)

MAIN RESEARCH FIELD	2009/10 %	2010/11 %	2011/12 %	2012/13 %	2013/14 %	2014/15 %	2015/16 %	2016/17 %	2017/18 %	2018/19 %
Division 1: Natural sciences, technology and engineering	87.0	85.3	85.2	81.2	80.2	80.7	79.1	76.4	74.0	75.0
Mathematical sciences	2.0	2.6	2.9	2.7	2.4	2.2	2.0	2.0	2.3	2.5
Physical sciences	3.1	1.5	1.5	1.6	1.5	2.0	2.4	2.5	2.8	2.5
Chemical sciences	4.1	4.3	5.7	6.1	5.1	4.4	4.6	4.9	4.3	4.6
Earth sciences	1.9	2.0	1.8	2.1	1.9	2.4	2.0	2.2	2.0	2.2
Information, computer and communication technologies	15.6	13.9	12.8	8.4	7.8	10.0	12.0	12.6	10.3	9.9
Applied sciences and technologies	8.3	10.6	9.5	9.4	8.4	5.3	4.7	4.4	4.2	4.2
Engineering sciences	21.9	17.8	17.0	16.4	16.8	18.7	16.8	12.9	13.1	12.9
Biological sciences	3.8	6.5	6.1	6.5	6.2	4.8	4.5	4.0	4.0	4.3
Agricultural sciences	6.9	6.5	7.7	7.6	8.6	9.1	8.0	7.7	7.7	8.3
Medical and health sciences	16.7	17.1	17.2	17.2	18.2	18.6	19.8	19.2	19.5	21.2
Environmental sciences	1.1	1.7	2.0	2.5	2.4	1.8	1.2	2.8	2.9	1.2
Material sciences	1.2	0.5	0.7	0.7	0.7	1.3	0.9	0.8	0.5	0.5
Marine sciences	0.4	0.3	0.2	0.2	0.2	0.3	0.3	0.4	0.4	0.7
Division 2: Social sciences and humanities	13.0	14.7	14.8	18.8	19.8	19.3	20.9	23.6	26.0	25.0
Social sciences	10.7	12.4	12.6	16.8	17.5	17.0	18.7	21.0	23.7	22.4
Humanities	2.3	2.3	2.2	2.0	2.3	2.2	2.3	2.6	2.3	2.6
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Table C.15: R&D expenditure by socio-economic objective (2009/10 to 2018/19)

SOCIO-ECONOMIC OBJECTIVES	2009/10 R'000	2010/11 R'000	2011/12 R'000	2012/13 R'000	2013/14 R'000	2014/15 R'000	2015/16 R'000	2016/17 R'000	2017/18 R'000	2018/19 R'000
Division 1: Defence	1 276 269	1 341 460	1 069 289	1 351 337	1 386 428	1 826 784	1 814 789	1 629 650	2 124 098	1 571 796
Defence	1 276 269	1 341 460	1 069 289	1 351 337	1 386 428	1 826 784	1 814 789	1 629 650	2 124 098	1 571 796
Division 2: Economic development	12 341 036	11 231 879	12 174 897	12 223 017	14 166 615	15 359 534	16 644 668	18 357 187	19 528 226	17 902 898
Economic development unclassified	0	0	0	0	0	0	0	0	0	0
Plant production and plant primary products	1 055 316	1 045 114	1 137 706	1 218 852	1 739 038	1 364 018	1 426 609	1 920 246	1 701 055	1 746 483

SOCIO-ECONOMIC OBJECTIVES	2009/10 R'000	2010/11 R'000	2011/12 R'000	2012/13 R'000	2013/14 R'000	2014/15 R'000	2015/16 R'000	2016/17 R'000	2017/18 R'000	2018/19 R'000
Animal production and animal primary products	354 639	293 873	565 729	598 602	803 403	694 423	655 059	746 579	794 314	748 145
Mineral resources (excluding energy)	1 212 226	1 123 063	1 065 384	1 143 762	1 351 239	1 779 068	1 759 268	1 328 413	1 256 826	1 321 249
Energy resources	407 091	274 220	273 390	294 820	288 314	197 072	178 434	556 147	546 831	605 311
Energy supply	540 463	623 953	676 491	509 128	590 980	778 805	636 596	730 849	853 099	927 403
Manufacturing	2 602 319	2 374 657	2 489 799	2 394 239	2 608 207	2 619 974	2 665 871	2 543 694	2 628 725	2 495 718
Construction	521 289	311 897	392 440	426 960	450 907	270 226	229 284	300 582	318 837	363 788
Transport	924 183	905 571	984 225	992 504	1 115 027	998 136	1 115 349	1 195 426	1 247 963	1 099 974
Information and communication services	1 381 989	1 104 273	1 271 591	1 159 823	1 124 614	1 661 660	2 347 021	2 694 355	2 129 740	1 768 149
Commercial services	2 045 919	1 849 534	1 866 449	1 895 734	2 443 529	2 701 523	2 789 611	3 134 235	4 448 419	3 492 749
Economic framework	598 312	600 662	611 868	715 759	689 386	1 331 844	1 797 751	1 997 933	2 343 788	2 147 239
Natural resources	697 290	725 062	839 825	872 835	961 971	962 787	1 043 816	1 208 728	1 258 630	1 186 690
Division 3: Society	3 276 198	3 247 428	3 861 889	4 473 657	4 585 825	5 885 267	6 815 987	7 558 386	8 517 207	8 323 617
Society unclassified	0	0	0	0	0	0	0	0	0	0
Health	2 247 629	2 089 570	2 301 764	2 942 262	2 859 623	3 638 036	4 154 557	4 733 478	5 118 330	5 675 740
Education and training	458 060	442 181	554 463	672 473	882 976	1 346 974	1 603 117	1 307 791	1 398 846	1 344 005
Social development and community services	570 508	715 677	1 005 662	858 922	843 226	900 257	1 058 313	1 517 117	2 000 031	1 303 872
Division 4: Environment	992 840	735 909	905 570	979 981	861 976	1 414 524	1 475 053	2 015 344	2 092 706	2 166 332
Environment unclassified	0	0	0	0	0	0	0	0	0	0
Environmental knowledge	463 786	310 888	398 977	443 987	388 688	828 768	853 071	969 476	1 016 592	964 261
Environmental aspects of development	181 907	189 344	216 406	258 144	226 299	288 823	304 008	361 391	357 509	455 915
Environmental and other aspects	347 147	235 677	290 187	277 849	246 989	296 934	317 975	684 478	718 604	746 156
Division 5: Advancement of knowledge	3 068 334	3 697 128	4 197 547	4 843 227	4 659 729	4 858 868	5 586 182	6 132 406	6 462 352	6 819 325
Advancement of knowledge unclassified	0	0	0	0	0	0	0	0	0	0
Natural sciences, technologies and engineering	2 036 622	2 672 224	3 025 841	3 497 129	3 407 325	3 445 842	3 891 834	4 424 024	4 771 950	5 022 207
Social sciences and humanities	1 031 712	1 024 904	1 171 706	1 346 098	1 252 404	1 413 026	1 694 348	1 708 382	1 690 403	1 797 118
Total	20 954 677	20 253 805	22 209 192	23 871 219	25 660 573	29 344 977	32 336 679	35 692 973	38 724 590	36 783 968

Table C.16: Proportional R&D expenditure by socio-economic objective (2009/10 to 2018/19)

SOCIO-ECONOMIC OBJECTIVES	2009/10 %	2010/11 %	2011/12 %	2012/13 %	2013/14 %	2014/15 %	2015/16 %	2016/17 %	2017/18 %	2018/19 %
Division 1: Defence	6.1	6.6	4.8	5.7	5.4	6.2	5.6	4.6	5.5	4.3
Defence	6.1	6.6	4.8	5.7	5.4	6.2	5.6	4.6	5.5	4.3
Division 2: Economic development	58.9	55.5	54.8	51.2	55.2	52.3	51.5	51.4	50.4	48.7
Economic development unclassified	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Plant production and plant primary products	5.0	5.2	5.1	5.1	6.8	4.6	4.4	5.4	4.4	4.7
Animal production and animal primary products	1.7	1.5	2.5	2.5	3.1	2.4	2.0	2.1	2.1	2.0
Mineral resources (excluding energy)	5.8	5.5	4.8	4.8	5.3	6.1	5.4	3.7	3.2	3.6
Energy resources	1.9	1.4	1.2	1.2	1.1	0.7	0.6	1.6	1.4	1.6
Energy supply	2.6	3.1	3.0	2.1	2.3	2.7	2.0	2.0	2.2	2.5
Manufacturing	12.4	11.7	11.2	10.0	10.2	8.9	8.2	7.1	6.8	6.8
Construction	2.5	1.5	1.8	1.8	1.8	0.9	0.7	0.8	0.8	1.0
Transport	4.4	4.5	4.4	4.2	4.3	3.4	3.4	3.3	3.2	3.0
Information and communication services	6.6	5.5	5.7	4.9	4.4	5.7	7.3	7.5	5.5	4.8
Commercial services	9.8	9.1	8.4	7.9	9.5	9.2	8.6	8.8	11.5	9.5
Economic framework	2.9	3.0	2.8	3.0	2.7	4.5	5.6	5.6	6.1	5.8
Natural resources	3.3	3.6	3.8	3.7	3.7	3.3	3.2	3.4	3.3	3.2
Division 3: Society	15.6	16.0	17.4	18.7	17.9	20.1	21.1	21.2	22.0	22.6
Society unclassified	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Health	10.7	10.3	10.4	12.3	11.1	12.4	12.8	13.3	13.2	15.4
Education and training	2.2	2.2	2.5	2.8	3.4	4.6	5.0	3.7	3.6	3.7
Social development and community services	2.7	3.5	4.5	3.6	3.3	3.1	3.3	4.3	5.2	3.5
Division 4: Environment	4.7	3.6	4.1	4.1	3.4	4.8	4.6	5.6	5.4	5.9
Environment unclassified	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Environmental knowledge	2.2	1.5	1.8	1.9	1.5	2.8	2.6	2.7	2.6	2.6
Environmental aspects of development	0.9	0.9	1.0	1.1	0.9	1.0	0.9	1.0	0.9	1.2

SOCIO-ECONOMIC OBJECTIVES	2009/10	2010/11	2011/12	2012/13	2013/14	2014/15	2015/16	2016/17	2017/18	2018/19
	%	%	%	%	%	%	%	%	%	%
Environmental and other aspects	1.7	1.2	1.3	1.2	1.0	1.0	1.0	1.9	1.9	2.0
Division 5: Advancement of knowledge	14.6	18.3	18.9	20.3	18.2	16.6	17.3	17.2	16.7	18.5
Advancement of knowledge unclassified	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Natural sciences, technologies and engineering	9.7	13.2	13.6	14.6	13.3	11.7	12.0	12.4	12.3	13.7
Social sciences and humanities	4.9	5.1	5.3	5.6	4.9	4.8	5.2	4.8	4.4	4.9
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Table C.17: R&D expenditure by province (2009/10 to 2018/19)

YEAR	GERD	EASTERN CAPE	FREE STATE	GAUTENG	KWAZULU-NATAL	LIMPOPO	MPUMA-LANGA	NORTHERN CAPE	NORTH-WEST	WESTERN CAPE
	R'000	R'000	R'000	R'000	R'000	R'000	R'000	R'000	R'000	R'000
2009/10	**20 954 677**	1 121 484	1 370 779	10 377 381	2 167 048	340 379	393 822	217 774	540 951	4 425 059
2010/11	**20 253 805**	1 048 959	1 332 224	9 772 806	2 290 711	395 042	397 878	250 320	532 456	4 233 409
2011/12	**22 209 192**	1 278 870	1 718 602	10 391 272	2 515 736	583 857	522 963	341 136	732 363	4 124 394
2012/13	**23 871 219**	1 463 589	1 714 473	10 602 434	3 013 372	619 437	612 031	400 974	890 364	4 554 545
2013/14	**25 660 573**	1 478 850	1 943 131	11 975 916	2 752 543	444 015	615 773	473 722	1 027 448	4 949 174
2014/15	**29 344 977**	1 734 411	1 456 461	13 686 734	3 187 481	628 607	859 201	575 584	1 402 742	5 813 758
2015/16	**32 336 679**	2 142 919	1 778 469	14 666 111	3 335 141	627 125	791 248	660 963	1 209 434	7 125 269
2016/17	**35 692 973**	2 206 473	1 834 572	16 421 582	3 639 100	728 874	699 720	532 530	1 298 778	8 331 345
2017/18	**38 724 590**	2 300 631	2 149 267	17 319 635	4 172 713	854 885	715 616	576 963	1 306 478	9 328 402
2018/19	**36 783 968**	2 211 524	1 976 953	15 767 101	4 074 154	806 624	853 859	905 844	1 682 406	8 505 504

Table C.18: Proportional R&D expenditure by province (2009/10 to 2018/19)

YEAR	EASTERN CAPE	FREE STATE	GAUTENG	KWAZULU-NATAL	LIMPOPO	MPUMA-LANGA	NORTHERN CAPE	NORTH-WEST	WESTERN CAPE
	%	%	%	%	%	%	%	%	%
2009/10	5.4	6.5	49.5	10.3	1.6	1.9	1.0	2.6	21.1
2010/11	5.2	6.6	48.3	11.3	2.0	2.0	1.2	2.6	20.9
2011/12	5.8	7.7	46.8	11.3	2.6	2.4	1.5	3.3	18.6
2012/13	6.1	7.2	44.4	12.6	2.6	2.6	1.7	3.7	19.1
2013/14	5.8	7.6	46.7	10.7	1.7	2.4	1.8	4.0	19.3
2014/15	5.9	5.0	46.6	10.9	2.1	2.9	2.0	4.8	19.8
2015/16	6.6	5.5	45.4	10.3	1.9	2.4	2.0	3.7	22.0
2016/17	6.2	5.1	46.0	10.2	2.0	2.0	1.5	3.6	23.3
2017/18	5.9	5.6	44.7	10.8	2.2	1.8	1.5	3.4	24.1
2018/19	6.0	5.4	42.9	11.1	2.2	2.3	2.5	4.6	23.1

C.1.2. Source of R&D funds

Table C.19: Funding for R&D by source (2009/10 to 2018/19)

YEAR	TOTAL FUNDS	GOVERNMENT*	BUSINESS	OTHER SOUTH AFRICAN SOURCES**	FOREIGN SOURCES
	R'000	R'000	R'000	R'000	R'000
2009/10	**20 954 676**	9 313 028	8 907 527	195 682	2 538 439
2010/11	**20 253 805**	9 018 874	8 128 246	661 676	2 445 009
2011/12	**22 209 192**	9 561 917	8 663 105	653 674	3 330 496
2012/13	**23 871 219**	10 831 893	9 152 042	770 300	3 116 984
2013/14	**25 660 573**	11 007 083	10 615 902	722 361	3 315 227
2014/15	**29 344 977**	12 873 458	11 981 974	923 530	3 566 015
2015/16	**32 336 679**	14 425 992	12 578 499	1 122 328	4 209 861
2016/17	**35 692 973**	16 427 596	14 045 892	1 047 980	4 171 507
2017/18	**38 724 590**	18 082 182	16 066 846	638 858	3 936 705
2018/19	**36 783 968**	17 475 173	14 534 123	775 938	3 998 734

*Includes science council and university own funds.

**Includes funds from higher education institutions, not-for-profit organisations and individual donations disbursed to all sectors.

Table C.20: Proportional funding for R&D by source (2009/10 to 2018/19)

YEAR	GOVERNMENT*	BUSINESS	OTHER SOUTH AFRICAN SOURCES**	FOREIGN SOURCES
	%	%	%	%
2009/10	44.4	42.5	0.9	12.1
2010/11	44.5	40.1	3.3	12.1
2011/12	43.1	39.0	2.9	15.0
2012/13	45.4	38.3	3.2	13.1
2013/14	42.9	41.4	2.8	12.9
2014/15	43.9	40.8	3.1	12.2
2015/16	44.6	38.9	3.5	13.0
2016/17	46.0	39.4	2.9	11.7
2017/18	46.7	41.5	1.6	10.2
2018/19	47.5	39.5	2.1	10.9

*Includes science council and university own funds.

**Includes funds from higher education institutions, not-for-profit organisations and individual donations disbursed to all sectors.

Table C.21: Sources of R&D funding by sector, amount and as a percentage of total funds (2018/19)

SOURCE OF FUNDS	TOTAL		GOVERNMENT		SCIENCE COUNCILS		HIGHER EDUCATION		BUSINESS		NOT-FOR-PROFIT	
	R'000	%	R'000	%	R'000	%	R'000	%	R'000	%	R'000	%
Own funds	22 983 208	62.5	1 420 312	63.9	249 902	4.6	7 417 849	56.3	13 664 082	94.6	231 063	15.6
Internal sources	22 983 208	62.5	1 420 312	63.9	249 902	4.6	7 417 849	56.3	13 664 082	94.6	231 063	15.6
Government	8 387 111	22.8	477 918	21.5	4 394 513	80.7	3 083 217	23.4	214 541	1.5	216 922	14.6
Grants	3 540 977	9.6	461 628	20.8	2 812 801	51.7	N/A	N/A	168 331	1.2	98 216	6.6
Contracts	1 762 917	4.8	16 290	0.7	1 581 712	29.1	N/A	N/A	46 209	0.3	118 706	8.0
All other	3 083 217	8.4	N/A	N/A	N/A	N/A	3 083 217	23	N/A	N/A	N/A	N/A
Business	870 041	2.4	4 614	0.2	206 648	3.8	463 413	3.5	123 429	0.9	71 937	4.8
Local business	870 041	2.4	4 614	0.2	206 648	3.8	463 413	3.5	123 429	0.9	71 937	4.8
Other SA sources	544 874	1.5	23 664	1.1	42 367	0.8	366 740	2.8	45 319	0.3	66 784	4.5
Higher education	157 949	0.4	140	0.0	20 694	0.4	101 828	0.8	0	0.0	35 287	2.4
Not-for-profit	304 906	0.8	23 364	1.1	21 673	0.4	188 704	1.4	45 194	0.3	25 971	1.7
Individual donations	82 020	0.2	160	0.0	0	0.0	76 208	0.6	125	0.0	5 527	0.4
Foreign	3 998 734	10.9	296 918	13.4	550 456	10.1	1 851 900	14.0	400 462	2.8	898 998	60.5
All sources	3 998 734	10.9	296 918	13.4	550 456	10.1	1 851 900	14.0	400 462	2.8	898 998	60.5
Total	36 783 968	100.0	2 223 426	100.0	5 443 885	100.0	13 183 119	100.0	14 447 833	100.0	1 485 704	100.0

Note: N/A indicates that data were not collected.

Table C.22: *Government-funded R&D by sector (2009/10 to 2018/19)

YEAR	TOTAL	GOVERNMENT	SCIENCE COUNCILS	HIGHER EDUCATION	BUSINESS	NOT-FOR-PROFIT
	R'000	R'000	R'000	R'000	R'000	R'000
2009/10	**9 313 028**	1 008 475	2 917 683	3 918 620	1 429 766	38 484
2010/11	**9 018 874**	990 290	2 932 489	4 222 092	832 173	41 830
2011/12	**9 561 917**	1 112 307	3 310 894	4 598 426	499 298	40 992
2012/13	**10 831 893**	1 269 337	3 368 555	5 395 871	683 669	114 461
2013/14	**11 007 083**	1 436 141	3 412 790	5 369 334	685 670	103 148
2014/15	**12 873 458**	1 711 809	4 319 393	6 020 572	690 396	131 288
2015/16	**14 425 992**	1 425 598	4 922 223	7 393 857	522 631	161 682
2016/17	**16 427 596**	1 530 964	5 076 805	9 222 246	453 958	143 623
2017/18	**18 082 182**	1 769 929	5 311 190	10 486 989	371 165	142 908
2018/19	**17 475 173**	1 898 230	4 644 414	10 501 066	214 541	216 922

*Includes science council and university own funds.

Table C.23: *Proportional government-funded R&D by sector (2009/10 to 2018/19)

YEAR	GOVERNMENT	SCIENCE COUNCILS	HIGHER EDUCATION	BUSINESS	NOT-FOR-PROFIT
	%	%	%	%	%
2009/10	10.8	31.3	42.1	15.4	0.4
2010/11	11.0	32.5	46.8	9.2	0.5
2011/12	11.6	34.6	48.1	5.2	0.4
2012/13	11.7	31.1	49.8	6.3	1.1
2013/14	13.0	31.0	48.8	6.2	0.9
2014/15	13.3	33.6	46.8	5.4	1.0
2015/16	9.9	34.1	51.3	3.6	1.1
2016/17	9.3	30.9	56.1	2.8	0.9
2017/18	9.8	29.4	58.0	2.1	0.8
2018/19	10.9	26.6	60.1	1.2	1.2

*Includes science council and university own funds.

Table C.24: Business-funded R&D by sector (2009/10 to 2018/19)

YEAR	TOTAL	GOVERNMENT	SCIENCE COUNCILS	HIGHER EDUCATION	BUSINESS	NOT-FOR-PROFIT
	R'000	R'000	R'000	R'000	R'000	R'000
2009/10	**8 907 527**	2 326	120 528	609 250	8 142 996	32 427
2010/11	**8 128 246**	2 406	198 206	367 340	7 528 667	31 627
2011/12	**8 663 105**	1 355	67 614	505 510	8 056 545	32 081
2012/13	**9 152 042**	11 552	135 729	577 527	8 402 340	24 894
2013/14	**10 615 902**	1 759	419 469	588 598	9 552 717	53 359
2014/15	**11 981 974**	290	222 892	885 280	10 810 428	63 084
2015/16	**12 578 499**	41 109	326 648	770 448	11 384 710	55 585
2016/17	**14 045 892**	1 261	483 166	906 651	12 586 109	68 705
2017/18	**16 066 846**	519	354 820	679 563	14 963 198	68 747
2018/19	**14 534 123**	4 614	206 648	463 413	13 787 512	71 937

Table C.25: Proportional business-funded R&D by sector (2009/10 to 2018/19)

YEAR	GOVERNMENT	SCIENCE COUNCILS	HIGHER EDUCATION	BUSINESS	NOT-FOR-PROFIT
	%	%	%	%	%
2009/10	0.0	1.4	6.8	91.4	0.4
2010/11	0.0	2.4	4.5	92.6	0.4
2011/12	0.0	0.8	5.8	93.0	0.4
2012/13	0.1	1.5	6.3	91.8	0.3
2013/14	0.0	4.0	5.5	90.0	0.5
2014/15	0.0	1.9	7.4	90.2	0.5
2015/16	0.3	2.6	6.1	90.5	0.4
2016/17	0.0	3.4	6.5	89.6	0.5
2017/18	0.0	2.2	4.2	93.1	0.4
2018/19	0.0	1.4	3.2	94.9	0.5

Table C.26: Foreign-funded R&D by sector (2009/10 to 2018/19)

YEAR	TOTAL	GOVERNMENT	SCIENCE COUNCILS	HIGHER EDUCATION	BUSINESS	NOT-FOR-PROFIT
	R'000	R'000	R'000	R'000	R'000	R'000
2009/10	**2 538 439**	54 129	416 571	443 109	1 538 917	85 713
2010/11	**2 445 009**	16 236	460 580	473 145	1 442 334	52 714
2011/12	**3 330 496**	118 127	321 257	1 272 173	1 562 277	56 662
2012/13	**3 116 984**	143 994	510 846	1 010 244	1 189 865	262 035
2013/14	**3 315 227**	258 531	454 527	1 042 627	1 226 966	332 576
2014/15	**3 566 015**	179 473	431 215	1 079 732	1 418 823	456 772
2015/16	**4 209 861**	499 966	469 507	1 206 192	1 532 766	501 430
2016/17	**4 171 507**	512 090	537 503	1 143 451	1 338 662	639 801
2017/18	**3 936 705**	471 786	617 838	1 506 077	474 762	866 241
2018/19	**3 998 734**	296 918	550 456	1 851 900	400 462	898 998

Table C.27: Proportional foreign-funded R&D by sector (2009/10 to 2018/19)

YEAR	GOVERNMENT	SCIENCE COUNCILS	HIGHER EDUCATION	BUSINESS	NOT-FOR-PROFIT
	%	%	%	%	%
2009/10	2.1	16.4	17.5	60.6	3.4
2010/11	0.7	18.8	19.4	59.0	2.2
2011/12	3.5	9.6	38.2	46.9	1.7
2012/13	4.6	16.4	32.4	38.2	8.4
2013/14	7.8	13.7	31.4	37.0	10.0
2014/15	5.0	12.1	30.3	39.8	12.8
2015/16	11.9	11.2	28.7	36.4	11.9
2016/17	12.3	12.9	27.4	32.1	15.3
2017/18	12.0	15.7	38.3	12.1	22.0
2018/19	7.4	13.8	46.3	10.0	22.5

C.1.3. R&D personnel

Table C.28: R&D personnel in headcounts and full-time equivalents by occupation (2009/10 to 2018/19)

YEAR	R&D PERSONNEL			RESEARCHERS			TECHNICIANS		OTHER R&D PERSONNEL	
	(HEAD-COUNTS*)	(FTEs)	(FTEs) PER 1000 IN TOTAL EM-PLOYMENT	(HEAD-COUNTS*)	(FTEs)	(FTEs) PER 1000 IN TOTAL EM-PLOYMENT	(HEAD-COUNTS)	(FTEs)	(HEAD-COUNTS)	(FTEs)
2009/10	**59 494**	**30 891.3**	**2.3**	40 797	19 793.1	1.5	9 443	5 792.2	9 254	5 306.0
2010/11	**55 531**	**29 486.4**	**2.2**	37 901	18 719.6	1.4	8 559	5 409.6	9 071	5 357.3
2011/12	**59 487**	**30 978.4**	**2.3**	40 653	20 115.1	1.5	9 260	5 566.9	9 574	5 296.5
2012/13	**64 917**	**35 050.3**	**2.4**	42 828	21 382.4	1.5	10 790	6 582.3	11 299	7 085.5
2013/14	**68 838**	**37 956.5**	**2.5**	45 935	23 346.0	1.6	10 800	6 905.5	12 103	7 705.0
2014/15	**72 400**	**38 465.0**	**2.5**	48 479	23 571.9	1.5	12 183	7 731.3	11 738	7 161.9
2015/16	**74 931**	**41 054.5**	**2.6**	51 877	26 159.4	1.7	11 518	7 688.3	11 536	7 206.9
2016/17	**80 029**	**42 533.0**	**2.6**	56 761	27 656.2	1.7	11 346	7 563.1	11 922	7 313.6
2017/18	**84 262**	**44 259.3**	**2.7**	61 840	29 515.2	1.8	11 219	7 383.3	11 203	7 360.8
2018/19	**84 036**	**43 774.3**	**2.7**	62 166	29 110.8	1.8	10 545	7 069.0	11 325	7 594.5

*Includes doctoral students and post-doctoral fellows. Also includes specific categories of R&D personnel (from 2016/17).
Note: Headcounts include non-SA R&D personnel (from 2016/17). Non-SA personnel are classified as those that are not from South Africa but are undertaking research in South Africa for a period exceeding six months. They can be temporary or permanent residents as described by the SNA.

Table C.29: R&D personnel in headcounts (*including and **exluding doctoral and post-doctoral students) and full-time equivalents by occupation and gender (2016/17 to 2018/19)

YEAR	HEADCOUNTS			FULL-TIME EQUIVALENTS (FTEs)			
2016/17	**TOTAL**	**MALE**	**FEMALE**	**TOTAL**	**MALE**	**FEMALE**	**FTEs AS % OF HEADCOUNTS**
Researchers*	**56 761**	31 170	25 591	**27 656.2**	15 312.5	12 343.8	48.7
Technicians directly supporting R&D	**11 346**	7 028	4 318	**7 563.1**	4 570.8	2 992.4	66.7
Other personnel directly supporting R&D	**11 922**	5 722	6 200	**7 313.6**	3 755.9	3 557.8	61.3
Total	80 029	43 920	36 109	42 533.0	23 639.1	18 893.9	53.1
Researchers**	**33 035**	17 957	15 078	**13 247.8**	7 289.6	5 958.2	40.1
Technicians directly supporting R&D	**11 346**	7 028	4 318	**7 563.1**	4 570.8	2 992.4	66.7
Other personnel directly supporting R&D	**11 922**	5 722	6 200	**7 313.6**	3 755.9	3 557.8	61.3
Total	56 303	30 707	25 596	28 124.5	15 616.2	12 508.3	50.0
2017/18	**TOTAL**	**MALE**	**FEMALE**	**TOTAL**	**MALE**	**FEMALE**	**FTEs AS % OF HEADCOUNTS**
Researchers*	**61 840**	34 066	27 774	**29 515.2**	16 404.3	13 111.0	47.7
Technicians directly supporting R&D	**11 219**	6 673	4 546	**7 383.3**	4 289.6	3 093.7	65.8
Other personnel directly supporting R&D	**11 203**	5 580	5 623	**7 360.8**	3 870.4	3 490.5	65.7
Total	84 262	46 319	37 943	44 259.3	24 564.2	19 695.1	52.5
Researchers**	**36 233**	19 800	16 433	**14 559.6**	8 008.6	6 551.0	40.2
Technicians directly supporting R&D	**11 219**	6 673	4 546	**7 383.3**	4 289.6	3 093.7	65.8
Other personnel directly supporting R&D	**11 203**	5 580	5 623	**7 360.8**	3 870.4	3 490.5	65.7
Total	58 655	32 053	26 602	29 303.6	16 168.5	13 135.1	50.0
2018/19	**TOTAL**	**MALE**	**FEMALE**	**TOTAL**	**MALE**	**FEMALE**	**FTEs AS % OF HEADCOUNTS**
Researchers*	**62 166**	33 765	28 401	**29 110.8**	16 005.1	13 105.8	46.8
Technicians directly supporting R&D	**10 545**	6 270	4 275	**7 069.0**	4 036.1	3 032.9	67.0
Other personnel directly supporting R&D	**11 325**	5 473	5 852	**7 594.5**	3 660.9	3 933.6	67.1
Total	84 036	45 508	38 528	43 774.3	23 702.0	20 072.3	52.1
Researchers**	**35 597**	19 116	16 481	**13 527.4**	7 273.6	6 253.7	38.0
Technicians directly supporting R&D	**10 545**	6 270	4 275	**7 069.0**	4 036.1	3 032.9	67.0
Other personnel directly supporting R&D	**11 325**	5 473	5 852	**7 594.5**	3 660.9	3 933.6	67.1
Total	57 467	30 859	26 608	28 190.8	14 970.6	13 220.2	49.1

*Includes doctoral students and post-doctoral fellows. Also includes specific categories of R&D personnel (from 2016/17).
**Excluding doctoral and post-doctoral students. Also includes specific categories of R&D personnel (from 2016/17).
Note: Headcounts include non-SA R&D personnel (from 2016/17). Non-SA personnel are classified as those that are not from South Africa but are undertaking research in South Africa for a period exceeding six months. They can be temporary or permanent residents as described by the SNA.

Table C.30: R&D personnel in headcounts by sector (2009/10 to 2018/19)

YEAR	TOTAL R&D PERSONNEL (HEADCOUNTS*)	GOVERNMENT	SCIENCE COUNCILS	HIGHER EDUCATION	BUSINESS	NOT-FOR-PROFIT
2009/10	**59 494**	2 580	5 926	32 392	18 216	380
2010/11	**55 531**	2 704	4 923	32 571	14 933	400
2011/12	**59 487**	3 143	4 494	36 157	15 288	405
2012/13	**64 917**	3 252	5 399	38 205	17 155	906
2013/14	**68 838**	2 874	5 884	41 464	17 599	1 017
2014/15	**72 400**	2 893	4 836	44 457	18 743	1 471
2015/16	**74 931**	2 997	5 162	48 034	17 245	1 493
2016/17	**80 029**	3 076	4 955	52 384	17 998	1 616
2017/18	**84 262**	3 027	4 866	57 074	17 554	1 741
2018/19	**84 036**	2 910	4 514	57 799	16 876	1 937

*Includes doctoral students and post-doctoral fellows. Also includes specific categories of R&D personnel (from 2016/17).
Note: Headcounts include non-SA R&D personnel (from 2016/17). Non-SA personnel are classified as those that are not from South Africa but are undertaking research in South Africa for a period exceeding six months. They can be temporary or permanent residents as described by the SNA.

Table C.31: R&D personnel full-time equivalents by sector (2009/10 to 2018/19)

YEAR	TOTAL R&D PERSONNEL* (FTEs)	GOVERNMENT	SCIENCE COUNCILS	HIGHER EDUCATION	BUSINESS	NOT-FOR-PROFIT
2009/10	**30 891.3**	1 903.9	4 782.7	11 870.4	12 024.6	309.7
2010/11	**29 486.4**	2 178.6	4 312.4	12 477.3	10 205.1	313.1
2011/12	**30 978.4**	2 404.5	3 803.5	14 563.4	9 894.9	312.1
2012/13	**35 050.3**	2 597.0	4 748.5	15 614.4	11 322.3	768.0
2013/14	**37 956.5**	2 245.5	5 164.5	17 777.7	11 877.4	891.4
2014/15	**38 465.0**	2 181.5	4 180.4	17 944.4	12 927.5	1 231.2
2015/16	**41 054.5**	2 056.2	4 361.2	20 812.0	12 457.8	1 367.3
2016/17	**42 533.0**	2 031.6	4 421.4	22 061.4	12 549.2	1 469.5
2017/18	**44 259.3**	2 000.4	4 294.9	23 415.1	12 952.9	1 596.0
2018/19	**43 774.3**	1 999.0	3 941.8	24 456.8	11 691.0	1 685.8

*Includes doctoral students and post-doctoral fellows. Also includes specific categories of R&D personnel (2016/17 only).

Note: Headcounts include non-SA R&D personnel (2016/17 only). Non-SA personnel are classified as those that are not from South Africa but are undertaking research in South Africa for a period exceeding six months. They can be temporary or permanent residents as described by the SNA.

Table C.32: Researcher headcounts by sector (2009/10 to 2018/19)

YEAR	TOTAL RESEARCHERS (HEADCOUNTS*)	GOVERNMENT	SCIENCE COUNCILS	HIGHER EDUCATION	BUSINESS	NOT-FOR-PROFIT
2009/10	**40 797**	986	2 669	28 552	8 366	224
2010/11	**37 901**	1 184	1 941	28 154	6 372	250
2011/12	**40 653**	1 411	1 803	30 993	6 192	254
2012/13	**42 828**	1 409	1 879	32 955	6 191	394
2013/14	**45 935**	1 229	1 956	36 133	6 182	435
2014/15	**48 479**	1 343	1 988	38 381	6 261	506
2015/16	**51 877**	1 573	2 072	41 639	6 128	465
2016/17	**56 761**	1 677	2 189	46 028	6 463	404
2017/18	**61 840**	1 671	2 053	50 549	7 142	425
2018/19	**62 166**	1 662	1 951	51 187	6 942	424

*Includes doctoral students and post-doctoral fellows. Also includes specific categories of R&D personnel (from 2016/17).

Note: Headcounts include non-SA R&D personnel (from 2016/17). Non-SA personnel are classified as those that are not from South Africa but are undertaking research in South Africa for a period exceeding six months. They can be temporary or permanent residents as described by the SNA.

Table C.33: Researcher headcounts by gender (2009/10 to 2018/19)

YEAR	TOTAL RESEARCHERS* (HEADCOUNTS)	MALE	FEMALE
2009/10	**29 255**	17 614	11 641
2010/11	**25 300**	14 823	10 477
2011/12	**25 954**	15 065	10 889
2012/13	**27 314**	15 378	11 936
2013/14	**28 014**	15 520	12 494
2014/15	**28 723**	15 824	12 899
2015/16	**29 455**	16 150	13 305
2016/17	**33 035**	17 957	15 078
2017/18	**36 233**	19 800	16 433
2018/19	**35 597**	19 116	16 481

*Excludes doctoral students and post-doctoral fellows. Researchers includes specific categories of R&D personnel (from 2016/17).

Note: Headcounts include non-SA R&D personnel (from 2016/17). Non-SA personnel are classified as those that are not from South Africa but are undertaking research in South Africa for a period exceeding six months. They can be temporary or permanent residents as described by the SNA.

Table C.34: Researcher headcounts by race (2009/10 to 2018/19)

YEAR	TOTAL RESEARCHERS* (HEADCOUNTS)	AFRICAN	COLOURED	INDIAN/ASIAN	WHITE	NON-SA
2009/10	**29 255**	7 210	1 573	2 448	18 024	N/A
2010/11	**25 300**	6 756	1 316	2 438	14 789	N/A
2011/12	**25 954**	7 201	1 438	2 202	15 113	N/A
2012/13	**27 314**	8 101	1 591	2 514	15 108	N/A
2013/14	**28 014**	8 024	1 685	2 530	15 775	N/A
2014/15	**28 723**	8 468	1 815	2 522	15 919	N/A
2015/16	**29 454**	9 548	1 881	2 629	15 396	N/A
2016/17	**33 035**	9 968	1 957	2 921	15 151	3 038
2017/18	**36 233**	10 815	2 209	3 352	15 795	4 062
2018/19	**35 597**	10 572	2 099	3 370	14 890	4 667

*Excludes doctoral students and post-doctoral fellows. Researchers includes specific categories of R&D personnel (from 2016/17). Note: Headcounts include non-SA R&D personnel (from 2016/17). Non-SA personnel are classified as those that are not from South Africa but are undertaking research in South Africa for a period exceeding six months. They can be temporary or permanent residents as described by the SNA.
N/A: data was not collected for these years.

Table C.35: R&D personnel (*including doctoral and post-doctoral students) in headcounts

OCCUPATION AND QUALIFICATION	TOTAL R&D PERSONNEL (HEADCOUNTS)	SUBTOTAL		AFRICAN		COLOURED		INDIAN/ASIAN		WHITE		NON-SA	
		MALE	FEMALE	MALE	FEMALE	MALE	FEMALE	MALE	FEMALE	MALE	FEMALE	MALE	FEMALE
Researchers*	62 166	33 765	28 401	9 872	8 502	1 455	1 762	2 065	2 699	10 250	10 242	10 123	5 196
Doctoral degree or equivalent	40 543	22 635	17 908	5 902	4 681	825	1 010	978	1 434	5 649	6 195	9 281	4 587
Master's, honours, bachelor or equivalent	18 159	9 252	8 908	3 227	3 192	518	631	947	1 096	3 846	3 491	714	498
Diplomas	3 464	1 878	1 585	743	629	112	121	140	169	755	556	128	110
Technicians directly supporting R&D	10 545	6 270	4 275	2 418	2 098	621	450	467	373	2 459	1 121	305	233
Doctoral degree or equivalent	316	176	140	25	17	7	5	7	12	93	69	43	36
Master's, honours, bachelor or equivalent	4 330	2 317	2 013	850	875	192	214	218	245	983	642	74	37
Diplomas	5 899	3 777	2 122	1 543	1 206	422	231	242	116	1 382	410	188	159
Other personnel directly supporting R&D	11 325	5 473	5 852	2 750	2 338	527	884	540	419	1 258	1 716	398	495
Doctoral degree or equivalent	383	178	205	56	45	12	27	7	13	75	90	28	29
Master's, honours, bachelor or equivalent	3 430	1 398	2 032	518	704	117	237	118	137	539	828	105	126
Diplomas	7 512	3 897	3 615	2 175	1 589	398	620	415	269	644	798	265	340
Total	84 036	45 508	38 528	15 039	12 938	2 603	3 096	3 073	3 491	13 967	13 079	10 827	5 924

*Researchers includes specific categories of R&D personnel (from 2016/17). To enable comparison, the table below excludes doctoral students and post-doctoral fellows from the Researchers indicator, as well as provides a total for this modified Researchers value, including Technicians directly supporting R&D (unchanged) and Other personnel directly supporting R&D (unchanged). Note: Non-SA student data are not collected by population group. Note: Headcounts include non-SA R&D personnel (from 2016/17). Non-SA personnel are classified as those that are not from South Africa but are undertaking research in South Africa for a period exceeding six months. They can be temporary or permanent residents as described by the SNA. **Total may vary due to extrapolations.

OCCUPATION AND QUALIFICATION	TOTAL R&D PERSONNEL (HEADCOUNTS)	SUBTOTAL		AFRICAN		COLOURED		INDIAN/ASIAN		WHITE		NON-SA	
		MALE	FEMALE	MALE	FEMALE	MALE	FEMALE	MALE	FEMALE	MALE	FEMALE	MALE	FEMALE
Researchers*	35 597	19 116	16 481	5 659	4 913	993	1 106	1 570	1 799	7 854	7 036	3 040	1 627
Doctoral degree or equivalent	13 974	7 986	5 988	1 689	1 092	363	354	483	534	3 253	2 989	2 198	1 018
Master's, honours, bachelor or equivalent	18 159	9 252	8 908	3 227	3 192	518	631	947	1 096	3 846	3 491	714	498
Diplomas	3 464	1 878	1 585	743	629	112	121	140	169	755	556	128	110
Technicians directly supporting R&D	10 545	6 270	4 275	2 418	2 098	621	450	467	373	2 459	1 121	305	233
Other personnel directly supporting R&D	11 325	5 473	5 852	2 750	2 338	527	884	540	419	1 258	1 716	398	495
Total	57 467	30 859	26 608	10 826	9 349	2 141	2 440	2 578	2 591	11 571	9 873	3 744	2 355

C.2. Sector tables

C.2.1. Business sector

Table C.36: Business sector R&D expenditure by type of research (2009/10 to 2018/19)

TYPE OF RESEARCH	2009/10 R'000	2010/11 R'000	2011/12 R'000	2012/13 R'000	2013/14 R'000	2014/15 R'000	2015/16 R'000	2016/17 R'000	2017/18 R'000	2018/19 R'000
Basic research	1 267 759	1 025 389	922 888	802 753	968 504	845 527	906 730	909 278	1 021 152	948 319
Applied research	3 301 773	3 949 410	4 461 770	5 569 024	6 087 791	7 541 596	7 492 229	8 389 888	10 551 512	9 819 344
Experimental development research	6 569 705	5 084 210	5 079 364	4 198 949	4 726 553	4 903 827	5 416 037	5 482 104	4 286 521	3 680 170
Total	11 139 237	10 059 010	10 464 022	10 570 726	11 782 848	13 290 951	13 814 995	14 781 270	15 859 185	14 447 833

Table C.37: Proportional business sector R&D expenditure by type of research (2009/10 to 2018/19)

TYPE OF RESEARCH	2009/10 %	2010/11 %	2011/12 %	2012/13 %	2013/14 %	2014/15 %	2015/16 %	2016/17 %	2017/18 %	2018/19 %
Basic research	11.4	10.2	8.8	7.6	8.2	6.4	6.6	6.2	6.4	6.6
Applied research	29.6	39.3	42.6	52.7	51.7	56.7	54.2	56.8	66.5	68.0
Experimental development research	59.0	50.5	48.5	39.7	40.1	36.9	39.2	37.1	27.0	25.5
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Table C.38: Business sector R&D expenditure by accounting category (2009/10 to 2018/19)

TYPE OF EXPENDITURE	2009/10 R'000	2010/11 R'000	2011/12 R'000	2012/13 R'000	2013/14 R'000	2014/15 R'000	2015/16 R'000	2016/17 R'000	2017/18 R'000	2018/19 R'000
Capital expenditure	1 638 994	1 306 444	1 650 541	1 072 556	1 132 520	1 397 243	1 289 228	1 727 929	1 421 699	1 545 944
Land: buildings & other structures	285 285	202 835	217 126	140 053	159 162	117 656	186 396	288 957	270 191	370 231
Vehicles, plant, machinery, equipment	1 353 709	1 103 609	1 433 415	932 503	973 358	1 279 587	1 102 833	1 438 972	1 151 508	1 175 713
Current expenditure	9 500 243	8 752 566	8 813 481	9 498 170	10 650 328	11 893 708	12 525 767	13 053 341	14 437 485	12 901 890
Labour costs	5 207 695	4 467 214	4 723 488	5 821 884	6 768 527	7 659 365	7 821 865	8 486 640	9 747 037	8 612 310
Other current expenditure	4 292 548	4 285 352	4 089 993	3 676 286	3 881 801	4 234 343	4 703 901	4 566 701	4 690 449	4 289 579
Total	11 139 237	10 059 010	10 464 022	10 570 726	11 782 848	13 290 951	13 814 995	14 781 270	15 859 185	14 447 833

Table C.39: Proportional business sector R&D expenditure by accounting category (2009/10 to 2018/19)

TYPE OF EXPENDITURE	2009/10 %	2010/11 %	2011/12 %	2012/13 %	2013/14 %	2014/15 %	2015/16 %	2016/17 %	2017/18 %	2018/19 %
Capital expenditure	14.7	13.0	15.8	10.1	9.6	10.5	9.3	11.7	9.0	10.7
Land: buildings & other structures	2.6	2.0	2.1	1.3	1.4	0.9	1.3	2.0	1.7	2.6
Vehicles, plant, machinery, equipment	12.2	11.0	13.7	8.8	8.3	9.6	8.0	9.7	7.3	8.1
Current expenditure	85.3	87.0	84.2	89.9	90.4	89.5	90.7	88.3	91.0	89.3
Labour costs	46.8	44.4	45.1	55.1	57.4	57.6	56.6	57.4	61.5	59.6
Other current expenditure	38.5	42.6	39.1	34.8	32.9	31.9	34.0	30.9	29.6	29.7
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Table C.40: Business sector expenditure on multidisciplinary areas of R&D (2009/10 to 2018/19)

MULTI-DISCIPLINARY AREA OF R&D	2009/10 R'000	2010/11 R'000	2011/12 R'000	2012/13 R'000	2013/14 R'000	2014/15 R'000	2015/16 R'000	2016/17 R'000	2017/18 R'000	2018/19 R'000
Biotechnology	330 232	341 695	422 121	499 589	556 275	578 747	729 299	685 170	721 698	702 168
Nanotechnology	150 474	102 670	171 808	225 557	170 479	217 216	134 063	268 320	113 260	155 956
Total	480 706	444 366	593 929	725 145	726 754	795 963	863 362	953 490	834 958	858 124
Business expenditure on R&D	**11 139 237**	**10 059 010**	**10 464 022**	**10 570 726**	**11 782 848**	**13 290 951**	**13 814 995**	**14 781 270**	**15 859 185**	**14 447 833**

Note: Data on these multidisciplinary areas of R&D were collected for the first time in the 2005/06 R&D survey.

Table C.41: Proportional business sector expenditure on multidisciplinary areas of R&D (2009/10 to 2018/19)

MULTI-DISCIPLINARY AREA OF R&D	2009/10 %	2010/11 %	2011/12 %	2012/13 %	2013/14 %	2014/15 %	2015/16 %	2016/17 %	2017/18 %	2018/19 %
Biotechnology	3.0	3.4	4.0	4.7	4.7	4.4	5.3	4.6	4.6	4.9
Nanotechnology	1.4	1.0	1.6	2.1	1.4	1.6	1.0	1.8	0.7	1.1
Total	4.3	4.4	5.7	6.9	6.2	6.0	6.2	6.5	5.3	5.9

Table C.42: Business sector R&D expenditure on selected areas of interest (2009/10 to 2018/19)

AREA OF INTEREST	2009/10 R'000	2010/11 R'000	2011/12 R'000	2012/13 R'000	2013/14 R'000	2014/15 R'000	2015/16 R'000	2016/17 R'000	2017/18 R'000	2018/19 R'000
Environment related	N/A	N/A	31 349	183 921	228 905	176 463	173 356	280 651	377 030	472 759
Open-source software	91 818	68 105	85 787	87 200	233 576	241 710	326 856	207 849	193 239	154 894
New materials	173 308	227 682	277 152	225 897	151 890	245 752	224 433	179 108	186 858	268 298
Tuberculosis (TB), HIV/AIDS, malaria	460 233	631 996	812 580	929 121	992 538	1 082 646	1 176 149	1 153 668	1 332 248	1 801 869
Space science	N/A	N/A	N/A	N/A	N/A	N/A	N/A	33 099	42 291	47 018
Total	725 359	927 783	1 206 869	1 426 139	1 606 909	1 746 571	1 900 794	1 854 375	2 131 666	2 744 839
Business expenditure on R&D	**11 139 237**	**10 059 010**	**10 464 022**	**10 570 726**	**11 782 848**	**13 290 951**	**13 814 995**	**14 781 270**	**15 859 185**	**14 447 833**

N/A: Environment-related data were collected from the 2011/12 R&D Survey onwards. Space science data were collected for the first time in the 2016/17 R&D Survey.

Table C.43: Proportional business sector R&D expenditure on selected areas of interest (2009/10 to 2018/19)

AREA OF INTEREST	2009/10 %	2010/11 %	2011/12 %	2012/13 %	2013/14 %	2014/15 %	2015/16 %	2016/17 %	2017/18 %	2018/19 %
Environment related	N/A	N/A	0.3	1.7	1.9	1.3	1.3	1.9	2.4	3.3
Open-source software	0.8	0.7	0.8	0.8	2.0	1.8	2.4	1.4	1.2	1.1
New materials	1.6	2.3	2.6	2.1	1.3	1.8	1.6	1.2	1.2	1.9
Tuberculosis (TB), HIV/AIDS, malaria	4.1	6.3	7.8	8.8	8.4	8.1	8.5	7.8	8.4	12.5
Space science	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.2	0.3	0.3
Total	6.5	9.2	11.5	13.5	13.6	13.1	13.8	12.5	13.4	19.0

N/A: Environment-related data were collected from the 2011/12 R&D Survey onwards. Space science data were collected for the first time in the 2016/17 R&D Survey.

Table C.44: Business sector R&D expenditure by research field (2009/10 to 2018/19)

MAIN RESEARCH FIELD	2009/10 R'000	2010/11 R'000	2011/12 R'000	2012/13 R'000	2013/14 R'000	2014/15 R'000	2015/16 R'000	2016/17 R'000	2017/18 R'000	2018/19 R'000
Division 1: Natural Sciences, Technology and Engineering	10 743 523	9 612 221	9 992 916	9 127 446	9 765 859	10 977 250	11 447 693	11 918 539	11 793 445	11 719 001
Mathematical sciences	183 426	110 543	204 594	149 220	209 344	211 324	119 900	138 858	188 550	196 143
Physical sciences	190 292	32 669	28 490	47 672	50 708	56 997	35 616	45 816	90 281	87 440
Chemical sciences	627 729	687 843	934 005	980 021	979 760	847 321	972 398	1 153 685	1 154 404	1 102 373
Earth sciences	90 098	106 759	92 439	102 892	109 665	118 539	93 302	104 072	160 745	156 112
Information, computer and communication technologies	2 855 355	2 502 454	2 481 028	1 576 163	1 610 718	1 908 985	2 572 364	3 111 146	2 584 726	2 295 683
Applied sciences and technologies	1 271 414	1 132 538	902 425	872 014	808 899	955 119	903 958	915 101	1 143 251	942 480
Engineering sciences	3 311 902	2 768 035	2 751 145	2 827 677	3 093 088	3 548 019	3 429 786	2 651 327	2 971 162	2 786 664

MAIN RESEARCH FIELD	2009/10 R'000	2010/11 R'000	2011/12 R'000	2012/13 R'000	2013/14 R'000	2014/15 R'000	2015/16 R'000	2016/17 R'000	2017/18 R'000	2018/19 R'000
Biological sciences	194 671	207 456	212 633	210 627	213 124	248 838	254 071	250 356	220 193	154 696
Agricultural sciences	323 603	371 310	471 529	444 593	593 315	665 703	671 194	686 697	778 583	1 008 216
Medical and health sciences	1 567 493	1 622 215	1 843 005	1 812 411	1 974 213	2 170 317	2 300 587	2 283 200	2 384 920	2 855 116
Environmental sciences	47 692	5 818	2 206	44 563	50 909	85 932	21 920	480 612	60 379	69 676
Material sciences	70 949	59 723	65 092	53 855	64 090	154 500	71 967	97 670	56 253	63 653
Marine sciences	8 899	4 859	4 324	5 738	8 026	5 655	630	0	0	750
Division 2: Social Sciences and Humanities	395 714	446 789	471 106	1 443 280	2 016 989	2 313 701	2 367 302	2 862 731	4 065 740	2 728 832
Social sciences	395 115	446 789	471 106	1 443 280	2 016 989	2 313 701	2 367 302	2 858 585	4 065 740	2 727 641
Humanities	599	0	0	0	0	0	0	4 146	0	1 191
Total	11 139 237	10 059 010	10 464 022	10 570 726	11 782 848	13 290 951	13 814 995	14 781 270	15 859 185	14 447 833

Table C.45: Proportional business sector R&D expenditure by research field (2009/10 to 2018/19)

MAIN RESEARCH FIELD	2009/10 %	2010/11 %	2011/12 %	2012/13 %	2013/14 %	2014/15 %	2015/16 %	2016/17 %	2017/18 %	2018/19 %
Division 1: Natural Sciences, Technology and Engineering	96.4	95.6	95.5	86.3	82.9	82.6	82.9	80.6	74.4	81.1
Mathematical sciences	1.6	1.1	2.0	1.4	1.8	1.6	0.9	0.9	1.2	1.4
Physical sciences	1.7	0.3	0.3	0.5	0.4	0.4	0.3	0.3	0.6	0.6
Chemical sciences	5.6	6.8	8.9	9.3	8.3	6.4	7.0	7.8	7.3	7.6
Earth sciences	0.8	1.1	0.9	1.0	0.9	0.9	0.7	0.7	1.0	1.1
Information, computer and communication technologies	25.6	24.9	23.7	14.9	13.7	14.4	18.6	21.0	16.3	15.9
Applied sciences and technologies	11.4	11.3	8.6	8.2	6.9	7.2	6.5	6.2	7.2	6.5
Engineering sciences	29.7	27.5	26.3	26.8	26.3	26.7	24.8	17.9	18.7	19.3
Biological sciences	1.7	2.1	2.0	2.0	1.8	1.9	1.8	1.7	1.4	1.1
Agricultural sciences	2.9	3.7	4.5	4.2	5.0	5.0	4.9	4.6	4.9	7.0
Medical and health sciences	14.1	16.1	17.6	17.1	16.8	16.3	16.7	15.4	15.0	19.8
Environmental sciences	0.4	0.1	0.0	0.4	0.4	0.6	0.2	3.3	0.4	0.5
Material sciences	0.6	0.6	0.6	0.5	0.5	1.2	0.5	0.7	0.4	0.4
Marine sciences	0.1	0.0	0.0	0.1	0.1	0.0	0.0	0.0	0.0	0.0
Division 2: Social Sciences and Humanities	3.6	4.4	4.5	13.7	17.1	17.4	17.1	19.4	25.6	18.9
Social sciences	3.5	4.4	4.5	13.7	17.1	17.4	17.1	19.3	25.6	18.9
Humanities	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Table C.46: Business sector R&D expenditure by socio-economic objective (2009/10 to 2018/19)

SOCIO-ECONOMIC OBJECTIVE	2009/10 R'000	2010/11 R'000	2011/12 R'000	2012/13 R'000	2013/14 R'000	2014/15 R'000	2015/16 R'000	2016/17 R'000	2017/18 R'000	2018/19 R'000
Division 1: Defence	959 761	1 103 510	813 259	1 040 025	1 096 986	1 034 893	937 964	830 331	1 187 443	975 765
Defence	959 761	1 103 510	813 259	1 040 025	1 096 986	1 034 893	937 964	830 331	1 187 443	975 765
Division 2: Economic Development	8 258 491	7 012 272	7 381 289	7 234 533	8 308 177	9 663 402	10 362 668	11 554 708	11 730 578	10 197 220
Economic development unclassified	0	0	0	0	0	0	0	0	0	0
Plant production and plant primary products	309 370	288 323	315 806	374 327	454 990	593 610	622 367	1 026 707	628 123	791 508
Animal production and animal primary products	110 295	46 709	46 316	38 484	69 916	74 045	74 267	66 547	41 588	55 615
Mineral resources (excluding energy)	741 401	728 130	733 280	853 544	977 365	1 405 074	1 348 618	947 258	812 439	867 249
Energy resources	290 662	93 532	90 377	90 975	95 375	100 061	79 210	470 860	431 681	488 026
Energy supply	426 407	470 030	490 490	321 456	349 710	503 222	362 656	461 804	555 067	574 180
Manufacturing	2 037 129	1 747 369	1 863 289	1 639 077	1 869 926	2 096 271	2 106 255	1 924 020	1 965 446	1 788 564
Construction	367 510	16 284	46 158	96 071	125 059	138 237	55 625	54 328	22 942	32 416
Transport	843 301	872 149	920 081	951 435	1 080 427	935 483	1 046 235	1 098 281	1 124 099	1 045 650
Information and communication services	1 189 650	851 392	978 187	908 640	842 341	1 097 649	1 685 124	2 085 856	1 403 512	1 011 167
Commercial services	1 747 450	1 773 253	1 739 933	1 755 506	2 255 642	2 555 783	2 643 503	2 929 445	4 196 652	3 154 500
Economic framework	106 693	70 795	57 474	103 240	91 464	79 065	273 497	422 742	476 032	302 938
Natural resources	88 624	54 306	99 898	101 778	95 962	84 901	65 312	66 859	72 996	85 409
Division 3: Society	1 224 481	1 041 616	1 232 867	1 242 066	1 303 321	1 435 870	1 433 935	1 498 255	2 027 742	2 476 255
Society unclassified	0	0	0	0	0	0	0	0	0	0
Health	1 103 816	880 549	1 054 182	1 045 048	1 097 446	1 212 844	1 216 127	1 289 142	1 364 830	2 419 773
Education and training	26 444	32 486	32 767	29 566	33 913	35 728	33 707	21 076	23 586	16 021
Social development and community services	94 220	128 581	145 918	167 452	171 962	187 298	184 102	188 036	639 326	40 461
Division 4: Environment	211 208	211 025	220 698	173 535	171 747	219 212	196 802	201 177	283 454	207 806
Environment unclassified	0	0	0	0	0	0	0	0	0	0
Environmental knowledge	53 022	51 845	58 565	46 213	43 935	55 885	62 471	45 213	116 313	50 017
Environmental aspects of development	22 456	55 577	42 226	17 957	14 344	38 437	18 915	48 553	52 852	52 754

SOCIO-ECONOMIC OBJECTIVE	2009/10 R'000	2010/11 R'000	2011/12 R'000	2012/13 R'000	2013/14 R'000	2014/15 R'000	2015/16 R'000	2016/17 R'000	2017/18 R'000	2018/19 R'000
Environmental and other aspects	135 730	103 602	119 907	109 365	113 468	124 889	115 415	107 410	114 289	105 035
Division 5: Advancement of Knowledge	485 296	690 587	815 909	880 567	902 617	937 575	883 626	696 800	629 967	590 788
Advancement of knowledge unclassified	0	0	0	0	0	0	0	0	0	0
Natural sciences, technologies and engineering	479 999	682 401	813 150	877 557	899 840	932 030	880 474	696 770	629 967	590 788
Social sciences and humanities	5 298	8 186	2 758	3 010	2 776	5 545	3 152	30	0	0
Total	11 139 237	10 059 010	10 464 022	10 570 726	11 782 848	13 290 951	13 814 995	14 781 270	15 859 185	14 447 833

Table C.47: Proportional business sector R&D expenditure by socio-economic objective (2009/10 to 2018/19)

SOCIO-ECONOMIC OBJECTIVE	2009/10 %	2010/11 %	2011/12 %	2012/13 %	2013/14 %	2014/15 %	2015/16 %	2016/17 %	2017/18 %	2018/19 %
Division 1: Defence	8.6	11.0	7.8	9.8	9.3	7.8	6.8	5.6	7.5	6.8
Defence	8.6	11.0	7.8	9.8	9.3	7.8	6.8	5.6	7.5	6.8
Division 2: Economic Development	74.1	69.7	70.5	68.4	70.5	72.7	75.0	78.2	74.0	70.6
Economic development unclassified	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Plant production and plant primary products	2.8	2.9	3.0	3.5	3.9	4.5	4.5	6.9	4.0	5.5
Animal production and animal primary products	1.0	0.5	0.4	0.4	0.6	0.6	0.5	0.5	0.3	0.4
Mineral resources (excluding energy)	6.7	7.2	7.0	8.1	8.3	10.6	9.8	6.4	5.1	6.0
Energy resources	2.6	0.9	0.9	0.9	0.8	0.8	0.6	3.2	2.7	3.4
Energy supply	3.8	4.7	4.7	3.0	3.0	3.8	2.6	3.1	3.5	4.0
Manufacturing	18.3	17.4	17.8	15.5	15.9	15.8	15.2	13.0	12.4	12.4
Construction	3.3	0.2	0.4	0.9	1.1	1.0	0.4	0.4	0.1	0.2
Transport	7.6	8.7	8.8	9.0	9.2	7.0	7.6	7.4	7.1	7.2
Information and communication services	10.7	8.5	9.3	8.6	7.1	8.3	12.2	14.1	8.8	7.0
Commercial services	15.7	17.6	16.6	16.6	19.1	19.2	19.1	19.8	26.5	21.8
Economic framework	1.0	0.7	0.5	1.0	0.8	0.6	2.0	2.9	3.0	2.1
Natural resources	0.8	0.5	1.0	1.0	0.8	0.6	0.5	0.5	0.5	0.6

SOCIO-ECONOMIC OBJECTIVE	2009/10	2010/11	2011/12	2012/13	2013/14	2014/15	2015/16	2016/17	2017/18	2018/19
	%	%	%	%	%	%	%	%	%	%
Division 3: Society	11.0	10.4	11.8	11.8	11.1	10.8	10.4	10.1	12.8	17.1
Society unclassified	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Health	9.9	8.8	10.1	9.9	9.3	9.1	8.8	8.7	8.6	16.7
Education and training	0.2	0.3	0.3	0.3	0.3	0.3	0.2	0.1	0.1	0.1
Social development and community services	0.8	1.3	1.4	1.6	1.5	1.4	1.3	1.3	4.0	0.3
Division 4: Environment	1.9	2.1	2.1	1.6	1.5	1.6	1.4	1.4	1.8	1.4
Environment unclassified	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Environmental knowledge	0.5	0.5	0.6	0.4	0.4	0.4	0.5	0.3	0.7	0.3
Environmental aspects of development	0.2	0.6	0.4	0.2	0.1	0.3	0.1	0.3	0.3	0.4
Environmental and other aspects	1.2	1.0	1.1	1.0	1.0	0.9	0.8	0.7	0.7	0.7
Division 5: Advancement of Knowledge	4.4	6.9	7.8	8.3	7.7	7.1	6.4	4.7	4.0	4.1
Advancement of knowledge unclassified	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Natural sciences, technologies and engineering	4.3	6.8	7.8	8.3	7.6	7.0	6.4	4.7	4.0	4.1
Social sciences and humanities	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Table C.48: Business sector R&D expenditure by province (2009/10 to 2018/19)

PROVINCE	2009/10	2010/11	2011/12	2012/13	2013/14	2014/15	2015/16	2016/17	2017/18	2018/19
	R'000	R'000	R'000	R'000	R'000	R'000	R'000	R'000	R'000	R'000
Eastern Cape	320 955	217 880	354 553	468 197	646 497	608 398	651 533	690 478	707 348	674 516
Free State	999 554	943 508	1 308 833	1 265 285	1 374 960	831 575	1 124 042	1 060 177	1 105 873	991 206
Gauteng	6 120 062	5 439 718	5 558 409	5 356 550	5 813 673	7 160 280	7 183 557	7 876 139	8 285 425	7 617 873
KwaZulu-Natal	1 183 636	1 280 014	1 160 507	1 237 563	1 434 084	1 501 659	1 436 737	1 553 130	1 679 718	1 446 281
Limpopo	49 375	41 850	62 728	127 451	140 026	161 331	145 736	171 567	223 014	184 199
Mpumalanga	161 154	139 771	157 158	222 974	301 831	435 770	339 985	284 655	304 990	392 986
North West	267 528	256 428	45 267	380 144	435 849	681 634	451 891	526 962	565 486	601 653
Northern Cape	7 988	17 017	302 164	78 471	124 150	226 303	206 786	49 508	60 007	50 561
Western Cape	2 028 984	1 722 823	1 514 404	1 434 090	1 511 778	1 684 001	2 274 728	2 568 653	2 927 324	2 488 558
Total	11 139 237	10 059 010	10 464 022	10 570 726	11 782 848	13 290 951	13 814 995	14 781 270	15 859 185	14 447 833

Table C.49: Proportional business sector R&D expenditure by province (2009/10 to 2018/19)

PROVINCE	2009/10	2010/11	2011/12	2012/13	2013/14	2014/15	2015/16	2016/17	2017/18	2018/19
	%	%	%	%	%	%	%	%	%	%
Eastern Cape	2.9	2.2	3.4	4.4	5.5	4.6	4.7	4.7	4.5	4.7
Free State	9.0	9.4	12.5	12.0	11.7	6.3	8.1	7.2	7.0	6.9
Gauteng	54.9	54.1	53.1	50.7	49.3	53.9	52.0	53.3	52.2	52.7
KwaZulu-Natal	10.6	12.7	11.1	11.7	12.2	11.3	10.4	10.5	10.6	10.0
Limpopo	0.4	0.4	0.6	1.2	1.2	1.2	1.1	1.2	1.4	1.3
Mpumalanga	1.4	1.4	1.5	2.1	2.6	3.3	2.5	1.9	1.9	2.7
North West	2.4	2.5	2.9	3.6	3.7	5.1	3.3	3.6	3.6	4.2
Northern Cape	0.1	0.2	0.4	0.7	1.1	1.7	1.5	0.3	0.4	0.3
Western Cape	18.2	17.1	14.5	13.6	12.8	12.7	16.5	17.4	18.5	17.2
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Table C.50: Business sector R&D expenditure by Standard Industrial Classification (SIC) code (2009/10 to 2018/19)

STANDARD INDUSTRIAL CLASSIFICATION	2009/10	2010/11	2011/12	2012/13	2013/14	2014/15	2015/16	2016/17	2017/18	2018/19
	R'000	R'000	R'000	R'000	R'000	R'000	R'000	R'000	R'000	R'000
Agriculture, Hunting, Forestry and Fishing	208 447	157 916	211 132	286 832	364 424	460 464	484 384	472 472	395 011	560 631
Mining and Quarrying	499 286	1 055 963	1 352 877	1 554 284	1 675 153	1 340 103	1 220 985	1 069 826	1 101 202	1 748 437
Manufacturing	4 321 327	3 592 204	3 551 234	3 476 647	3 793 066	4 501 146	4 442 466	4 107 936	4 473 167	3 166 486
Manufacture of Food Products, Beverages and Tobacco Products	162 851	221 370	283 262	319 143	340 427	364 178	376 884	328 832	455 335	498 001
Manufacture of Textiles, Clothing and Leather Goods	16 946	2 437	0	2 073	32 091	34 609	9 335	8 932	21 968	11 129
Manufacture of Wood and Products of Wood and Cork, except furniture; Manufacture of Articles of Straw and Plaiting Materials; Manufacture of Paper and Paper Products; Manufacture of Publishing, Printing and Reproduction of Recorded Material	111 255	106 448	80 255	50 531	60 437	72 870	95 555	87 814	91 005	76 413
Manufacture of Refined Petroleum, Coke and Nuclear Fuel; Manufacture of Chemicals and Chemical Products (incl. Pharmaceuticals); Manufacture of Rubber and Plastic Products	1 758 353	1 197 179	1 381 001	1 139 617	1 256 313	1 835 837	1 800 420	1 696 770	1 692 447	802 217
Manufacture of Non-Metallic Mineral Products	120 508	87 037	72 039	49 974	52 263	51 097	28 095	37 531	24 657	43 350
Manufacture of Basic Metals, Fabricated Metal Products, Machinery & Equipment; Manufacture of Office, Accounting and Computing Machinery	330 137	240 408	392 800	585 635	620 923	607 574	660 205	519 108	581 073	525 937
Manufacture of Electrical Machinery and Apparatus	146 169	207 954	310 599	312 102	254 042	302 575	381 971	455 378	635 655	374 509

STANDARD INDUSTRIAL CLASSIFICATION	2009/10 R'000	2010/11 R'000	2011/12 R'000	2012/13 R'000	2013/14 R'000	2014/15 R'000	2015/16 R'000	2016/17 R'000	2017/18 R'000	2018/19 R'000
Manufacture of Radio, Television and Communication Equipment and Apparatus; Manufacture of Medical, Precision and Optical Instruments, Watches and Clocks	591 774	590 174	639 217	656 639	742 033	706 308	569 127	629 240	625 773	486 808
Manufacture of Transport Equipment	1 022 589	881 958	310 145	267 788	334 276	408 448	402 772	321 638	316 503	315 433
Manufacture of Furniture; Recycling; Manufacturing not elsewhere classified	60 743	57 240	81 914	93 145	100 261	117 649	118 102	22 692	28 752	32 689
Electricity, Gas & Water Supply	955 690	536 050	494 745	385 770	355 720	548 015	439 157	544 850	639 298	708 166
Construction	3 490	3 213	6 495	9 051	8 037	6 637	5 613	4 297	3 562	9 408
Wholesale and Retail	434 522	620 541	547 194	179 383	100 176	85 491	42 977	54 553	84 403	102 393
Transport, Storage & Communication	415 243	354 311	484 222	467 411	451 336	632 243	897 359	1 543 763	978 548	1 111 760
Financial Intermediation, Real Estate and Business Services	3 777 124	3 326 985	3 645 625	3 914 543	4 724 439	5 357 151	5 910 332	6 555 245	7 744 370	6 402 099
Community, Social and Personal Services	524 108	411 826	170 499	296 805	310 498	359 701	371 723	428 328	439 625	638 452
Total	11 139 237	10 059 010	10 464 022	10 570 726	11 782 848	13 290 951	13 814 995	14 781 270	15 859 185	14 447 833

Table C.51: Proportional business sector R&D expenditure by Standard Industrial Classification (SIC) code (2009/10 to 2018/19)

STANDARD INDUSTRIAL CLASSIFICATION	2009/10 %	2010/11 %	2011/12 %	2012/13 %	2013/14 %	2014/15 %	2015/16 %	2016/17 %	2017/18 %	2018/19 %
Agriculture, Hunting, Forestry and Fishing	1.9	1.6	2.0	2.7	3.1	3.5	3.5	3.2	2.5	3.9
Mining and Quarrying	4.5	10.5	12.9	14.7	14.2	10.1	8.8	7.2	6.9	12.1
Manufacturing	38.8	35.7	33.9	32.9	32.2	33.9	32.2	27.8	28.2	21.9
Manufacture of Food Products, Beverages and Tobacco Products	1.5	2.2	2.7	3.0	2.9	2.7	2.7	2.2	2.9	3.4
Manufacture of Textiles, Clothing and Leather Goods	0.2	0.0	0.0	0.0	0.3	0.3	0.1	0.1	0.1	0.1
Manufacture of Wood and Products of Wood and Cork, except furniture; Manufacture of Articles of Straw and Plaiting Materials; Manufacture of Paper and Paper Products; Manufacture of Publishing, Printing and Reproduction of Recorded Material	1.0	1.1	0.8	0.5	0.5	0.5	0.7	0.6	0.6	0.5
Manufacture of Refined Petroleum, Coke and Nuclear Fuel; Manufacture of Chemicals and Chemical Products (incl. Pharmaceuticals); Manufacture of Rubber and Plastic Products	15.8	11.9	13.2	10.8	10.7	13.8	13.0	11.5	10.7	5.6
Manufacture of Non-Metallic Mineral Products	1.1	0.9	0.7	0.5	0.4	0.4	0.2	0.3	0.2	0.3
Manufacture of Basic Metals, Fabricated Metal Products, Machinery & Equipment; Manufacture of Office, Accounting and Computing Machinery	3.0	2.4	3.8	5.5	5.3	4.6	4.8	3.5	3.7	3.6

STANDARD INDUSTRIAL CLASSIFICATION	2009/10 %	2010/11 %	2011/12 %	2012/13 %	2013/14 %	2014/15 %	2015/16 %	2016/17 %	2017/18 %	2018/19 %
Manufacture of Electrical Machinery and Apparatus	1.3	2.1	3.0	3.0	2.2	2.3	2.8	3.1	4.0	2.6
Manufacture of Radio, Television and Communication Equipment and Apparatus; Manufacture of Medical, Precision and Optical Instruments, Watches and Clocks	5.3	5.9	6.1	6.2	6.3	5.3	4.1	4.3	3.9	3.4
Manufacture of Transport Equipment	9.2	8.8	3.0	2.5	2.8	3.1	2.9	2.2	2.0	2.2
Manufacture of Furniture; Recycling; Manufacturing not elsewhere classified	0.5	0.6	0.8	0.9	0.9	0.9	0.9	0.2	0.2	0.2
Electricity, Gas & Water Supply	8.6	5.3	4.7	3.6	3.0	4.1	3.2	3.7	4.0	4.9
Construction	0.0	0.0	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.1
Wholesale and Retail	3.9	6.2	5.2	1.7	0.9	0.6	0.3	0.4	0.5	0.7
Transport, Storage & Communication	3.7	3.5	4.6	4.4	3.8	4.8	6.5	10.4	6.2	7.7
Financial Intermediation, Real Estate and Business Services	33.9	33.1	34.8	37.0	40.1	40.3	42.8	44.3	48.8	44.3
Community, Social and Personal Services	4.7	4.1	1.6	2.8	2.6	2.7	2.7	2.9	2.8	4.4
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Table C.52: Business sector R&D personnel in headcounts and full-time equivalents by occupation (2009/10 to 2018/19)

YEAR	HEADCOUNTS				FULL-TME EQUIVALENTS (FTEs)			
	TOTAL	RESEARCHERS	TECHNICIANS	OTHER R&D PERSONNEL	TOTAL	RESEARCHERS	TECHNICIANS	OTHER R&D PERSONNEL
2009/10	**18 216**	8 366	5 362	4 488	**12 024.6**	6 059.5	3 612.6	2 352.6
2010/11	**14 933**	6 372	4 630	3 931	**10 205.1**	4 804.0	3 318.7	2 082.3
2011/12	**15 288**	6 192	5 095	4 001	**9 894.9**	4 451.9	3 343.5	2 099.5
2012/13	**17 155**	6 191	6 394	4 570	**11 322.3**	4 555.9	4 065.5	2 700.9
2013/14	**17 599**	6 182	6 397	5 020	**11 877.4**	4 530.1	4 253.1	3 094.2
2014/15	**18 743**	6 261	6 912	5 570	**12 927.5**	4 636.2	4 494.4	3 796.9
2015/16	**17 245**	6 128	6 090	5 027	**12 457.8**	4 626.8	4 227.4	3 603.6
2016/17	**17 998**	6 463	6 156	5 379	**12 549.2**	4 777.3	4 149.4	3 622.5
2017/18	**17 554**	7 142	5 655	4 757	**12 952.9**	5 481.7	3 807.5	3 663.8
2018/19	**16 876**	6 942	5 286	4 648	**11 691.0**	4 535.1	3 546.9	3 609.0

Note: Headcounts include non-SA R&D personnel (from 2016/17).

Non-SA personnel are classified as those that are not from South Africa but are undertaking research in South Africa for a period exceeding six months. They can be temporary or permanent residents as described by the SNA.

Table C.53: Business sector R&D personnel in headcounts and full-time equivalents by occupation and gender (2016/17 to 2018/19)

OCCUPATION	HEADCOUNTS			FULL-TIME EQUIVALENTS (FTEs)			
2016/17	**TOTAL**	**MALE**	**FEMALE**	**TOTAL**	**MALE**	**FEMALE**	**FTEs AS % OF HEADCOUNTS**
Researchers	**6 463**	4 071	2 392	**4 777.3**	2 807.4	1 969.9	73.9
Technicians directly supporting R&D	**6 156**	4 258	1 898	**4 149.4**	2 731.1	1 418.3	67.4
Other personnel directly supporting R&D	**5 379**	3 183	2 196	**3 622.5**	2 218.7	1 403.7	67.3
Total	17 998	11 512	6 486	12 549.2	7 757.2	4 792.0	69.7
2017/18	**TOTAL**	**MALE**	**FEMALE**	**TOTAL**	**MALE**	**FEMALE**	**FTEs AS % OF HEADCOUNTS**
Researchers	**7 142**	4 515	2 627	**5 481.7**	3 263.5	2 218.2	76.8
Technicians directly supporting R&D	**5 655**	3 839	1 816	**3 807.5**	2 482.9	1 324.6	67.3
Other personnel directly supporting R&D	**4 757**	2 893	1 864	**3 663.8**	2 184.4	1 479.4	77.0
Total	17 554	11 247	6 307	12 952.9	7 930.8	5 022.1	73.8
2018/19	**TOTAL**	**MALE**	**FEMALE**	**TOTAL**	**MALE**	**FEMALE**	**FTEs AS % OF HEADCOUNTS**
Researchers	**6 942**	4 323	2 619	**4 535.1**	2 577.4	1 957.7	65.3
Technicians directly supporting R&D	**5 286**	3 508	1 778	**3 546.9**	2 199.3	1 347.6	67.1
Other personnel directly supporting R&D	**4 648**	2 823	1 825	**3 609.0**	2 034.5	1 574.5	77.6
Total	16 876	10 654	6 222	11 691.0	6 811.1	4 879.8	69.3

Note: Headcounts include non-SA R&D personnel (from 2016/17).

Non-SA personnel are classified as those that are not from South Africa but are undertaking research in South Africa for a period exceeding six months. They can be temporary or permanent residents as described by the SNA.

Table C.54: Business sector R&D personnel in headcounts by occupation, qualification, population group and gender (2018/19)

OCCUPATION AND QUALIFICATION	TOTAL	SUBTOTAL		AFRICAN		COLOURED		INDIAN/ASIAN		WHITE		NON-SA	
		MALE	FEMALE	MALE	FEMALE	MALE	FEMALE	MALE	FEMALE	MALE	FEMALE	MALE	FEMALE
Researchers	6 942	4 323	2 619	1 005	674	185	149	485	341	2 581	1 425	67	30
Doctoral degree or equivalent	670	351	319	49	30	10	17	14	20	257	249	21	2
Master's, honours, bachelor or equivalent	4 903	3 084	1 820	633	464	126	91	407	264	1 881	986	37	15
Diplomas	1 369	888	480	323	180	49	41	64	57	443	190	9	12
Technicians directly supporting R&D	5 286	3 508	1 778	1 052	763	324	217	354	204	1 761	586	17	8
Doctoral degree or equivalent	46	30	16	3	2	0	0	2	2	22	10	2	1
Master's, honours, bachelor or equivalent	2 070	1 222	848	302	277	92	102	149	123	670	343	9	3
Diplomas	3 170	2 256	914	747	484	232	115	203	79	1 068	233	6	3
Other personnel directly supporting R&D	4 648	2 823	1 825	1 332	663	181	241	449	245	768	670	93	6
Doctoral degree or equivalent	39	22	17	6	2	0	0	2	1	14	12	0	1
Master's, honours, bachelor or equivalent	1 061	579	482	147	109	39	28	75	48	316	297	1	0
Diplomas	3 548	2 222	1 326	1 178	552	142	213	372	196	438	361	92	5
Total	16 876	10 654	6 222	3 388	2 100	690	607	1 289	790	5 110	2 681	178	44

Note: Headcounts Includes Non-SA R&D staff.

Table C.55: Number of foreign and local business sector partners engaged in collaborative R&D, and total R&D collaboration expenditure (2016/17 to 2018/19)

COLLABORATION PARTNERS	2016/17		2017/18		2018/19	
	WITHIN SOUTH AFRICA	OUTSIDE SOUTH AFRICA	WITHIN SOUTH AFRICA	OUTSIDE SOUTH AFRICA	WITHIN SOUTH AFRICA	OUTSIDE SOUTH AFRICA
Government research institutes	22	10	28	13	27	12
Higher education institutions	82	25	81	28	81	25
Members of own company	28	11	35	17	34	16
Not-for-profit organisations	12	3	11	5	12	3
Other companies	63	36	60	33	60	34
Science councils	55	10	59	11	61	10
Total number of R&D collaborations	262	95	274	107	275	100
No collaboration	N/A	N/A	N/A	N/A	N/A	N/A
R&D EXPENDITURE	**R'000**	**R'000**	**R'000**	**R'000**	**R'000**	**R'000**
Total in-house plus outsourced R&D collaboration expenditure (excl. VAT)	N/A	N/A	N/A	N/A	N/A	N/A

Note: Collaborative R&D entails partnerships, alliances and collaborations.

N/A: The indicator 'No collaboration' was not assessed from 2016/17 onwards. Collaboration expenditure was also not calculated for 2016/17 onwards.

C.2.1.1 Business sector: State-owned enterprises

Table C.56: Business sector: SOEs – Number, R&D expenditure, and R&D expenditure as a proportion of BERD (2009/10 to 2018/19

YEAR	NUMBER OF R&D PERFORMERS	R&D EXPENDITURE	PROPORTION OF BERD
		R'000	%
2009/10	21	2 158 238	19.4
2010/11	19	1 685 520	16.8
2011/12	18	1 318 492	12.6
2012/13	19	1 512 021	14.3
2013/14	19	1 609 771	13.7
2014/15	19	2 019 919	15.2
2015/16	18	1 973 416	14.3
2016/17	16	2 621 883	17.7
2017/18	16	2 536 374	16.0
2018/19	16	2 492 520	17.3

Note: SOEs revised list differ from the 2014/15 list.

Table C.57: Business sector: SOEs – R&D expenditure by type of research (2009/10 to 2018/19)

TYPE OF RESEARCH	2009/10	2010/11	2011/12	2012/13	2013/14	2014/15	2015/16	2016/17	2017/18	2018/19
	R'000	R'000	R'000	R'000	R'000	R'000	R'000	R'000	R'000	R'000
Basic research	131 212	68 838	55 107	59 187	263 523	65 489	65 556	110 249	140 989	153 137
Applied research	866 097	835 262	832 505	805 106	641 358	1 216 953	860 904	1 588 222	1 886 756	1 970 733
Experimental development research	1 160 929	781 421	430 880	647 728	704 890	737 477	1 046 956	923 413	508 629	368 650
Total	2 158 238	1 685 520	1 318 492	1 512 021	1 609 771	2 019 919	1 973 416	2 621 883	2 536 374	2 492 520

Table C.58: Business sector: SOEs – Proportional R&D expenditure by type of research (2009/10 to 2018/19)

TYPE OF RESEARCH	2009/10 %	2010/11 %	2011/12 %	2012/13 %	2013/14 %	2014/15 %	2015/16 %	2016/17 %	2017/18 %	2018/19 %
Basic research	6.1	4.1	4.2	3.9	16.4	3.2	3.3	4.2	5.6	6.1
Applied research	40.1	49.6	63.1	53.2	39.8	60.2	43.6	60.6	74.4	79.1
Experimental development research	53.8	46.4	32.7	42.8	43.8	36.5	53.1	35.2	20.1	14.8
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Table C.59: Business sector: SOEs – R&D expenditure by accounting category (2009/10 to 2018/19)

TYPE OF EXPENDITURE	2009/10 R'000	2010/11 R'000	2011/12 R'000	2012/13 R'000	2013/14 R'000	2014/15 R'000	2015/16 R'000	2016/17 R'000	2017/18 R'000	2018/19 R'000
Capital expenditure	401 776	408 927	333 325	179 959	245 077	355 725	122 272	726 071	702 156	768 912
Land: buildings & other structures	60 525	47 672	14 032	11 195	12 920	16 307	31 884	183 145	173 025	193 483
Vehicles, plant, machinery, equipment	341 251	361 255	319 293	168 764	232 157	339 418	90 388	542 926	529 131	575 429
Current expenditure	1 756 460	1 276 593	985 167	1 332 062	1 364 694	1 664 194	1 851 145	1 895 812	1 834 218	1 723 607
Labour costs	1 033 378	692 407	658 509	795 414	849 371	922 321	976 713	1 040 703	968 562	892 376
Other current expenditure	723 082	584 186	326 658	536 648	515 323	741 873	874 432	855 109	865 656	831 231
Total	2 158 236	1 685 520	1 318 492	1 512 021	1 609 771	2 019 919	1 973 417	2 621 883	2 536 374	2 492 520

Table C.60: Business sector: SOEs – Proportional R&D expenditure by accounting category (2009/10 to 2018/19)

TYPE OF EXPENDITURE	2009/10 %	2010/11 %	2011/12 %	2012/13 %	2013/14 %	2014/15 %	2015/16 %	2016/17 %	2017/18 %	2018/19 %
Capital expenditure	18.6	24.3	25.3	11.9	15.2	17.6	6.2	27.7	27.7	30.8
Land: buildings & other structures	2.8	2.8	1.1	0.7	0.8	0.8	1.6	7.0	6.8	7.8
Vehicles, plant, machinery, equipment	15.8	21.4	24.2	11.2	14.4	16.8	4.6	20.7	20.9	23.1
Current expenditure	81.4	75.7	74.7	88.1	84.8	82.4	93.8	72.3	72.3	69.2
Labour costs	47.9	41.1	49.9	52.6	52.8	45.7	49.5	39.7	38.2	35.8
Other current expenditure	33.5	34.7	24.8	35.5	32.0	36.7	44.3	32.6	34.1	33.3
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Table C.61: Business sector: SOEs – Expenditure on multidisciplinary areas of R&D (2009/10 to 2018/19)

MULTI-DISCIPLINARY AREA OF R&D	2009/10 R'000	2010/11 R'000	2011/12 R'000	2012/13 R'000	2013/14 R'000	2014/15 R'000	2015/16 R'000	2016/17 R'000	2017/18 R'000	2018/19 R'000
Biotechnology	6 834	15 100	14 615	23 479	21 845	16 591	12 278	16 457	18 514	8 116
Nanotechnology	2 553	2 995	7 103	3 768	654	700	144	0	0	0
Total	9 386	18 095	21 717	27 247	22 499	17 290	12 422	16 457	18 514	8 116
Business expenditure on R&D	2 158 238	1 685 520	1 318 492	1 512 021	1 609 771	2 019 919	1 973 416	2 621 883	2 536 374	2 492 520

Table C.62: Business sector: SOEs – Proportional expenditure on multidisciplinary areas of R&D (2009/10 to 2018/19)

MULTI-DISCIPLINARY AREA OF R&D	2009/10 %	2010/11 %	2011/12 %	2012/13 %	2013/14 %	2014/15 %	2015/16 %	2016/17 %	2017/18 %	2018/19 %
Biotechnology	0.3	0.9	1.1	1.6	1.4	0.8	0.6	0.6	0.7	0.3
Nanotechnology	0.1	0.2	0.5	0.2	0.0	0.0	0.0	0.0	0.0	0.0
Total	0.4	1.1	1.6	1.8	1.4	0.9	0.6	0.6	0.7	0.3

Note: Data on these selected areas of R&D were collected for the first time in the 2005/06 R&D survey.
N/A: Environment-related data were collected from the 2011/12 R&D Survey onward.

Table C.63: Business sector: SOEs – R&D expenditure on selective areas of interest (2009/10 to 2018/19)

AREA OF INTEREST	2009/10 R'000	2010/11 R'000	2011/12 R'000	2012/13 R'000	2013/14 R'000	2014/15 R'000	2015/16 R'000	2016/17 R'000	2017/18 R'000	2018/19 R'000
Environment related	N/A	N/A	10 029	15 284	22 448	51 522	30 864	136 523	150 811	171 166
Open-source software	5 597	9 087	8 736	7 599	4 124	0	50 589	0	0	0
New materials	17 054	14 598	14 872	12 082	12 233	11 111	64 021	15 353	21 144	23 841
Tuberculosis (TB), HIV/AIDS, malaria	0	0	0	0	0	0	0	0	0	0
Space science	N/A	N/A	N/A	N/A	N/A	N/A	N/A	32 571	33 063	34 998
Total	22 652	23 684	33 636	34 965	38 806	62 633	145 474	184 446	205 018	230 005

N/A: Environment-related data were collected from the 2011/12 R&D Survey onwards. Space science data were collected for the first time in the 2016/17 R&D Survey.

Table C.64: Business sector: SOEs – Proportional R&D expenditure on selective areas of interest (2009/10 to 2018/19)

AREA OF INTEREST	2009/10 %	2010/11 %	2011/12 %	2012/13 %	2013/14 %	2014/15 %	2015/16 %	2016/17 %	2017/18 %	2018/19 %
Environment related	N/A	N/A	0.8	1.0	1.4	2.6	1.6	5.2	5.9	6.9
Open-source software	0.3	0.5	0.7	0.5	0.3	0.0	2.6	0.0	0.0	0.0
New materials	0.8	0.9	1.1	0.8	0.8	0.6	3.2	0.6	0.8	1.0
Tuberculosis (TB), HIV/AIDS, malaria	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Space science	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.2	1.3	1.4
Total	1.0	1.4	2.6	2.3	2.4	3.1	7.4	7.0	8.1	9.2

N/A: Environment-related data were collected from the 2011/12 R&D Survey onwards. Space science data were collected for the first time in the 2016/17 R&D Survey.

Table C.65: Business sector: SOEs – R&D expenditure by research field (2009/10 to 2018/19)

MAIN RESEARCH FIELD	2009/10 R'000	2010/11 R'000	2011/12 R'000	2012/13 R'000	2013/14 R'000	2014/15 R'000	2015/16 R'000	2016/17 R'000	2017/18 R'000	2018/19 R'000
Division 1: Natural Sciences, Technology and Engineering	2 145 037	1 670 869	1 318 492	1 512 021	1 609 771	1 963 779	1 963 821	2 524 169	2 437 185	2 387 524
Mathematical sciences	34 896	38 311	142 930	86 576	93 820	137 076	87 387	85 055	134 335	142 171
Physical sciences	174 483	21 123	14 992	40 742	44 460	46 559	32 100	42 210	81 896	86 032
Chemical sciences	57 109	66 503	80 556	133 867	132 399	86 408	64 230	68 251	55 705	50 406
Earth sciences	25 151	27 912	0	44 006	48 671	24 356	12 254	17 750	17 522	9 297
Information, computer and communication technologies	88 484	64 163	126 456	155 601	168 174	304 806	541 009	935 325	483 015	511 409
Applied sciences and technologies	616 089	493 368	151 475	176 600	176 391	165 214	133 687	277 702	446 635	363 768
Engineering sciences	1 091 019	926 729	768 675	781 073	824 057	1 034 900	981 683	971 414	1 059 843	1 040 397
Biological sciences	2 727	0	0	13 496	30 701	29 183	33 874	13 112	12 338	26 520
Agricultural sciences	718.8	6 816	8 137	5 343	11 711	12 507	12 665	9 079	9 282	5 857
Medical and health sciences	0	15 614	17 491	18 012	18 316	49 357	36 548	23 990	76 571	80 711
Environmental sciences	41 092	3 052	0	42 440	45 772	59 270	16 310	47 674	51 225	58 605
Material sciences	8 296	7 279	7 780	8 605	9 198	9 849	12 073	32 605	8 818	12 352
Marine sciences	4 972	0	0	5659	6103	4294	0	0	0	0
Division 2: Social Sciences and Humanities	13 201	14 651	0	0	0	56 140	9 595	97 714	99 189	104 995
Social sciences	13 201	14 651	0	0	0	56 140	9 595	97 714	99 189	104 995
Humanities	0	0	0	0	0	0	0	0	0	0
Total	2 158 238	1 685 520	1 318 492	1 512 021	1 609 771	2 019 919	1 973 416	2 621 883	2 536 374	2 492 520

Table C.66: Business sector: SOEs – Proportional R&D expenditure by research field (2009/10 to 2018/19)

MAIN RESEARCH FIELD	2009/10 %	2010/11 %	2011/12 %	2012/13 %	2013/14 %	2014/15 %	2015/16 %	2016/17 %	2017/18 %	2018/19 %
Division 1: Natural Sciences, Technology and Engineering	99.4	99.1	100.0	100.0	100.0	97.2	99.5	96.3	96.1	95.8
Mathematical sciences	1.6	2.3	10.8	5.7	5.8	6.8	4.4	3.2	5.3	5.7
Physical sciences	8.1	1.3	1.1	2.7	2.8	2.3	1.6	1.6	3.2	3.5
Chemical sciences	2.6	3.9	6.1	8.9	8.2	4.3	3.3	2.6	2.2	2.0
Earth sciences	1.2	1.7	0.0	2.9	3.0	1.2	0.6	0.7	0.7	0.4

MAIN RESEARCH FIELD	2009/10	2010/11	2011/12	2012/13	2013/14	2014/15	2015/16	2016/17	2017/18	2018/19
	%	%	%	%	%	%	%	%	%	%
Information, computer and communication technologies	4.1	3.8	9.6	10.3	10.4	15.1	27.4	35.7	19.0	20.5
Applied sciences and technologies	28.5	29.3	11.5	11.7	11.0	8.2	6.8	10.6	17.6	14.6
Engineering sciences	50.6	55.0	58.3	51.7	51.2	51.2	49.7	37.1	41.8	41.7
Biological sciences	0.1	0.0	0.0	0.9	1.9	1.4	1.7	0.5	0.5	1.1
Agricultural sciences	0.0	0.4	0.6	0.4	0.7	0.6	0.6	0.3	0.4	0.2
Medical and health sciences	0.0	0.9	1.3	1.2	1.1	2.4	1.9	0.9	3.0	3.2
Environmental sciences	1.9	0.2	0.0	2.8	2.8	2.9	0.8	1.8	2.0	2.4
Material sciences	0.4	0.4	0.6	0.6	0.6	0.5	0.6	1.2	0.3	0.5
Marine sciences	0.2	0.0	0.0	0.4	0.4	0.2	0.0	0.0	0.0	0.0
Division 2: Social Sciences and Humanities	0.6	0.9	0.0	0.0	0.0	2.8	0.5	3.7	3.9	4.2
Social sciences	0.6	0.9	0.0	0.0	0.0	2.8	0.5	3.7	3.9	4.2
Humanities	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Table C.67: Business sector: SOEs – R&D expenditure by socio-economic objective (2009/10 to 2018/19)

SOCIO-ECONOMIC OBJECTIVE	2009/10	2010/11	2011/12	2012/13	2013/14	2014/15	2015/16	2016/17	2017/18	2018/19
	R'000	R'000	R'000	R'000	R'000	R'000	R'000	R'000	R'000	R'000
Division 1: Defence	696 861	718 698	356 627	485 487	512 440	563 927	399 183	304 302	676 595	497 808
Defence	696 861	718 698	356 627	485 487	512 440	563 927	399 183	304 302	676 595	497 808
Division 2: Economic Development	1 271 859	765 929	770 791	831 597	887 024	1 187 718	1 360 120	1 901 235	1 424 957	1 522 995
Economic development unclassified	0	0	0	0	0	0	0	0	0	0
Plant production and plant primary products	0	0	0	9 030	9 380	10 076	10 203	8 610	8 610	9 287
Animal production and animal primary products	2 396	1 704	4 069	0	0	0	0	0	0	0
Mineral resources (excluding energy)	0	5 576	6 247	6 433	6 541	6 996	7 743	8 500	8 818	9 236
Energy resources	185 159	20 372	22 488	23 158	23 549	25 185	27 874	30 602	12 479	13 070
Energy supply	355 509	405 120	367 866	249 963	253 757	419 084	316 868	410 091	516 908	546 952
Manufacturing	43 790	26 828	57 794	77 574	105 372	178 376	103 757	110 104	112 307	114 695
Construction	342 212	603	26 433	70 899	99 484	81 944	0	0	0	0
Transport	266 227	250 553	60 839	125 965	122 633	126 069	253 742	333 284	335 410	357 608

SOCIO-ECONOMIC OBJECTIVE	2009/10 R'000	2010/11 R'000	2011/12 R'000	2012/13 R'000	2013/14 R'000	2014/15 R'000	2015/16 R'000	2016/17 R'000	2017/18 R'000	2018/19 R'000
Information and communication services	46 766	35 131	179 318	193 815	191 811	270 175	609 251	873 600	302 316	319 210
Commercial services	19 856	19 290	1 504	9 893	10 644	11 434	16 235	16 878	18 002	19 049
Economic framework	9 944	0	17 049	36 408	40 833	37 065	14 447	109 566	110 107	115 191
Natural resources	0	752	27 185	28 459	23 019	21 316	0	0	0	18 697
Division 3: Society	**55 826**	**61 017**	**57 479**	**46 872**	**59 171**	**67 371**	**54 784**	**51 876**	**70 963**	**87 496**
Society unclassified	0	0	0	0	0	0	0	0	0	0
Health	24 288	25 320	22 992	19 743	29 360	26 193	19 804	25 631	39 533	54 213
Education and training	2 750	3 052	11 496	10 862	13 281	14 266	14 447	0	0	0
Social development and community services	28 788	32 645	22 992	16 268	16 530	26 912	20 533	26 246	31 431	33 282
Division 4: Environment	**46 300**	**55 984**	**47 487**	**31 245**	**31 720**	**68 425**	**56 760**	**86 865**	**94 694**	**100 236**
Environment unclassified	0	0	0	0	0	0	0	0	0	0
Environmental knowledge	22 188	25 696	23 368	15 623	15 860	26 193	33 494	28 662	30 816	32 619
Environmental aspects of development	1 925	3 841	0	0	0	16 040	2 741	32 571	33 063	34 998
Environmental and other aspects	22 188	26 448	24 119	15 623	15 860	26 193	20 525	25 631	30 816	32 619
Division 5: Advancement of Knowledge	**87 391**	**83 891**	**86 108**	**116 819**	**119 417**	**132 476**	**102 570**	**277 605**	**269 165**	**283 984**
Advancement of knowledge unclassified	0	0	0	0	0	0	0	0	0	0
Natural sciences, technologies and engineering	82 441	75 716	83 349	113 836	116 668	129 393	99 448	277 605	269 165	283 984
Social sciences and humanities	4 951	8 176	2 758	2 983	2 750	3 083	3 122	0	0	0
Total	2 158 238	1 685 520	1 318 492	1 512 021	1 609 771	2 019 919	1 973 416	2 621 883	2 536 374	2 492 520

Table C.68: Business sector: SOEs – Proportional R&D expenditure by socio-economic objective (2009/10 to 2018/19)

SOCIO-ECONOMIC OBJECTIVE	2009/10	2010/11	2011/12	2012/13	2013/14	2014/15	2015/16	2016/17	2017/18	2018/19
	%	%	%	%	%	%	%	%	%	%
Division 1: Defence	32.3	42.6	27.0	32.1	31.8	27.9	20.2	11.6	26.7	20.0
Defence	32.3	42.6	27.0	32.1	31.8	27.9	20.2	11.6	26.7	20.0
Division 2: Economic Development	58.9	45.4	58.5	55.0	55.1	58.8	68.9	72.5	56.2	61.1
Economic development unclassified	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Plant production and plant primary products	0.0	0.0	0.0	0.6	0.6	0.5	0.5	0.3	0.3	0.4
Animal production and animal primary products	0.1	0.1	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Mineral resources (excluding energy)	0.0	0.3	0.5	0.4	0.4	0.3	0.4	0.3	0.3	0.4
Energy resources	8.6	1.2	1.7	1.5	1.5	1.2	1.4	1.2	0.5	0.5
Energy supply	16.5	24.0	27.9	16.5	15.8	20.7	16.1	15.6	20.4	21.9
Manufacturing	2.0	1.6	4.4	5.1	6.5	8.8	5.3	4.2	4.4	4.6
Construction	15.9	0.0	2.0	4.7	6.2	4.1	0.0	0.0	0.0	0.0
Transport	12.3	14.9	4.6	8.3	7.6	6.2	12.9	12.7	13.2	14.3
Information and communication services	2.2	2.1	13.6	12.8	11.9	13.4	30.9	33.3	11.9	12.8
Commercial services	0.9	1.1	0.1	0.7	0.7	0.6	0.8	0.6	0.7	0.8
Economic framework	0.5	0.0	1.3	2.4	2.5	1.8	0.7	4.2	4.3	4.6
Natural resources	0.0	0.0	2.1	1.9	1.4	1.1	0.0	0.0	0.0	0.8
Division 3: Society	2.6	3.6	4.4	3.1	3.7	3.3	2.8	2.0	2.8	3.5
Society unclassified	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Health	1.1	1.5	1.7	1.3	1.8	1.3	1.0	1.0	1.6	2.2
Education and training	0.1	0.2	0.9	0.7	0.8	0.7	0.7	0.0	0.0	0.0
Social development and community services	1.3	1.9	1.7	1.1	1.0	1.3	1.0	1.0	1.2	1.3
Division 4: Environment	2.1	3.3	3.6	2.1	2.0	3.4	2.9	3.3	3.7	4.0
Environment unclassified	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Environmental knowledge	1.0	1.5	1.8	1.0	1.0	1.3	1.7	1.1	1.2	1.3
Environmental aspects of development	0.1	0.2	0.0	0.0	0.0	0.8	0.1	1.2	1.3	1.4

SOCIO-ECONOMIC OBJECTIVE	2009/10	2010/11	2011/12	2012/13	2013/14	2014/15	2015/16	2016/17	2017/18	2018/19
	%	%	%	%	%	%	%	%	%	%
Environmental and other aspects	1.0	1.6	1.8	1.0	1.0	1.3	1.0	1.0	1.2	1.3
Division 5: Advancement of Knowledge	4.0	5.0	6.5	7.7	7.4	6.6	5.2	10.6	10.6	11.4
Advancement of knowledge unclassified	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Natural sciences, technologies and engineering	3.8	4.5	6.3	7.5	7.2	6.4	5.0	10.6	10.6	11.4
Social sciences and humanities	0.2	0.5	0.2	0.2	0.2	0.2	0.2	0.0	0.0	0.0
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Table C.69: Business sector: SOEs – R&D expenditure by province (2009/10 to 2018/19)

PROVINCE	2009/10	2010/11	2011/12	2012/13	2013/14	2014/15	2015/16	2016/17	2017/18	2018/19
	R'000	R'000	R'000	R'000	R'000	R'000	R'000	R'000	R'000	R'000
Eastern Cape	17 582	12 562	21 897	33 436	38 634	37 244	10 854	45 081	52 404	50 850
Free State	17 432	24 865	31 842	28 367	26 428	25 193	10 854	42 824	45 798	48 477
Gauteng	1 603 650	1 169 019	915 824	1 014 194	1 012 556	1 448 092	1 558 538	1 937 851	1 682 598	1 715 224
KwaZulu-Natal	66 955	54 716	61 139	66 477	91 406	45 588	86 565	188 606	197 355	242 371
Limpopo	0	7 157	15 917	19 724	19 596	18 612	3 019	615	1 024	1 094
Mpumalanga	0	7 157	15 917	27 038	28 976	33 927	13 222	9 594	9 594	10 348
North West	138 305	118 682	140 853	151 514	160 739	289 990	170 118	180 261	214 709	189 393
Northern Cape	0	7 157	17 446	18 630	52 104	17 998	2 397	0	409	431
Western Cape	314 314	284 206	97 655	152 641	179 332	103 275	117 850	217 052	332 484	234 330
Total	2 158 238	1 685 520	1 318 492	1 512 021	1 609 771	2 019 919	1 973 416	2 621 883	2 536 374	2 492 520

Table C.70: Business sector: SOEs – Proportional R&D expenditure by province (2009/10 to 2018/19)

PROVINCE	2009/10	2010/11	2011/12	2012/13	2013/14	2014/15	2015/16	2016/17	2017/18	2018/19
	%	%	%	%	%	%	%	%	%	%
Eastern Cape	0.8	0.7	1.7	2.2	2.4	1.8	0.5	1.7	2.1	2.0
Free State	0.8	1.5	2.4	1.9	1.6	1.2	0.5	1.6	1.8	1.9
Gauteng	74.3	69.4	69.5	67.1	62.9	71.7	79.0	73.9	66.3	68.8
KwaZulu-Natal	3.1	3.2	4.6	4.4	5.7	2.3	4.4	7.2	7.8	9.7
Limpopo	0.0	0.4	1.2	1.3	1.2	0.9	0.2	0.0	0.0	0.0
Mpumalanga	0.0	0.4	1.2	1.8	1.8	1.7	0.7	0.4	0.4	0.4
North West	6.4	7.0	10.7	10.0	10.0	14.4	8.6	6.9	8.5	7.6
Northern Cape	0.0	0.4	1.3	1.2	3.2	0.9	0.1	0.0	0.0	0.0
Western Cape	14.6	16.9	7.4	10.1	11.1	5.1	6.0	8.3	13.1	9.4
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Table C.71: Business sector: SOEs – R&D expenditure by Standard Industrial Classification code (2009/10 to 2018/19)

STANDARD INDUSTRIAL CLASSIFICATION	2009/10 R'000	2010/11 R'000	2011/12 R'000	2012/13 R'000	2013/14 R'000	2014/15 R'000	2015/16 R'000	2016/17 R'000	2017/18 R'000	2018/19 R'000
Agriculture, Hunting, Forestry and Fishing	479	0	0	12 592	17 187	18 413	18 646	20 052	20 390	21 702
Mining and Quarrying	0	0	0	0	0	0	0	0	0	0
Manufacturing	547 593	530 635	248 309	444 185	475 294	480 601	370 407	161 096	461 776	270 718
Manufacture of Food Products, Beverages and Tobacco Products	0	0	0	0	0	0	0	0	0	0
Manufacture of Textiles, Clothing and Leather Goods	0	0	0	0	0	0	0	0	0	0
Manufacture of Wood and Products of Wood and Cork, except furniture; Manufacture of Articles of Straw and Plaiting Materials; Manufacture of Paper and Paper Products; Manufacture of Publishing, Printing and Reproduction of Recorded Material	0	0	0	1 290	1 340	1 439	1 458	1 230	1 230	1 327
Manufacture of Refined Petroleum, Coke and Nuclear Fuel; Manufacture of Chemicals and Chemical Products (incl. Pharmaceuticals); Manufacture of Rubber and Plastic Products	99 411	61 654	58 362	69 607	72 216	77 350	8 616	14 489	24 007	14 343
Manufacture of Non-Metallic Mineral Products	0	6 692	7 496	7 719	7 850	8 395	0	0	0	0
Manufacture of Basic Metals, Fabricated Metal Products, Machinery & Equipment; Manufacture of Office, Accounting and Computing Machinery	21 252	0	84 285	224 661	272 253	293 575	297 289	75 855	146 953	74 588
Manufacture of Electrical Machinery and Apparatus	0	0	88 159	76 590	63 824	52 760	20 430	21 690	242 822	127 036
Manufacture of Radio, Television and Communication Equipment and Apparatus; Manufacture of Medical, Precision and Optical Instruments, Watches and Clocks	0	0	0	0	0	0	0	0	0	0
Manufacture of Transport Equipment	426 930	462 290	10 007	64 318	57 812	47 081	42 614	47 833	46 764	53 425
Manufacture of Furniture; Recycling; Manufacturing not elsewhere classified	0	0	0	0	0	0	0	0	0	0
Electricity, Gas & Water Supply	936 310	521 665	463 592	325 822	340 670	534 569	424 561	531 606	633 700	698 810
Construction	0	0	0	0	0	0	0	0	0	0
Wholesale and Retail	2 750	3 052	0	0	0	0	0	0	0	0
Transport, Storage & Communication	179 602	164 337	304 346	371 495	397 326	565 363	826 532	1 516 160	952 348	1 004 572
Financial Intermediation, Real Estate and Business Services	259 855	204 455	302 245	137 898	158 060	150 347	196 661	174 576	176 127	184 533
Community, Social and Personal Services	231 648	261 375	0	220 029	221 233	270 626	136 609	218 393	292 033	312 183
Total	2 158 238	1 685 520	1 318 492	1 512 021	1 609 771	2 019 919	1 973 416	2 621 883	2 536 374	2 492 520

Table C.72: Business sector: SOEs – Proportional R&D expenditure by Standard Industrial Classification code (2009/10 to 2018/19)

STANDARD INDUSTRIAL CLASSIFICATION	2009/10 %	2010/11 %	2011/12 %	2012/13 %	2013/14 %	2014/15 %	2015/16 %	2016/17 %	2017/18 %	2018/19 %
Agriculture, Hunting, Forestry and Fishing	0.0	0.0	0.0	0.8	1.1	0.9	0.9	0.8	0.8	0.9
Mining and Quarrying	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Manufacturing	25.4	31.5	18.8	29.4	29.5	23.8	18.8	6.1	18.2	10.9
Manufacture of Food Products, Beverages and Tobacco Products	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Manufacture of Textiles, Clothing and Leather Goods	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Manufacture of Wood and Products of Wood and Cork, except furniture; Manufacture of Articles of Straw and Plaiting Materials; Manufacture of Paper and Paper Products; Manufacture of Publishing, Printing and Reproduction of Recorded Material	0.0	0.0	0.0	0.1	0.1	0.1	0.1	0.0	0.0	0.1
Manufacture of Refined Petroleum, Coke and Nuclear Fuel; Manufacture of Chemicals and Chemical Products (incl. Pharmaceuticals); Manufacture of Rubber and Plastic Products	4.6	3.7	4.4	4.6	4.5	3.8	0.4	0.6	0.9	0.6
Manufacture of Non-Metallic Mineral Products	0.0	0.4	0.6	0.5	0.5	0.4	0.0	0.0	0.0	0.0
Manufacture of Basic Metals, Fabricated Metal Products, Machinery & Equipment; Manufacture of Office, Accounting and Computing Machinery	1.0	0.0	6.4	14.9	16.9	14.5	15.1	2.9	5.8	3.0
Manufacture of Electrical Machinery and Apparatus	0.0	0.0	6.7	5.1	4.0	2.6	1.0	0.8	9.6	5.1
Manufacture of Radio, Television and Communication Equipment and Apparatus; Manufacture of Medical, Precision and Optical Instruments, Watches and Clocks	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Manufacture of Transport Equipment	19.8	27.4	0.8	4.3	3.6	2.3	2.2	1.8	1.8	2.1
Manufacture of Furniture; Recycling; Manufacturing not elsewhere classified	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Electricity, Gas & Water Supply	43.4	30.9	35.2	21.5	21.2	26.5	21.5	20.3	25.0	28.0
Construction	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Wholesale and Retail	0.1	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Transport, Storage & Communication	8.3	9.7	23.1	24.6	24.7	28.0	41.9	57.8	37.5	40.3
Financial Intermediation, Real Estate and Business Services	12.0	12.1	22.9	9.1	9.8	7.4	10.0	6.7	6.9	7.4
Community, Social and Personal Services	10.7	15.5	0.0	14.6	13.7	13.4	6.9	8.3	11.5	12.5
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Table C.73: Business sector: SOEs – R&D personnel in headcounts and full-time equivalents by occupation (2009/10 to 2018/19)

YEAR	HEADCOUNTS				FULL-TME EQUIVALENTS (FTEs)			
	TOTAL	RESEARCHERS	TECHNICIANS	OTHER R&D PERSONNEL	TOTAL	RESEARCHERS	TECHNICIANS	OTHER R&D PERSONNEL
2009/10	**2 550**	1 115	752	683	**1 981.2**	915.8	593.3	472.2
2010/11	**1 878**	773	681	424	**1 366.3**	598.0	493.0	275.3
2011/12	**2 336**	841	1 018	477	**1 068.6**	458.2	431.0	179.4
2012/13	**2 699**	890	1 351	458	**1 307.1**	548.4	563.8	194.9
2013/14	**2 674**	892	1 334	448	**1 301.1**	541.8	573.0	186.3
2014/15	**2 760**	918	1 479	363	**1 335.3**	541.5	593.2	200.7
2015/16	**2 476**	959	1 163	354	**1 150.1**	477.7	587.9	84.5
2016/17	**2 983**	1 113	1 437	433	**1 213.8**	415.2	688.2	110.4
2017/18	**2 853**	1 509	1 021	323	**1 182.5**	668.6	394.4	119.6
2018/19	**2 738**	1 445	992	301	**984.3**	555.0	316.9	112.5

Note: Headcounts include non-SA R&D personnal (from 2016/17). Non-SA personnel are classified as those that are not from South Africa but are undertaking research in South Africa for a period exceeding six months. They can be temporary or permanent residents as described by the SNA.

Table C.74: Business sector: SOEs – R&D personnel in headcounts and full-time equivalents by occupation and gender (2016/17 to 2018/19)

OCCUPATION	HEADCOUNTS			FULL-TIME EQUIVALENTS (FTEs)			
2016/17	**TOTAL**	**MALE**	**FEMALE**	**TOTAL**	**MALE**	**FEMALE**	**FTEs AS % OF HEADCOUNTS**
Researchers	**1 113**	899	214	**415.2**	315.4	99.8	37.3
Technicians directly supporting R&D	**1 437**	1 079	358	**688.2**	490.1	198.1	47.9
Other personnel directly supporting R&D	**433**	218	215	**110.4**	48.0	62.4	25.5
Total	2 983	2 196	787	1 213.8	853.5	360.3	40.7
2017/18	**TOTAL**	**MALE**	**FEMALE**	**TOTAL**	**MALE**	**FEMALE**	**FTEs AS % OF HEADCOUNTS**
Researchers	**1 509**	1 228	281	**668.6**	539.9	128.8	44.3
Technicians directly supporting R&D	**1 021**	761	260	**394.4**	309.2	85.2	38.6
Other personnel directly supporting R&D	**323**	143	180	**119.6**	49.7	69.9	37.0
Total	2 853	2 132	721	1 182.5	898.7	283.8	41.4
2018/19	**TOTAL**	**MALE**	**FEMALE**	**TOTAL**	**MALE**	**FEMALE**	**FTEs AS % OF HEADCOUNTS**
Researchers	**1 445**	1 173	272	**555.0**	424.5	130.6	38.4
Technicians directly supporting R&D	**992**	732	260	**316.9**	235.9	81.0	31.9
Other personnel directly supporting R&D	**301**	131	170	**112.5**	45.2	67.3	37.4
Total	2 738	2 036	702	984.3	705.5	278.8	36.0

Note: Headcounts include non-SA R&D personnal (from 2016/17). Non-SA personnel are classified as those that are not from South Africa but are undertaking research in South Africa for a period exceeding six months. They can be temporary or permanent residents as described by the SNA.

Table C.75: Business sector: SOEs – R&D personnel in headcounts by occupation, qualification, population group and gender (2018/19)

OCCUPATION AND QUALIFICATION	TOTAL	SUBTOTAL		AFRICAN		COLOURED		INDIAN/ASIAN		WHITE		NON-SA	
		MALE	FEMALE	MALE	FEMALE	MALE	FEMALE	MALE	FEMALE	MALE	FEMALE	MALE	FEMALE
Researchers	1 445	1 173	272	441	109	43	14	133	35	541	103	15	11
Doctoral degree or equivalent	76	63	13	14	10	2	0	5	1	35	1	7	1
Master's, honours, bachelor or equivalent	919	733	186	219	76	28	11	96	28	383	69	7	2
Diplomas	450	377	73	208	23	13	3	32	6	123	33	1	8
Technicians directly supporting R&D	992	732	260	321	175	30	23	30	9	350	52	1	1
Doctoral degree or equivalent	5	4	1	0	0	0	0	0	0	3	1	1	0
Master's, honours, bachelor or equivalent	201	132	69	56	46	6	1	14	7	56	14	0	1
Diplomas	786	596	190	265	129	24	22	16	2	291	37	0	0
Other personnel directly supporting R&D	301	131	170	64	88	8	9	2	3	57	70	0	0
Doctoral degree or equivalent	0	0	0	0	0	0	0	0	0	0	0	0	0
Master's, honours, bachelor or equivalent	24	8	16	4	9	0	3	1	0	3	4	0	0
Diplomas	277	123	154	60	79	8	6	1	3	54	66	0	0
Total	2 738	2 036	702	826	372	81	46	165	47	948	225	16	12

Note: Headcounts include non-SA R&D personnal (from 2016/17). Non-SA personnel are classified as those that are not from South Africa but are undertaking research in South Africa for a period exceeding six months. They can be temporary or permanent residents as described by the SNA.

Table C.76: Business sector: SOEs – Number of foreign and local business sector partners engaged in collaborative R&D, and total R&D collaboration expenditure (2016/17 to 2018/19)

COLLABORATION PARTNERS	2016/17		2017/18		2018/19	
	WITHIN SOUTH AFRICA	OUTSIDE SOUTH AFRICA	WITHIN SOUTH AFRICA	OUTSIDE SOUTH AFRICA	WITHIN SOUTH AFRICA	OUTSIDE SOUTH AFRICA
Government research institutes	2	2	3	3	5	3
Higher education institutions	11	2	11	4	11	4
Members of own company	3	0	5	3	5	2
Not-for-profit organisations	3	1	3	1	4	1
Other companies	3	1	3	1	3	1
Science councils	9	1	10	2	9	2
Total number of R&D collaborations	31	7	35	14	37	13
No collaboration	N/A	N/A	N/A	N/A	N/A	N/A
R&D EXPENDITURE	**R'000**	**R'000**	**R'000**	**R'000**	**R'000**	**R'000**
Total in-house plus outsourced R&D collaboration expenditure (excl. VAT)	N/A	N/A	N/A	N/A	N/A	N/A

Note: Collaborative R&D entails partnerships, alliances and collaborations.
N/A: The indicator 'No collaboration' was not assessed from 2016/17 onwards. Collaboration expenditure was also not calculated for 2016/17 onwards.

C.2.2. Not-for-profit sector

Table C.77: Not-for-profit sector R&D expenditure by type of research (2009/10 to 2018/19)

TYPE OF RESEARCH	2009/10 R'000	2010/11 R'000	2011/12 R'000	2012/13 R'000	2013/14 R'000	2014/15 R'000	2015/16 R'000	2016/17 R'000	2017/18 R'000	2018/19 R'000
Basic research	111 377	59 302	62 134	114 755	132 478	181 492	200 040	232 304	280 032	291 509
Applied research	53 530	87 435	79 105	346 179	322 295	426 132	508 738	558 059	661 575	841 861
Experimental development research	23 933	16 092	29 366	42 898	128 391	171 149	182 365	227 254	274 703	352 334
Total	188 840	162 830	170 605	503 833	583 165	778 772	891 142	1 017 616	1 216 310	1 485 704

Table C.78: Proportional not-for-profit sector R&D expenditure by type of research (2009/10 to 2018/19)

TYPE OF RESEARCH	2009/10 %	2010/11 %	2011/12 %	2012/13 %	2013/14 %	2014/15 %	2015/16 %	2016/17 %	2017/18 %	2018/19 %
Basic research	59.0	36.4	36.4	22.8	22.7	23.3	22.4	22.8	23.0	19.6
Applied research	28.3	53.7	46.4	68.7	55.3	54.7	57.1	54.8	54.4	56.7
Experimental development research	12.7	9.9	17.2	8.5	22.0	22.0	20.5	22.3	22.6	23.7
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Table C.79: Not-for-profit sector R&D expenditure by accounting category (2009/10 to 2018/19)

TYPE OF EXPENDITURE	2009/10 R'000	2010/11 R'000	2011/12 R'000	2012/13 R'000	2013/14 R'000	2014/15 R'000	2015/16 R'000	2016/17 R'000	2017/18 R'000	2018/19 R'000
Capital expenditure	8 564	8 820	18 702	37 564	39 983	49 647	53 800	91 083	75 522	103 851
Land: buildings & other structures	3 486	4 447	6 905	11 152	19 047	18 794	18 391	20 765	23 962	41 676
Vehicles, plant, machinery, equipment	5 078	4 373	11 797	26 412	20 936	30 853	35 409	70 318	51 560	62 175
Current expenditure	180 276	154 010	151 903	466 269	543 182	729 125	837 342	926 534	1 140 787	1 381 853
Labour costs	94 673	92 098	100 176	243 871	303 644	420 462	468 883	506 181	634 168	648 726
Other current expenditure	85 603	61 912	51 727	222 398	239 538	308 663	368 459	420 353	506 620	733 127
Total	188 840	162 830	170 605	503 833	583 165	778 772	891 142	1 017 616	1 216 310	1 485 704

Table C.80: Proportional not-for-profit sector R&D expenditure by accounting category (2009/10 to 2018/19)

TYPE OF EXPENDITURE	2009/10 %	2010/11 %	2011/12 %	2012/13 %	2013/14 %	2014/15 %	2015/16 %	2016/17 %	2017/18 %	2018/19 %
Capital expenditure	4.5	5.4	11.0	7.5	6.9	6.4	6.0	9.0	6.2	7.0
Land: buildings & other structures	1.8	2.7	4.0	2.2	3.3	2.4	2.1	2.0	2.0	2.8
Vehicles, plant, machinery, equipment	2.7	2.7	6.9	5.2	3.6	4.0	4.0	6.9	4.2	4.2
Current expenditure	95.5	94.6	89.0	92.5	93.1	93.6	94.0	91.0	93.8	93.0
Labour costs	50.1	56.6	58.7	48.4	52.1	54.0	52.6	49.7	52.1	43.7
Other current expenditure	45.3	38.0	30.3	44.1	41.1	39.6	41.3	41.3	41.7	49.3
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Table C.81: Not-for-profit sector expenditure on multidisciplinary areas of R&D (2009/10 to 2018/19)

MULTI-DISCIPLINARY AREA OF R&D	2009/10 R'000	2010/11 R'000	2011/12 R'000	2012/13 R'000	2013/14 R'000	2014/15 R'000	2015/16 R'000	2016/17 R'000	2017/18 R'000	2018/19 R'000
Biotechnology	4 446	5 666	8 667	29 062	62 082	128 964	159 045	123 879	160 846	261 324
Nanotechnology	0	1 475	0	10 187	4 915	70 348	81 103	841	543	569
Total	4 446	7 141	8 667	39 249	66 997	199 312	240 148	124 720	161 389	261 892
NPO expenditure on R&D	**188 840**	**162 830**	**170 605**	**503 833**	**583 165**	**778 772**	**891 142**	**1 017 616**	**1 216 310**	**1 485 704**

Note: Data on these multidisciplinary areas of R&D were collected for the first time in the 2005/06 R&D survey.

Table C.82: Proportional not-for-profit sector expenditure on multidisciplinary areas of R&D (2009/10 to 2018/19)

MULTI-DISCIPLINARY AREA OF R&D	2009/10 %	2010/11 %	2011/12 %	2012/13 %	2013/14 %	2014/15 %	2015/16 %	2016/17 %	2017/18 %	2018/19 %
Biotechnology	2.4	3.5	5.1	5.8	10.6	16.6	17.8	12.2	13.2	17.6
Nanotechnology	0.0	0.9	0.0	2.0	0.8	9.0	9.1	0.1	0.0	0.0
Total	2.4	4.4	5.1	7.8	11.5	25.6	26.9	12.3	13.2	17.6

Note: Data on these multidisciplinary areas of R&D were collected for the first time in the 2005/06 R&D survey.

Table C.83: Not-for-profit sector R&D expenditure on selected areas of interest (2009/10 to 2018/19)

AREA OF INTEREST	2009/10 R'000	2010/11 R'000	2011/12 R'000	2012/13 R'000	2013/14 R'000	2014/15 R'000	2015/16 R'000	2016/17 R'000	2017/18 R'000	2018/19 R'000
Environment related	N/A	N/A	15 133	18 022	27 142	50 364	52 156	54 904	56 218	70 733
Open-source software	0	0	20	419	481	69 509	756	824	952	930
New materials	542	830	395	178	191	634	79 322	223	1 814	0
Tuberculosis (TB), HIV/AIDS, malaria	7 419	13 979	5 034	246 760	301 086	374 460	482 298	689 315	876 132	1 118 507
Space science	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0	0	0
Total	7 961	14 809	20 582	265 379	328 900	494 967	614 532	745 265	935 117	1 190 170
NPO expenditure on R&D	**188 840**	**162 830**	**170 605**	**503 833**	**583 165**	**778 772**	**891 142**	**1 017 616**	**1 216 310**	**1 485 704**

N/A: Environment-related data were collected from the 2011/12 R&D Survey onwards. Space science data were collected for the first time in the 2016/17 R&D Survey.

Table C.84: Proportional not-for-profit sector R&D expenditure on selected areas of interest (2009/10 to 2018/19)

AREA OF INTEREST	2009/10 %	2010/11 %	2011/12 %	2012/13 %	2013/14 %	2014/15 %	2015/16 %	2016/17 %	2017/18 %	2018/19 %
Environment related	N/A	N/A	8.9	3.6	4.7	6.5	5.9	5.4	4.6	4.8
Open-source software	0.0	0.0	0.0	0.1	0.1	8.9	0.1	0.1	0.1	0.1
New materials	0.3	0.5	0.2	0.0	0.0	0.1	8.9	0.0	0.1	0.0
Tuberculosis (TB), HIV/AIDS, malaria	3.9	8.6	3.0	49.0	51.6	48.1	54.1	67.7	72.0	75.3
Space science	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.0	0.0	0.0
Total	4.2	9.1	12.1	52.7	56.4	63.6	69.0	73.2	76.9	80.1

N/A: Environment-related data were collected from the 2011/12 R&D Survey onwards. Space science data were collected for the first time in the 2016/17 R&D Survey.

Table C.85: Not-for-profit sector R&D expenditure by research field (2009/10 to 2018/19)

MAIN RESEARCH FIELD	2009/10 R'000	2010/11 R'000	2011/12 R'000	2012/13 R'000	2013/14 R'000	2014/15 R'000	2015/16 R'000	2016/17 R'000	2017/18 R'000	2018/19 R'000
Division 1: Natural Sciences, Technology and Engineering	53 112	54 776	64 042	346 961	427 237	647 068	766 355	909 337	1 096 247	1 374 844
Mathematical sciences	0	0	0	8 223	9 674	14 613	14 293	13 540	14 797	16 009
Physical sciences	6 422	0	0	765	802	989	1 191	1 300	1 504	1 551
Chemical sciences	0	0	0	0	1 309	0	0	0	0	0
Earth sciences	452	2 585	2 407	2 598	5 907	8 371	8 356	8 727	8 008	8 594
Information, computer and communication technologies	2 207	0	595	2 919	39	197	528	0	1 925	0
Applied sciences and technologies	0	0	1 487	4 317	4 666	19 123	30 565	29 946	29 379	30 941
Engineering sciences	0	0	0	4 075	4 915	4 638	4 005	3 393	1 572	1 645
Biological sciences	904	1 473	7 978	15 475	23 435	23 338	11 400	42 787	44 312	62 027

MAIN RESEARCH FIELD	2009/10 R'000	2010/11 R'000	2011/12 R'000	2012/13 R'000	2013/14 R'000	2014/15 R'000	2015/16 R'000	2016/17 R'000	2017/18 R'000	2018/19 R'000
Agricultural sciences	20 404	25 679	25 819	33 105	34 165	53 777	60 727	62 269	63 037	52 807
Medical and health sciences	13 999	15 920	17 423	265 031	329 293	497 588	614 889	719 902	905 867	1 174 074
Environmental sciences	6 014	3 433	7 553	10 122	12 238	23 548	19 552	25 746	24 150	25 335
Material sciences	0	0	0	0	0	0	0	0	0	0
Marine sciences	2 711	5 687	781	331	794	886	848	1 725	1 697	1 860
Division 2: Social Sciences and Humanities	135 728	108 054	106 563	156 872	155 928	131 705	124 787	108 280	120 063	110 860
Social sciences	133 340	104 306	104 842	142 525	147 029	122 105	117 549	98 355	109 068	99 304
Humanities	2 388	3 749	1 720	14 348	8 898	9 599	7 238	9 925	10 995	11 556
Total	188 840	162 830	170 605	503 833	583 165	778 772	891 142	1 017 616	1 216 310	1 485 704

Table C.86: Proportional not-for-profit sector R&D expenditure by research field (2009/10 to 2018/19)

MAIN RESEARCH FIELD	2009/10 %	2010/11 %	2011/12 %	2012/13 %	2013/14 %	2014/15 %	2015/16 %	2016/17 %	2017/18 %	2018/19 %
Division 1: Natural Sciences, Technology and Engineering	28.1	33.6	37.5	68.9	73.3	83.1	86.0	89.4	90.1	92.5
Mathematical sciences	0.0	0.0	0.0	1.6	1.7	1.9	1.6	1.3	1.2	1.1
Physical sciences	3.4	0.0	0.0	0.2	0.1	0.1	0.1	0.1	0.1	0.1
Chemical sciences	0.0	0.0	0.0	0.0	0.2	0.0	0.0	0.0	0.0	0.0
Earth sciences	0.2	1.6	1.4	0.5	1.0	1.1	0.9	0.9	0.7	0.6
Information, computer and communication technologies	1.2	0.0	0.3	0.6	0.0	0.0	0.1	0.0	0.2	0.0
Applied sciences and technologies	0.0	0.0	0.9	0.9	0.8	2.5	3.4	2.9	2.4	2.1
Engineering sciences	0.0	0.0	0.0	0.8	0.8	0.6	0.4	0.3	0.1	0.1
Biological sciences	0.5	0.9	4.7	3.1	4.0	3.0	1.3	4.2	3.6	4.2
Agricultural sciences	10.8	15.8	15.1	6.6	5.9	6.9	6.8	6.1	5.2	3.6
Medical and health sciences	7.4	9.8	10.2	52.6	56.5	63.9	69.0	70.7	74.5	79.0
Environmental sciences	3.2	2.1	4.4	2.0	2.1	3.0	2.2	2.5	2.0	1.7
Material sciences	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Marine sciences	1.4	3.5	0.5	0.1	0.1	0.1	0.1	0.2	0.1	0.1
Division 2: Social Sciences and Humanities	71.9	66.4	62.5	31.1	26.7	16.9	14.0	10.6	9.9	7.5
Social sciences	70.6	64.1	61.5	28.3	25.2	15.7	13.2	9.7	9.0	6.7
Humanities	1.3	2.3	1.0	2.8	1.5	1.2	0.8	1.0	0.9	0.8
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Table C.87: Not-for-profit sector R&D expenditure by socio-economic objective (2009/10 to 2018/19)

SOCIO-ECONOMIC OBJECTIVE	2009/10 R'000	2010/11 R'000	2011/12 R'000	2012/13 R'000	2013/14 R'000	2014/15 R'000	2015/16 R'000	2016/17 R'000	2017/18 R'000	2018/19 R'000
Division 1: Defence	1 600	0	0	0	0	690	0	0	0	0
Defence	1 600	0	0	0	0	690	0	0	0	0
Division 2: Economic Development	71 939	65 777	60 758	110 866	113 991	152 573	157 608	129 359	118 415	103 702
Economic development unclassified	0	0	0	0	0	0	0	0	0	0
Plant production and plant primary products	18 873	25 441	24 850	36 127	35 511	28 974	32 936	35 240	35 197	26 579
Animal production and animal primary products	1 632	1 389	828	2 538	3 083	4 000	7 628	9 856	2 635	2 858
Mineral resources (excluding energy)	0	763	0	8 150	9 831	9 242	7 955	7 708	0	0
Energy resources	2 604	1 653	969	2 538	3 083	3 993	4 008	3 278	4 022	4 875
Energy supply	3 774	3 307	3 430	4 363	8 690	7 663	6 242	10 628	7 994	8 852
Manufacturing	0	0	2 197	3 896	2 955	26 291	31 646	230	0	308
Construction	0	0	0	0	0	0	0	0	0	0
Transport	208	0	137	465	424	0	0	0	0	0
Information and communication services	0	0	1 480	2 031	1 823	316	2 411	327	2 513	0
Commercial services	970	0	0	0	0	0	1 135	1 962	1 675	0
Economic framework	39 463	27 068	22 228	45 252	42 423	54 435	53 406	47 465	57 125	53 099
Natural resources	4 414	6 157	4 640	5 507	6 167	17 659	10 242	12 665	7 253	7 131
Division 3: Society	93 947	82 481	75 597	360 333	415 093	555 151	632 030	767 620	941 505	1 058 928
Society unclassified	0	0	0	0	0	0	0	0	0	0
Health	16 554	15 050	13 496	260 712	303 535	449 619	527 783	667 371	835 603	955 738
Education and training	19 986	22 303	23 762	58 894	63 833	61 150	59 917	59 123	61 652	60 123
Social development and community services	57 407	45 128	38 339	40 726	47 725	44 382	44 330	41 126	44 250	43 066
Division 4: Environment	7 052	10 051	13 356	12 841	15 044	16 135	17 503	19 734	38 078	39 974
Environment unclassified	0	0	0	0	0	0	0	0	0	0
Environmental knowledge	3 577	6 139	7 233	4 716	7 845	8 697	9 949	9 712	23 780	23 201
Environmental aspects of development	683	504	3 746	5 771	4 545	4 569	4 494	6 269	6 559	7 544

SOCIO-ECONOMIC OBJECTIVE	2009/10 R'000	2010/11 R'000	2011/12 R'000	2012/13 R'000	2013/14 R'000	2014/15 R'000	2015/16 R'000	2016/17 R'000	2017/18 R'000	2018/19 R'000
Environmental and other aspects	2 792	3 408	2 377	2 355	2 654	2 869	3 060	3 753	7 739	9 229
Division 5: Advancement of Knowledge	14 303	4 521	20 895	19 793	39 036	54 223	84 002	100 903	118 312	283 100
Advancement of knowledge unclassified	0	0	0	0	0	0	0	0	0	0
Natural sciences, technologies and engineering	452	632	13 166	7 754	31 450	42 017	69 845	90 114	107 310	272 540
Social sciences and humanities	13 851	3 889	7 729	12 039	7 586	12 206	14 157	10 789	11 001	10 561
Total	188 840	162 830	170 605	503 833	583 165	778 772	891 142	1 017 616	1 216 310	1 485 704

Table C.88: Proportional not-for-profit sector R&D expenditure by socio-economic objective (2009/10 to 2018/19)

SOCIO-ECONOMIC OBJECTIVE	2009/10 %	2010/11 %	2011/12 %	2012/13 %	2013/14 %	2014/15 %	2015/16 %	2016/17 %	2017/18 %	2018/19 %
Division 1: Defence	0.8	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0
Defence	0.8	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0
Division 2: Economic Development	38.1	40.4	35.6	22.0	19.5	19.6	17.7	12.7	9.7	7.0
Economic development unclassified	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Plant production and plant primary products	10.0	15.6	14.6	7.2	6.1	3.7	3.7	3.5	2.9	1.8
Animal production and animal primary products	0.9	0.9	0.5	0.5	0.5	0.5	0.9	1.0	0.2	0.2
Mineral resources (excluding energy)	0.0	0.5	0.0	1.6	1.7	1.2	0.9	0.8	0.0	0.0
Energy resources	1.4	1.0	0.6	0.5	0.5	0.5	0.4	0.3	0.3	0.3
Energy supply	2.0	2.0	2.0	0.9	1.5	1.0	0.7	1.0	0.7	0.6
Manufacturing	0.0	0.0	1.3	0.8	0.5	3.4	3.6	0.0	0.0	0.0
Construction	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Transport	0.1	0.0	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.0
Information and communication services	0.0	0.0	0.9	0.4	0.3	0.0	0.3	0.0	0.2	0.0
Commercial services	0.5	0.0	0.0	0.0	0.0	0.0	0.1	0.2	0.1	0.0
Economic framework	20.9	16.6	13.0	9.0	7.3	7.0	6.0	4.7	4.7	3.6
Natural resources	2.3	3.8	2.7	1.1	1.1	2.3	1.1	1.2	0.6	0.5

SOCIO-ECONOMIC OBJECTIVE	2009/10	2010/11	2011/12	2012/13	2013/14	2014/15	2015/16	2016/17	2017/18	2018/19
	%	%	%	%	%	%	%	%	%	%
Division 3: Society	49.7	50.7	44.3	71.5	71.2	71.3	70.9	75.4	77.4	71.3
Society unclassified	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Health	8.8	9.2	7.9	51.7	52.0	57.7	59.2	65.6	68.7	64.3
Education and training	10.6	13.7	13.9	11.7	10.9	7.9	6.7	5.8	5.1	4.0
Social development and community services	30.4	27.7	22.5	8.1	8.2	5.7	5.0	4.0	3.6	2.9
Division 4: Environment	3.7	6.2	7.8	2.5	2.6	2.1	2.0	1.9	3.1	2.7
Environment unclassified	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Environmental knowledge	1.9	3.8	4.2	0.9	1.3	1.1	1.1	1.0	2.0	1.6
Environmental aspects of development	0.4	0.3	2.2	1.1	0.8	0.6	0.5	0.6	0.5	0.5
Environmental and other aspects	1.5	2.1	1.4	0.5	0.5	0.4	0.3	0.4	0.6	0.6
Division 5: Advancement of Knowledge	7.6	2.8	12.2	3.9	6.7	7.0	9.4	9.9	9.7	19.1
Advancement of knowledge unclassified	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Natural sciences, technologies and engineering	0.2	0.4	7.7	1.5	5.4	5.4	7.8	8.9	8.8	18.3
Social sciences and humanities	7.3	2.4	4.5	2.4	1.3	1.6	1.6	1.1	0.9	0.7
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Table C.89: Not-for-profit sector R&D expenditure by province (2009/10 to 2018/19)

PROVINCE	2009/10	2010/11	2011/12	2012/13	2013/14	2014/15	2015/16	2016/17	2017/18	2018/19
	R'000	R'000	R'000	R'000	R'000	R'000	R'000	R'000	R'000	R'000
Eastern Cape	8 136	9 790	9 493	25 610	25 478	27 219	21 026	17 053	15 150	19 452
Free State	4 418	6 385	5 096	15 297	15 953	14 214	8 890	6 643	8 086	11 332
Gauteng	104 420	61 496	69 321	162 866	175 651	287 783	345 937	333 359	440 863	528 725
KwaZulu-Natal	30 548	35 765	33 740	163 221	166 603	181 052	232 636	277 770	317 706	316 771
Limpopo	4 524	4 541	7 449	11 779	13 719	49 971	56 143	64 105	78 996	67 940
Mpumalanga	8 311	13 206	16 027	23 195	26 979	30 594	25 944	29 964	32 775	29 863
North West	2 382	5 612	6 353	42 960	72 446	105 904	97 918	136 641	133 473	136 626
Northern Cape	4 493	2 030	1 889	3 867	3 583	1 546	2 200	4 782	4 868	3 238
Western Cape	21 609	24 003	21 236	55 038	82 753	80 489	100 448	147 299	184 392	371 758
Total	188 840	162 830	170 605	503 833	583 165	778 772	891 142	1 017 616	1 216 310	1 485 704

Table C.90: Proportional not-for-profit sector R&D expenditure by province (2009/10 to 2018/19)

PROVINCE	2009/10	2010/11	2011/12	2012/13	2013/14	2014/15	2015/16	2016/17	2017/18	2018/19
	%	%	%	%	%	%	%	%	%	%
Eastern Cape	4.3	6.0	5.6	5.1	4.4	3.5	2.4	1.7	1.2	1.3
Free State	2.3	3.9	3.0	3.0	2.7	1.8	1.0	0.7	0.7	0.8
Gauteng	55.3	37.8	40.6	32.3	30.1	37.0	38.8	32.8	36.2	35.6
KwaZulu-Natal	16.2	22.0	19.8	32.4	28.6	23.2	26.1	27.3	26.1	21.3
Limpopo	2.4	2.8	4.4	2.3	2.4	6.4	6.3	6.3	6.5	4.6
Mpumalanga	4.4	8.1	9.4	4.6	4.6	3.9	2.9	2.9	2.7	2.0
North West	2.4	3.4	1.1	8.5	12.4	13.6	11.0	13.4	11.0	9.2
Northern Cape	1.3	1.2	3.7	0.8	0.6	0.2	0.2	0.5	0.4	0.2
Western Cape	11.4	14.7	12.4	10.9	14.2	10.3	11.3	14.5	15.2	25.0
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Table C.91: Not-for-profit sector R&D personnel in headcounts and full-time equivalents by occupation (2009/10 to 2018/19)

YEAR	HEADCOUNTS				FULL-TME EQUIVALENTS (FTEs)			
	TOTAL	RESEARCHERS	TECHNICIANS	OTHER R&D PERSONNEL	TOTAL	RESEARCHERS	TECHNICIANS	OTHER R&D PERSONNEL
2009/10	**380**	224	76	80	**309.7**	187.5	63.7	58.6
2010/11	**400**	250	49	101	**313.1**	196.2	47.6	69.3
2011/12	**405**	254	56	95	**312.1**	190.8	47.2	74.1
2012/13	**906**	394	132	380	**768.0**	294.5	114.2	359.4
2013/14	**1 017**	435	205	377	**891.4**	338.4	195.1	357.9
2014/15	**1 471**	506	368	597	**1 231.2**	396.0	355.5	479.8
2015/16	**1 493**	465	436	592	**1 367.3**	384.8	411.2	571.2
2016/17	**1 616**	404	607	605	**1 469.5**	340.5	575.6	553.4
2017/18	**1 741**	425	678	638	**1 596.0**	346.1	644.7	605.2
2018/19	**1 937**	424	843	670	**1 685.8**	367.3	693.2	625.4

Note: Headcounts include non-SA R&D personnel (from 2016/17). Non-SA personnel are classified as those that are not from South Africa but are undertaking research in South Africa for a period exceeding six months. They can be temporary or permanent residents as described by the SNA.

Table C.92: Not-for-profit sector R&D personnel in headcounts and full-time equivalents by occupation and gender (2016/17 to 2018/19)

OCCUPATION	HEADCOUNTS			FULL-TIME EQUIVALENTS (FTEs)			
2016/17	**TOTAL**	**MALE**	**FEMALE**	**TOTAL**	**MALE**	**FEMALE**	**FTEs AS % OF HEADCOUNTS**
Researchers	**404**	187	217	**340.5**	149.7	190.8	84.3
Technicians directly supporting R&D	**607**	174	433	**575.6**	165.2	410.4	94.8
Other personnel directly supporting R&D	**605**	164	441	**553.4**	149.4	404.0	91.5
Total	1 616	525	1 091	1 469.5	464.3	1 005.2	90.9
2017/18	**TOTAL**	**MALE**	**FEMALE**	**TOTAL**	**MALE**	**FEMALE**	**FTEs AS % OF HEADCOUNTS**
Researchers	**425**	181	244	**346.1**	139.8	206.4	81.4
Technicians directly supporting R&D	**678**	207	471	**644.7**	191.3	453.4	95.1
Other personnel directly supporting R&D	**638**	169	469	**605.2**	160.7	444.5	94.9
Total	1 741	557	1 184	1 596.0	491.7	1 104.3	91.7
2018/19	**TOTAL**	**MALE**	**FEMALE**	**TOTAL**	**MALE**	**FEMALE**	**FTEs AS % OF HEADCOUNTS**
Researchers	**424**	165	259	**367.3**	142.6	224.7	86.6
Technicians directly supporting R&D	**843**	231	612	**693.2**	192.0	501.2	82.2
Other personnel directly supporting R&D	**670**	182	488	**625.4**	167.8	457.5	93.3
Total	1 937	578	1 359	1 685.8	502.4	1 183.4	87.0

Note: Headcounts include non-SA R&D personnel (from 2016/17). Non-SA personnel are classified as those that are not from South Africa but are undertaking research in South Africa for a period exceeding six months. They can be temporary or permanent residents as described by the SNA.

Table C.93: Not-for-profit sector R&D personnel in headcounts by occupation, qualification, population group and gender (2018/19)

OCCUPATION AND QUALIFICATION	TOTAL	SUBTOTAL		AFRICAN		COLOURED		INDIAN/ASIAN		WHITE		NON-SA	
		MALE	FEMALE	MALE	FEMALE	MALE	FEMALE	MALE	FEMALE	MALE	FEMALE	MALE	FEMALE
Researchers	424	165	259	48	89	9	18	12	40	83	88	13	24
Doctoral degree or equivalent	115	62	53	10	9	1	4	6	12	40	18	5	10
Master's, honours, bachelor or equivalent	254	76	178	25	64	4	10	4	25	37	67	6	12
Diplomas	55	27	28	13	16	4	4	2	3	6	3	2	2
Technicians directly supporting R&D	843	231	612	174	434	20	70	10	54	19	51	8	3
Doctoral degree or equivalent	2	1	1	0	0	0	0	0	0	1	1	0	0
Master's, honours, bachelor or equivalent	275	56	219	25	111	6	28	5	40	15	38	5	2
Diplomas	566	174	392	149	323	14	42	5	14	3	12	3	1
Other personnel directly supporting R&D	670	182	488	143	343	9	29	10	43	14	64	6	9
Doctoral degree or equivalent	9	1	8	1	4	0	0	0	4	0	0	0	0
Master's, honours, bachelor or equivalent	118	24	94	10	31	2	11	4	22	7	24	1	6
Diplomas	543	157	386	132	308	7	18	6	17	7	40	5	3
Total	1 937	578	1 359	365	866	38	117	32	137	116	203	27	36

Note: Headcounts include non-SA R&D personnel (from 2016/17). Non-SA personnel are classified as those that are not from South Africa but are undertaking research in South Africa for a period exceeding six months. They can be temporary or permanent residents as described by the SNA.

C.2.3. Government sector

Table C.94: Government sector R&D expenditure by type of research (2009/10 to 2018/19)

TYPE OF RESEARCH	2009/10 R'000	2010/11 R'000	2011/12 R'000	2012/13 R'000	2013/14 R'000	2014/15 R'000	2015/16 R'000	2016/17 R'000	2017/18 R'000	2018/19 R'000
Basic research	257 806	257 235	263 380	331 587	245 167	338 250	358 666	348 775	329 263	416 131
Applied research	621 762	600 205	812 067	873 469	1 194 866	1 292 421	1 390 221	1 444 821	1 685 367	1 495 783
Experimental development research	187 734	153 900	160 223	232 453	257 118	262 339	264 134	305 051	311 246	311 513
Total	1 067 302	1 011 340	1 235 669	1 437 509	1 697 151	1 893 010	2 013 021	2 098 646	2 325 875	2 223 426

Table C.95: Proportional government sector R&D expenditure by type of research (2009/10 to 2018/19)

TYPE OF RESEARCH	2009/10 %	2010/11 %	2011/12 %	2012/13 %	2013/14 %	2014/15 %	2015/16 %	2016/17 %	2017/18 %	2018/19 %
Basic research	24.2	25.4	21.3	23.1	14.4	17.9	17.8	16.6	14.2	18.7
Applied research	58.3	59.3	65.7	60.8	70.4	68.3	69.1	68.8	72.5	67.3
Experimental development research	17.6	15.2	13.0	16.2	15.1	13.9	13.1	14.5	13.4	14.0
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Table C.96: Government sector R&D expenditure by spheres and institutes of government and accounting category (2009/10 to 2018/19)

TYPE OF EXPENDITURE	2009/10	2010/11	2011/12	2012/13	2013/14	2014/15	2015/16	2016/17	2017/18	2018/19
	R'000	R'000	R'000	R'000	R'000	R'000	R'000	R'000	R'000	R'000
Municipalities	N/A	N/A	14 959	65 541	59 418	62 485	61 703	76 493	59 114	84 160
Capital expenditure	**N/A**	**N/A**	**144**	**18 605**	**23 033**	**12 921**	**13 059**	**20 271**	**13 265**	**30 048**
Land, buildings and other structures	N/A	N/A	0	5 400	10 000	6 537	6 598	9 575	7 065	13 305
Vehicles, plant, machinery, equipment	N/A	N/A	144	13 205	13 033	6 384	6 461	10 696	6 200	16 743
Current expenditure	**N/A**	**N/A**	**14 815**	**46 936**	**36 385**	**49 564**	**48 644**	**56 222**	**45 849**	**54 112**
Labour costs	N/A	N/A	12 715	30 131	27 513	39 314	38 687	41 407	38 279	42 316
Other current expenditure	N/A	N/A	2 100	16 805	8 872	10 250	9 957	14 815	7 570	11 796
Provincial departments	245 031	284 539	335 607	372 231	390 301	421 126	401 512	405 760	411 195	410 454
Capital expenditure	**39 748**	**30 475**	**42 895**	**45 895**	**45 930**	**39 325**	**43 918**	**48 084**	**35 517**	**27 502**
Land, buildings and other structures	11 238	13 022	10 674	7 255	6 348	5 500	7 900	12 264	14 864	12 130
Vehicles, plant, machinery, equipment	28 510	17 453	32 221	38 640	39 582	33 825	36 018	35 820	20 653	15 372
Current expenditure	**205 283**	**254 064**	**292 712**	**326 336**	**344 371**	**381 801**	**357 594**	**357 676**	**375 678**	**382 951**
Labour costs	138 397	182 175	206 583	236 367	233 321	248 823	225 621	252 286	264 285	252 129
Other current expenditure	66 886	71 889	86 129	89 969	111 050	132 978	131 973	105 390	111 393	130 823
National departments	240 412	211 176	280 005	321 632	249 705	248 041	356 575	408 803	512 743	546 432
Capital expenditure	**2 022**	**38 629**	**31 879**	**32 669**	**17 540**	**4 406**	**57 905**	**56 999**	**71 632**	**77 174**
Land, buildings and other structures	500	3 657	11 820	12 783	2 122	811	18 037	6 424	6 920	16 143
Vehicles, plant, machinery, equipment	1 522	34 972	20 059	19 886	15 418	3 595	39 868	50 575	64 712	61 031
Current expenditure	**238 390**	**172 547**	**248 126**	**288 963**	**232 165**	**243 635**	**298 670**	**351 804**	**441 111**	**469 258**
Labour costs	81 619	144 779	140 146	158 808	198 440	150 921	171 849	216 103	228 761	194 471
Other current expenditure	156 771	27 768	107 980	130 155	33 725	92 714	126 821	135 701	212 350	274 787
Government research institutes	553 651	483 999	573 698	644 360	973 807	1 134 875	1 165 161	1 179 994	1 326 427	1 161 197
Capital expenditure	**168 544**	**113 395**	**35 071**	**157 221**	**98 010**	**233 386**	**202 878**	**199 952**	**271 029**	**342 078**
Land, buildings and other structures	115 101	43 360	2 487	58 280	4 542	93 477	112 710	107 971	131 824	105 507
Vehicles, plant, machinery, equipment	53 443	70 035	32 584	98 941	93 468	139 909	90 168	91 981	139 205	236 571
Current expenditure	**385 107**	**370 604**	**538 627**	**487 139**	**875 797**	**901 489**	**962 283**	**980 042**	**1 055 398**	**819 119**
Labour costs	245 767	269 965	316 835	355 503	316 256	375 939	311 876	323 121	328 656	394 182
Other current expenditure	139 340	100 639	221 792	131 636	559 541	525 550	650 407	656 921	726 741	424 937
Museums	28 208	31 626	31 400	33 745	23 920	26 484	28 070	27 596	16 396	21 184
Capital expenditure	**4 087**	**3 699**	**3 256**	**649**	**946**	**1 996**	**2 005**	**2 704**	**796**	**2 106**
Land, buildings and other structures	2 491	2 141	2 337	30	638	687	663	774	0	0
Vehicles, plant, machinery, equipment	1 596	1 558	919	619	308	1 309	1 342	1 930	796	2 106
Current expenditure	**24 121**	**27 927**	**28 144**	**33 096**	**22 974**	**24 488**	**26 065**	**24 892**	**15 600**	**19 078**
Labour costs	17 839	20 814	21 413	25 471	20 769	22 429	23 751	24 004	14 775	17 610
Other current expenditure	6 282	7 113	6 731	7 625	2 205	2 059	2 314	888	825	1 468
Government sector	1 067 302	1 011 340	1 235 669	1 437 509	1 697 151	1 893 010	2 013 021	2 098 646	2 325 875	2 223 426
Capital expenditure	**214 401**	**186 198**	**113 245**	**255 039**	**185 459**	**292 034**	**319 765**	**328 010**	**392 239**	**478 908**
Land, buildings and other structures	129 330	62 180	27 318	83 748	23 650	107 012	145 908	137 008	160 673	147 085
Vehicles, plant, machinery, equipment	85 071	124 018	85 927	171 291	161 809	185 022	173 857	191 002	231 566	331 823
Current expenditure	**852 901**	**825 142**	**1 122 424**	**1 182 470**	**1 511 692**	**1 600 976**	**1 693 256**	**1 770 636**	**1 933 636**	**1 744 518**
Labour costs	483 622	617 733	697 692	806 280	796 299	837 425	771 784	856 921	874 757	900 707
Other current expenditure	369 279	207 409	424 732	376 190	715 393	763 551	921 472	913 715	1 058 879	843 811

N/A: Municipal data were collected from the 2011/12 R&D survey onwards.

Table C.97: Proportional government sector R&D expenditure by spheres and institutes of government and accounting category (2009/10 to 2018/19)

TYPE OF EXPENDITURE	2009/10	2010/11	2011/12	2012/13	2013/14	2014/15	2015/16	2016/17	2017/18	2018/19
	%	%	%	%	%	%	%	%	%	%
Municipalities	N/A	N/A	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Capital expenditure	**N/A**	**N/A**	**1.0**	**28.4**	**38.8**	**20.7**	**21.2**	**26.5**	**22.4**	**35.7**
Land, buildings and other structures	N/A	N/A	0.0	8.2	16.8	10.5	10.7	12.5	12.0	15.8
Vehicles, plant, machinery, equipment	N/A	N/A	1.0	20.1	21.9	10.2	10.5	14.0	10.5	19.9
Current expenditure	**N/A**	**N/A**	**99.0**	**71.6**	**61.2**	**79.3**	**78.8**	**73.5**	**77.6**	**64.3**
Labour costs	N/A	N/A	85.0	46.0	46.3	62.9	62.7	54.1	64.8	50.3
Other current expenditure	N/A	N/A	14.0	25.6	14.9	16.4	16.1	19.4	12.8	14.0
Provincial departments	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Capital expenditure	**16.2**	**10.7**	**12.8**	**12.3**	**11.8**	**9.3**	**10.9**	**11.9**	**8.6**	**6.7**
Land, buildings and other structures	4.6	4.6	3.2	1.9	1.6	1.3	2.0	3.0	3.6	3.0
Vehicles, plant, machinery, equipment	11.6	6.1	9.6	10.4	10.1	8.0	9.0	8.8	5.0	3.7
Current expenditure	**83.8**	**89.3**	**87.2**	**87.7**	**88.2**	**90.7**	**89.1**	**88.1**	**91.4**	**93.3**
Labour costs	56.5	64.0	61.6	63.5	59.8	59.1	56.2	62.2	64.3	61.4
Other current expenditure	27.3	25.3	25.7	24.2	28.5	31.6	32.9	26.0	27.1	31.9
National departments	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Capital expenditure	**0.8**	**18.3**	**11.4**	**10.2**	**7.0**	**1.8**	**16.2**	**13.9**	**14.0**	**14.1**
Land, buildings and other structures	0.2	1.7	4.2	4.0	0.8	0.3	5.1	1.6	1.3	3.0
Vehicles, plant, machinery, equipment	0.6	16.6	7.2	6.2	6.2	1.4	11.2	12.4	12.6	11.2
Current expenditure	**99.2**	**81.7**	**88.6**	**89.8**	**93.0**	**98.2**	**83.8**	**86.1**	**86.0**	**85.9**
Labour costs	33.9	68.6	50.1	49.4	79.5	60.8	48.2	52.9	44.6	35.6
Other current expenditure	65.2	13.1	38.6	40.5	13.5	37.4	35.6	33.2	41.4	50.3
Government research institutes	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Capital expenditure	**30.4**	**23.4**	**6.1**	**24.4**	**10.1**	**20.6**	**17.4**	**16.9**	**20.4**	**29.5**
Land, buildings and other structures	20.8	9.0	0.4	9.0	0.5	8.2	9.7	9.2	9.9	9.1
Vehicles, plant, machinery, equipment	9.7	14.5	5.7	15.4	9.6	12.3	7.7	7.8	10.5	20.4
Current expenditure	**69.6**	**76.6**	**93.9**	**75.6**	**89.9**	**79.4**	**82.6**	**83.1**	**79.6**	**70.5**
Labour costs	44.4	55.8	55.2	55.2	32.5	33.1	26.8	27.4	24.8	33.9
Other current expenditure	25.2	20.8	38.7	20.4	57.5	46.3	55.8	55.7	54.8	36.6
Museums	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Capital expenditure	**14.5**	**11.7**	**10.4**	**1.9**	**4.0**	**7.5**	**7.1**	**9.8**	**4.9**	**9.9**
Land, buildings and other structures	8.8	6.8	7.4	0.1	2.7	2.6	2.4	2.8	0.0	0.0
Vehicles, plant, machinery, equipment	5.7	4.9	2.9	1.8	1.3	4.9	4.8	7.0	4.9	9.9
Current expenditure	**85.5**	**88.3**	**89.6**	**98.1**	**96.0**	**92.5**	**92.9**	**90.2**	**95.1**	**90.1**
Labour costs	63.2	65.8	68.2	75.5	86.8	84.7	84.6	87.0	90.1	83.1
Other current expenditure	22.3	22.5	21.4	22.6	9.2	7.8	8.2	3.2	5.0	6.9
Government sector	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Capital expenditure	**20.1**	**18.4**	**9.2**	**17.7**	**10.9**	**15.4**	**15.9**	**15.6**	**16.9**	**21.5**
Land, buildings and other structures	12.1	6.1	2.2	5.8	1.4	5.7	7.2	6.5	6.9	6.6
Vehicles, plant, machinery, equipment	8.0	12.3	7.0	11.9	9.5	9.8	8.6	9.1	10.0	14.9
Current expenditure	**79.9**	**81.6**	**90.8**	**82.3**	**89.1**	**84.6**	**84.1**	**84.4**	**83.1**	**78.5**
Labour costs	45.3	61.1	56.5	56.1	46.9	44.2	38.3	40.8	37.6	40.5
Other current expenditure	34.6	20.5	34.4	26.2	42.2	40.3	45.8	43.5	45.5	38.0

N/A: Municipal data were collected from the 2011/12 R&D survey onwards.

Table C.98: Government sector expenditure on multidisciplinary areas of R&D (2009/10 to 2018/19)

MULTI-DISCIPLINARY AREA OF R&D	2009/10 R'000	2010/11 R'000	2011/12 R'000	2012/13 R'000	2013/14 R'000	2014/15 R'000	2015/16 R'000	2016/17 R'000	2017/18 R'000	2018/19 R'000
Biotechnology	32 496	213 817	81 993	124 429	97 816	85 385	81 409	87 557	84 738	89 293
Nanotechnology	0	4 196	4 609	15 035	16 929	13 112	11 774	12 620	12 741	24 732
Total	32 496	218 013	86 602	139 464	114 745	98 497	93 183	100 176	97 479	114 025
Government expenditure on R&D	**1 067 302**	**1 011 340**	**1 235 669**	**1 437 509**	**1 697 151**	**1 893 010**	**2 013 021**	**2 098 646**	**2 325 875**	**2 223 426**

Table C.99: Proportional government sector expenditure on multidisciplinary areas of R&D (2009/10 to 2018/19)

MULTI-DISCIPLINARY AREA OF R&D	2009/10 %	2010/11 %	2011/12 %	2012/13 %	2013/14 %	2014/15 %	2015/16 %	2016/17 %	2017/18 %	2018/19 %
Biotechnology	3.0	21.1	6.6	8.7	5.8	4.5	4.0	4.2	3.6	4.0
Nanotechnology	0.0	0.4	0.4	1.0	1.0	0.7	0.6	0.6	0.5	1.1
Total	3.0	21.6	7.0	9.7	6.8	5.2	4.6	4.8	4.2	5.1

Note: Data on these multidisciplinary areas of R&D were collected for the first time in the 2005/06 R&D survey.

Table C.100: Government sector R&D expenditure on selected areas of interest (2009/10 to 2018/19

AREA OF INTEREST	2009/10 R'000	2010/11 R'000	2011/12 R'000	2012/13 R'000	2013/14 R'000	2014/15 R'000	2015/16 R'000	2016/17 R'000	2017/18 R'000	2018/19 R'000
Environment related	N/A	N/A	109 774	170 304	194 564	232 090	192 774	202 351	316 188	339 012
Open-source software	7 238	7 261	1 345	1 501	0	0	0	0	597	710.62
New materials	7 156	26 166	4 107	28 708	30 945	12 062	5 291	6 143	7 599	13 172
Tuberculosis (TB), HIV/AIDS, malaria	199 977	174 382	167 522	132 264	380 640	359 074	389 279	395 996	435 045	237 974
Space science	N/A	N/A	N/A	N/A	N/A	N/A	N/A	39 882	0	0
Total	214 371	207 809	282 748	332 777	606 149	603 226	587 343	644 372	759 430	590 869
Government expenditure on R&D	**1 067 302**	**1 011 340**	**1 235 669**	**1 437 509**	**1 697 151**	**1 893 010**	**2 013 021**	**2 098 646**	**2 325 875**	**2 223 426**

N/A: Environment-related data were collected from the 2011/12 R&D Survey onwards. Space science data were collected for the first time in the 2016/17 R&D Survey.

Table C.101: Proportional government sector R&D expenditure on selected areas of interest (2009/10 to 2018/19)

AREA OF INTEREST	2009/10 %	2010/11 %	2011/12 %	2012/13 %	2013/14 %	2014/15 %	2015/16 %	2016/17 %	2017/18 %	2018/19 %
Environment related	N/A	N/A	8.9	11.8	11.5	12.3	9.6	9.6	13.6	15.2
Open-source software	0.7	0.7	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0
New materials	0.7	2.6	0.3	2.0	1.8	0.6	0.3	0.3	0.3	0.6
Tuberculosis (TB), HIV/AIDS, malaria	18.7	17.2	13.6	9.2	22.4	19.0	19.3	18.9	18.7	10.7
Space science	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.9	0.0	0.0
Total	20.1	20.5	22.9	23.1	35.7	19.6	29.2	30.7	32.7	26.6

N/A: Environment-related data were collected from the 2011/12 R&D Survey onwards. Space science data were collected for the first time in the 2016/17 R&D Survey.

Table C.102: Government sector R&D expenditure by research field (2009/10 to 2018/19)

MAIN RESEARCH FIELD	2009/10 R'000	2010/11 R'000	2011/12 R'000	2012/13 R'000	2013/14 R'000	2014/15 R'000	2015/16 R'000	2016/17 R'000	2017/18 R'000	2018/19 R'000
Division 1: Natural Sciences, Technology and Engineering	806 995	634 237	863 949	1 045 006	1 359 179	1 558 094	1 520 894	1 560 315	1 722 617	1 592 766
Mathematical sciences	24 441	22 811	2 349	1 076	1 525	28 302	397	539	85	1 855
Physical sciences	12 093	0	0	5 064	0	30 154	26 455	28 529	49 051	54 017
Chemical sciences	21 698	10 653	1 223	21 823	19 394	61 881	61 688	68 937	73 898	81 603
Earth sciences	47 624	42 081	39 303	90 571	65 501	139 388	79 942	85 550	50 110	103 767
Information, computer and communication technologies	28 176	31 960	15 642	7 760	8 431	12 141	4 662	5 540	398	0
Applied sciences and technologies	9 315	4 154	10 183	32 467	23 216	29 723	22 531	25 444	23 016	38 562
Engineering sciences	14 996	4 165	4 515	10 430	11 853	13 176	12 129	13 572	17 076	14 574
Biological sciences	54 893	85 990	94 662	111 871	138 000	152 735	196 053	195 922	215 624	254 654
Agricultural sciences	274 781	225 441	362 241	460 921	397 687	506 445	471 798	485 417	523 343	557 157
Medical and health sciences	288 488	168 400	270 312	211 840	594 684	553 534	608 530	615 067	673 437	370 294
Environmental sciences	10 722	9 147	34 231	54 394	55 245	14 353	14 478	13 921	13 085	17 270
Material sciences	0	0	4 107	9 771	10 537	0	0	0	0	0
Marine sciences	19 768	29 434	25 182	27 019	33 106	16 262	22 232	21 877	83 495	99 013
Division 2: Social Sciences and Humanities	260 308	377 103	371 720	392 503	337 972	334 916	492 127	538 331	603 258	630 660
Social sciences	249 155	363 055	358 892	383 172	326 603	328 522	479 316	529 080	591 813	620 433
Humanities	11 152	14 048	12 828	9 331	11 369	6 394	12 811	9 251	11 445	10 227
Total	1 067 302	1 011 340	1 235 669	1 437 509	1 697 151	1 893 010	2 013 021	2 098 646	2 325 875	2 223 426

Table C.103: Proportional government sector R&D expenditure by research field (2009/10 to 2018/19

MAIN RESEARCH FIELD	2009/10 %	2010/11 %	2011/12 %	2012/13 %	2013/14 %	2014/15 %	2015/16 %	2016/17 %	2017/18 %	2018/19 %
Division 1: Natural Sciences, Technology and Engineering	75.6	62.7	69.9	72.7	80.1	82.3	75.6	74.3	74.1	71.6
Mathematical sciences	2.3	2.3	0.2	0.1	0.1	1.5	0.0	0.0	0.0	0.1
Physical sciences	1.1	0.0	0.0	0.4	0.0	1.6	1.3	1.4	2.1	2.4
Chemical sciences	2.0	1.1	0.1	1.5	1.1	3.3	3.1	3.3	3.2	3.7
Earth sciences	4.5	4.2	3.2	6.3	3.9	7.4	4.0	4.1	2.2	4.7

MAIN RESEARCH FIELD	2009/10 %	2010/11 %	2011/12 %	2012/13 %	2013/14 %	2014/15 %	2015/16 %	2016/17 %	2017/18 %	2018/19 %
Information, computer and communication technologies	2.6	3.2	1.3	0.5	0.5	0.6	0.2	0.3	0.0	0.0
Applied sciences and technologies	0.9	0.4	0.8	2.3	1.4	1.6	1.1	1.2	1.0	1.7
Engineering sciences	1.4	0.4	0.4	0.7	0.7	0.7	0.6	0.6	0.7	0.7
Biological sciences	5.1	8.5	7.7	7.8	8.1	8.1	9.7	9.3	9.3	11.5
Agricultural sciences	25.7	22.3	29.3	32.1	23.4	26.8	23.4	23.1	22.5	25.1
Medical and health sciences	27.0	16.7	21.9	14.7	35.0	29.2	30.2	29.3	29.0	16.7
Environmental sciences	1.0	0.9	2.8	3.8	3.3	0.8	0.7	0.7	0.6	0.8
Material sciences	0.0	0.0	0.3	0.7	0.6	0.0	0.0	0.0	0.0	0.0
Marine sciences	1.9	2.9	2.0	1.9	2.0	0.9	1.1	1.0	3.6	4.5
Division 2: Social Sciences and Humanities	24.4	37.3	30.1	27.3	19.9	17.7	24.4	25.7	25.9	28.4
Social sciences	23.3	35.9	29.0	26.7	19.2	17.4	23.8	25.2	25.4	27.9
Humanities	1.0	1.4	1.0	0.6	0.7	0.3	0.6	0.4	0.5	0.5
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Table C.104: Government sector R&D expenditure by socio-economic objective (2009/10 to 2018/19)

SOCIO-ECONOMIC OBJECTIVE	2009/10 R'000	2010/11 R'000	2011/12 R'000	2012/13 R'000	2013/14 R'000	2014/15 R'000	2015/16 R'000	2016/17 R'000	2017/18 R'000	2018/19 R'000
Division 1: Defence	0	2 303	2 736	19 314	21 118	21 472	42 233	34 213	7 582	46 886
Defence	0	2 303	2 736	19 314	21 118	21 472	42 233	34 213	7 582	46 886
Division 2: Economic Development	438 114	500 343	469 129	480 373	510 688	763 932	745 129	826 860	1 009 575	1 117 257
Economic development unclassified	0	0	0	0	0	0	0	0	0	0
Plant production and plant primary products	63 570	64 400	70 754	100 956	89 446	107 672	92 506	103 212	117 664	115 406
Animal production and animal primary products	84 842	91 877	86 710	93 504	137 279	156 437	125 737	134 227	129 024	135 755
Mineral resources (excluding energy)	0	0	0	0	311	5 403	6 548	2 854	12 395	5 508
Energy resources	0	37	0	0	1 023	12 062	5 291	5 716	5 706	6 413
Energy supply	2 522	6 154	10 552	7 193	8 482	34 845	29 705	32 772	40 959	53 254
Manufacturing	5 444	15 870	1 005	1 557	1 544	79 583	1 318	5 201	5 433	10 794
Construction	0	148	9 545	543	741	4 312	1 394	1 501	1 584	8 501
Transport	4 369	9 377	10 964	8 774	1 672	24 105	21 537	24 896	21 926	7 268

SOCIO-ECONOMIC OBJECTIVE	2009/10 R'000	2010/11 R'000	2011/12 R'000	2012/13 R'000	2013/14 R'000	2014/15 R'000	2015/16 R'000	2016/17 R'000	2017/18 R'000	2018/19 R'000
Information and communication services	13 244	44 257	20 590	5 678	5 515	14 397	7 977	6 071	19 938	18 583
Commercial services	9 957	7 471	4 708	3 587	12 162	15 532	13 531	12 616	47 515	72 388
Economic framework	161 326	187 931	157 364	161 541	116 604	167 690	262 289	343 537	394 216	404 073
Natural resources	92 838	72 820	96 938	97 042	135 909	141 895	177 298	154 258	213 214	279 313
Division 3: Society	326 691	341 387	538 749	592 285	872 096	912 216	952 108	951 859	1 029 316	746 234
Society unclassified	0	0	0	0	0	0	0	0	0	0
Health	77 845	106 522	221 435	171 741	487 130	475 983	482 472	511 031	554 746	303 831
Education and training	158 579	42 234	69 185	116 788	165 906	174 540	209 544	169 499	173 547	139 984
Social development and community services	90 268	192 630	248 129	303 756	219 061	261 693	260 092	271 328	301 023	302 419
Division 4: Environment	72 614	85 347	130 742	199 677	172 006	127 394	191 334	204 573	208 704	237 373
Environment unclassified	0	0	0	0	0	0	0	0	0	0
Environmental knowledge	45 360	40 610	83 089	137 679	124 445	91 677	107 265	116 996	100 339	117 228
Environmental aspects of development	18 153	27 635	38 467	51 795	38 877	27 206	53 541	55 508	50 936	64 148
Environmental and other aspects	9 101	17 102	9 186	10 204	8 684	8 511	30 528	32 069	57 429	55 997
Division 5: Advancement of Knowledge	229 883	81 960	94 314	145 860	121 243	67 996	82 217	81 141	70 698	75 676
Advancement of knowledge unclassified	0	0	0	0	0	0	0	0	0	0
Natural sciences, technologies and engineering	205 995	50 968	61 357	120 173	96 381	43 170	58 401	57 655	57 473	61 475
Social sciences and humanities	23 888	30 992	32 956	25 687	24 862	24 825	23 816	23 486	13 225	14 201
Total	1 067 302	1 011 340	1 235 669	1 437 509	1 697 151	1 893 010	2 013 021	2 098 646	2 325 875	2 223 426

Table C.105: Proportional government sector R&D expenditure by socio-economic objective (2009/10 to 2018/19)

SOCIO-ECONOMIC OBJECTIVE	2009/10 %	2010/11 %	2011/12 %	2012/13 %	2013/14 %	2014/15 %	2015/16 %	2016/17 %	2017/18 %	2018/19 %
Division 1: Defence	0.0	0.2	0.2	1.3	1.2	1.1	2.1	1.6	0.3	2.1
Defence	0.0	0.2	0.2	1.3	1.2	1.1	2.1	1.6	0.3	2.1
Division 2: Economic Development	41.0	49.5	38.0	33.4	30.1	40.4	37.0	39.4	43.4	50.2
Economic development unclassified	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Plant production and plant primary products	6.0	6.4	5.7	7.0	5.3	5.7	4.6	4.9	5.1	5.2
Animal production and animal primary products	7.9	9.1	7.0	6.5	8.1	8.3	6.2	6.4	5.5	6.1
Mineral resources (excluding energy)	0.0	0.0	0.0	0.0	0.0	0.3	0.3	0.1	0.5	0.2
Energy resources	0.0	0.0	0.0	0.0	0.1	0.6	0.3	0.3	0.2	0.3
Energy supply	0.2	0.6	0.9	0.5	0.5	1.8	1.5	1.6	1.8	2.4
Manufacturing	0.5	1.6	0.1	0.1	0.1	4.2	0.1	0.2	0.2	0.5
Construction	0.0	0.0	0.8	0.0	0.0	0.2	0.1	0.1	0.1	0.4
Transport	0.4	0.9	0.9	0.6	0.1	1.3	1.1	1.2	0.9	0.3
Information and communication services	1.2	4.4	1.7	0.4	0.3	0.8	0.4	0.3	0.9	0.8
Commercial services	0.9	0.7	0.4	0.2	0.7	0.8	0.7	0.6	2.0	3.3
Economic framework	15.1	18.6	12.7	11.2	6.9	8.9	13.0	16.4	16.9	18.2
Natural resources	8.7	7.2	7.8	6.8	8.0	7.5	8.8	7.4	9.2	12.6
Division 3: Society	30.6	33.8	43.6	41.2	51.4	48.2	47.3	45.4	44.3	33.6
Society unclassified	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Health	7.3	10.5	17.9	11.9	28.7	25.1	24.0	24.4	23.9	13.7
Education and training	14.9	4.2	5.6	8.1	9.8	9.2	10.4	8.1	7.5	6.3
Social development and community services	8.5	19.0	20.1	21.1	12.9	13.8	12.9	12.9	12.9	13.6
Division 4: Environment	6.8	8.4	10.6	13.9	10.1	6.7	9.5	9.7	9.0	10.7
Environment unclassified	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Environmental knowledge	4.2	4.0	6.7	9.6	7.3	4.8	5.3	5.6	4.3	5.3
Environmental aspects of development	1.7	2.7	3.1	3.6	2.3	1.4	2.7	2.6	2.2	2.9

SOCIO-ECONOMIC OBJECTIVE	2009/10	2010/11	2011/12	2012/13	2013/14	2014/15	2015/16	2016/17	2017/18	2018/19
	%	%	%	%	%	%	%	%	%	%
Environmental and other aspects	0.9	1.7	0.7	0.7	0.5	0.4	1.5	1.5	2.5	2.5
Division 5: Advancement of Knowledge	21.5	8.1	7.6	10.1	7.1	3.6	4.1	3.9	3.0	3.4
Advancement of knowledge unclassified	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Natural sciences, technologies and engineering	19.3	5.0	5.0	8.4	5.7	2.3	2.9	2.7	2.5	2.8
Social sciences and humanities	2.2	3.1	2.7	1.8	1.5	1.3	1.2	1.1	0.6	0.6
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Table C.106: Government sector R&D expenditure by province (2009/10 to 2018/19)

PROVINCE	2009/10	2010/11	2011/12	2012/13	2013/14	2014/15	2015/16	2016/17	2017/18	2018/19
	R'000	R'000	R'000	R'000	R'000	R'000	R'000	R'000	R'000	R'000
Eastern Cape	100 100	114 127	127 415	194 258	133 657	227 427	225 603	222 456	281 201	305 629
Free State	46 155	39 998	44 200	38 659	55 095	60 860	61 802	81 957	81 890	59 694
Gauteng	396 124	343 096	447 635	427 173	689 915	760 199	832 397	885 142	974 192	836 827
KwaZulu-Natal	54 914	48 056	126 857	168 029	161 962	177 517	187 088	172 655	206 551	236 602
Limpopo	60 421	57 797	65 017	74 621	95 668	83 683	84 232	76 541	86 876	89 889
Mpumalanga	68 796	69 980	78 335	80 201	77 479	93 566	112 173	107 237	104 154	88 922
North West	29 176	43 048	44 618	45 573	73 576	56 719	61 815	57 994	60 594	66 727
Northern Cape	77 978	58 918	63 556	75 440	61 932	52 579	69 174	66 200	94 659	88 575
Western Cape	233 639	236 320	238 035	333 555	347 869	380 461	378 737	428 465	435 757	450 560
Total	1 067 302	1 011 340	1 235 669	1 437 509	1 697 151	1 893 010	2 013 021	2 098 646	2 325 875	2 223 426

Table C.107: Proportional government sector R&D expenditure by province (2009/10 to 2018/19)

PROVINCE	2009/10	2010/11	2011/12	2012/13	2013/14	2014/15	2015/16	2016/17	2017/18	2018/19
	%	%	%	%	%	%	%	%	%	%
Eastern Cape	9.4	11.3	10.3	13.5	7.9	12.0	11.2	10.6	12.1	13.7
Free State	4.3	4.0	3.6	2.7	3.2	3.2	3.1	3.9	3.5	2.7
Gauteng	37.1	33.9	36.2	29.7	40.7	40.2	41.4	42.2	41.9	37.6
KwaZulu-Natal	5.1	4.8	10.3	11.7	9.5	9.4	9.3	8.2	8.9	10.6
Limpopo	5.7	5.7	5.3	5.2	5.6	4.4	4.2	3.6	3.7	4.0
Mpumalanga	6.4	6.9	6.3	5.6	4.6	4.9	5.6	5.1	4.5	4.0
North West	2.7	4.3	3.6	3.2	4.3	3.0	3.1	2.8	2.6	3.0
Northern Cape	7.3	5.8	5.1	5.2	3.6	2.8	3.4	3.2	4.1	4.0
Western Cape	21.9	23.4	19.3	23.2	20.5	20.1	18.8	20.4	18.7	20.3
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Table C.108: Government sector R&D personnel in headcounts and full-time equivalents by occupation (2009/10 to 2018/19)

YEAR	HEADCOUNTS				FULL-TME EQUIVALENTS (FTEs)			
	TOTAL	RESEARCHERS	TECHNICIANS	OTHER R&D PERSONNEL	TOTAL	RESEARCHERS	TECHNICIANS	OTHER R&D PERSONNEL
2009/10	**2 580**	986	509	1 085	**1 903.9**	680.4	356.8	866.7
2010/11	**2 704**	1 184	421	1 099	**2 178.6**	874.2	352.9	951.6
2011/12	**3 143**	1 411	432	1 300	**2 404.5**	1 009.8	330.4	1 064.3
2012/13	**3 252**	1 409	517	1 326	**2 597.0**	1 091.4	385.8	1 119.9
2013/14	**2 874**	1 229	518	1 127	**2 245.5**	923.7	366.3	955.4
2014/15	**2 893**	1 343	550	1 000	**2 181.5**	970.0	337.9	873.5
2015/16	**2 997**	1 573	537	887	**2 056.2**	953.9	365.7	736.7
2016/17	**3 076**	1 677	538	861	**2 031.6**	969.1	357.9	704.6
2017/18	**3 027**	1 671	517	839	**2 000.4**	899.1	347.7	753.7
2018/19	**2 910**	1 662	416	832	**1 999.0**	920.8	324.9	753.3

Note: Headcounts include non-SA R&D personnel (from 2016/17). Non-SA personnel are classified as those that are not from South Africa but are undertaking research in South Africa for a period exceeding six months. They can be temporary or permanent residents as described by the SNA.

Table C.109: Government sector R&D personnel in headcounts and full-time equivalents by occupation and gender (2016/17 to 2018/19)

OCCUPATION	HEADCOUNTS			FULL-TIME EQUIVALENTS (FTEs)			
2016/17	**TOTAL**	**MALE**	**FEMALE**	**TOTAL**	**MALE**	**FEMALE**	**FTEs AS % OF HEADCOUNTS**
Researchers	**1 677**	774	903	**969.1**	461.0	508.1	57.8
Technicians directly supporting R&D	**538**	283	255	**357.9**	202.2	155.7	66.5
Other personnel directly supporting R&D	**861**	568	293	**704.6**	494.6	210.0	81.8
Total	3 076	1 625	1 451	2 031.6	1 157.9	873.7	66.0
2017/18	**TOTAL**	**MALE**	**FEMALE**	**TOTAL**	**MALE**	**FEMALE**	**FTEs AS % OF HEADCOUNTS**
Researchers	**1 671**	756	915	**899.1**	429.4	469.7	53.8
Technicians directly supporting R&D	**517**	263	254	**347.7**	186.6	161.0	67.2
Other personnel directly supporting R&D	**839**	554	285	**753.7**	516.6	237.1	89.8
Total	3 027	1 573	1 454	2 000.4	1 132.6	867.9	66.1
2018/19	**TOTAL**	**MALE**	**FEMALE**	**TOTAL**	**MALE**	**FEMALE**	**FTEs AS % OF HEADCOUNTS**
Researchers	**1 662**	757	905	**920.8**	435.7	485.2	55.4
Technicians directly supporting R&D	**416**	226	190	**324.9**	179.6	145.3	78.1
Other personnel directly supporting R&D	**832**	573	259	**753.3**	533.7	219.6	90.5
Total	2 910	1 556	1 354	1 999.0	1 148.9	850.1	68.7

Note: Headcounts include non-SA R&D personnel (from 2016/17). Non-SA personnel are classified as those that are not from South Africa but are undertaking research in South Africa for a period exceeding six months. They can be temporary or permanent residents as described by the SNA.

Table C.110: Government sector R&D personnel in headcounts by occupation, qualification, population group and gender (2018/19)

OCCUPATION AND QUALIFICATION	TOTAL	SUBTOTAL		AFRICAN		COLOURED		INDIAN/ASIAN		WHITE		NON-SA	
		MALE	FEMALE	MALE	FEMALE	MALE	FEMALE	MALE	FEMALE	MALE	FEMALE	MALE	FEMALE
Researchers	1 662	757	905	434	512	46	70	43	85	223	236	11	2
Doctoral degree or equivalent	300	156	144	56	32	9	10	11	17	72	85	8	0
Master's, honours, bachelor or equivalent	1 209	536	673	338	420	35	54	28	60	132	138	3	1
Diplomas	153	65	88	40	60	2	6	4	8	19	13	0	1
Technicians directly supporting R&D	416	226	190	139	115	30	25	10	6	47	44	0	0
Doctoral degree or equivalent	2	2	0	1	0	0	0	0	0	1	0	0	0
Master's, honours, bachelor or equivalent	221	107	114	64	59	13	14	6	5	24	36	0	0
Diplomas	193	117	76	74	56	17	11	4	1	22	8	0	0
Other personnel directly supporting R&D	832	573	259	384	161	140	47	5	2	33	47	11	2
Doctoral degree or equivalent	11	6	5	0	1	0	0	0	1	2	2	4	1
Master's, honours, bachelor or equivalent	75	33	42	12	17	5	6	2	1	10	18	4	0
Diplomas	746	534	212	372	143	135	41	3	0	21	27	3	1
Total	2 910	1 556	1 354	957	788	216	142	58	93	303	327	22	4

Note: Headcounts include non-SA R&D personnel (from 2016/17). Non-SA personnel are classified as those that are not from South Africa but are undertaking research in South Africa for a period exceeding six months. They can be temporary or permanent residents as described by the SNA.

C.2.4. Science councils sector

Table C.111: Science councils sector R&D expenditure by type of research (2009/10 to 2018/19)

TYPE OF RESEARCH	2009/10 R'000	2010/11 R'000	2011/12 R'000	2012/13 R'000	2013/14 R'000	2014/15 R'000	2015/16 R'000	2016/17 R'000	2017/18 R'000	2018/19 R'000
Basic research	776 505	871 635	900 830	937 826	970 785	1 166 491	1 348 533	1 372 702	1 349 946	1 244 253
Applied research	1 552 560	1 531 563	1 756 157	1 885 484	2 114 943	2 421 309	2 781 198	3 202 019	3 460 650	2 855 564
Experimental development research	1 129 009	1 192 825	1 072 693	1 202 689	1 218 827	1 416 869	1 611 166	1 561 462	1 502 748	1 344 068
Total	3 458 074	3 596 023	3 729 680	4 025 998	4 304 556	5 004 669	5 740 897	6 136 183	6 313 344	5 443 885

Table C.112: Proportional science councils sector R&D expenditure by type of research (2009/10 to 2018/19)

TYPE OF RESEARCH	2009/10 %	2010/11 %	2011/12 %	2012/13 %	2013/14 %	2014/15 %	2015/16 %	2016/17 %	2017/18 %	2018/19 %
Basic research	22.5	24.2	24.2	23.3	22.6	23.3	23.5	22.4	21.4	22.9
Applied research	44.9	42.6	47.1	46.8	49.1	48.4	48.4	52.2	54.8	52.5
Experimental development research	32.6	33.2	28.8	29.9	28.3	28.3	28.1	25.4	23.8	24.7
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Table C.113: Science councils sector R&D expenditure by accounting category (2009/10 to 2018/19)

TYPE OF EXPENDITURE	2009/10 R'000	2010/11 R'000	2011/12 R'000	2012/13 R'000	2013/14 R'000	2014/15 R'000	2015/16 R'000	2016/17 R'000	2017/18 R'000	2018/19 R'000
Capital expenditure	452 801	291 830	323 070	275 750	323 190	598 429	916 480	857 241	823 937	460 304
Land: buildings & other structures	107 455	56 141	65 442	68 565	71 602	362 246	162 904	211 246	386 063	62 598
Vehicles, plant, machinery, equipment	345 346	235 689	257 628	207 185	251 588	236 183	753 576	645 995	437 874	397 706
Current expenditure	3 005 273	3 304 193	3 406 610	3 750 248	3 981 366	4 406 240	4 824 418	5 278 942	5 489 407	4 983 581
Labour costs	1 413 128	1 293 033	1 531 460	2 053 204	2 187 401	1 986 918	2 142 875	2 339 348	2 421 297	2 371 273
Other current expenditure	1 592 145	2 011 160	1 875 150	1 697 044	1 793 965	2 419 322	2 681 543	2 939 594	3 068 110	2 612 308
Total	3 458 074	3 596 023	3 729 680	4 025 998	4 304 556	5 004 669	5 740 897	6 136 183	6 313 344	5 443 885

Table C.114: Proportional science councils sector R&D expenditure by accounting category (2009/10 to 2018/19)

TYPE OF EXPENDITURE	2009/10 %	2010/11 %	2011/12 %	2012/13 %	2013/14 %	2014/15 %	2015/16 %	2016/17 %	2017/18 %	2018/19 %
Capital expenditure	13.1	8.1	8.7	6.8	7.5	12.0	16.0	14.0	13.1	8.5
Land: buildings & other structures	3.1	1.6	1.8	1.7	1.7	7.2	2.8	3.4	6.1	1.1
Vehicles, plant, machinery, equipment	10.0	6.6	6.9	5.1	5.8	4.7	13.1	10.5	6.9	7.3
Current expenditure	86.9	91.9	91.3	93.2	92.5	88.0	84.0	86.0	86.9	91.5
Labour costs	40.9	36.0	41.1	51.0	50.8	39.7	37.3	38.1	38.4	43.6
Other current expenditure	46.0	55.9	50.3	42.2	41.7	48.3	46.7	47.9	48.6	48.0
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Table C.115: Science councils sector expenditure on multidisciplinary areas of R&D (2009/10 to 2018/19)

MULTI-DISCIPLINARY AREA OF R&D	2009/10 R'000	2010/11 R'000	2011/12 R'000	2012/13 R'000	2013/14 R'000	2014/15 R'000	2015/16 R'000	2016/17 R'000	2017/18 R'000	2018/19 R'000
Biotechnology	183 844	199 934	208 466	145 671	143 868	312 793	320 048	360 163	299 783	257 498
Nanotechnology	117 215	101 386	102 007	118 555	114 990	125 107	139 107	139 783	272 372	222 662
Total	301 058	301 320	310 473	264 226	258 857	437 900	459 154	499 946	572 155	480 160
Science councils expenditure on R&D	3 458 074	3 596 023	3 729 680	4 025 998	4 304 556	5 004 669	5 740 897	6 136 183	6 313 344	5 443 885

Table C.116: Proportional science councils sector expenditure on multidisciplinary areas of R&D (2009/10 to 2018/19)

MULTI-DISCIPLINARY AREA OF R&D	2009/10 %	2010/11 %	2011/12 %	2012/13 %	2013/14 %	2014/15 %	2015/16 %	2016/17 %	2017/18 %	2018/19 %
Biotechnology	5.3	5.6	5.6	3.6	3.3	6.3	5.6	5.9	4.7	4.7
Nanotechnology	3.4	2.8	2.7	2.9	2.7	2.5	2.4	2.3	4.3	4.1
Total	8.7	8.4	8.3	6.6	6.0	8.7	8.0	8.1	9.1	8.8

Table C.117: Science councils sector R&D expenditure on selected areas of interest (2009/10 to 2018/19)

AREA OF INTEREST	2009/10 R'000	2010/11 R'000	2011/12 R'000	2012/13 R'000	2013/14 R'000	2014/15 R'000	2015/16 R'000	2016/17 R'000	2017/18 R'000	2018/19 R'000
Environment related	N/A	N/A	770 339	378 782	297 097	1 037 320	1 054 651	1 031 393	953 077	831 377
Open-source software	15 013	7 228	15 982	36 636	0	389 871	692 096	453 879	842 548	107 063
New materials	94 304	201 071	197 430	751 305	229 854	358 361	374 463	373 768	401 995	329 199
Tuberculosis (TB), HIV/AIDS, malaria	333 841	386 948	399 070	455 311	398 880	346 751	470 488	625 806	670 209	572 650
Space science	N/A	N/A	N/A	N/A	N/A	N/A	N/A	296 236	0	593 920
Total	443 158	595 247	1 382 821	1 622 034	925 831	2 132 304	2 591 697	2 781 082	2 867 828	2 434 208
Science councils expenditure on R&D	**3 458 074**	**3 596 023**	**3 729 680**	**4 025 998**	**4 304 556**	**5 004 669**	**5 740 897**	**6 136 183**	**6 313 344**	**5 443 885**

N/A: Environment-related data were collected from the 2011/12 R&D Survey onwards. Space science data were collected for the first time in the 2016/17 R&D Survey.

Table C.118: Proportional science councils sector R&D expenditure on selected areas of interest (2009/10 to 2018/19)

AREA OF INTEREST	2009/10 %	2010/11 %	2011/12 %	2012/13 %	2013/14 %	2014/15 %	2015/16 %	2016/17 %	2017/18 %	2018/19 %
Environment related	N/A	N/A	20.7	9.4	6.9	20.7	18.4	16.8	15.1	15.3
Open-source software	0.4	0.2	0.4	0.9	0.0	7.8	12.1	7.4	13.3	2.0
New materials	2.7	5.6	5.3	18.7	5.3	7.2	6.5	6.1	6.4	6.0
Tuberculosis (TB), HIV/AIDS, malaria	9.7	10.8	10.7	11.3	9.3	6.9	8.2	10.2	10.6	10.5
Space science	N/A	N/A	N/A	N/A	N/A	N/A	N/A	4.8	0.0	10.9
Total	12.8	16.6	37.1	40.3	21.5	42.6	45.1	45.3	45.4	44.7

N/A: Environment-related data were collected from the 2011/12 R&D Survey onwards. Space science data were collected for the first time in the 2016/17 R&D Survey.

Table C.119: Science councils sector R&D expenditure by research field (2009/10 to 2018/19)

MAIN RESEARCH FIELD	2009/10 R'000	2010/11 R'000	2011/12 R'000	2012/13 R'000	2013/14 R'000	2014/15 R'000	2015/16 R'000	2016/17 R'000	2017/18 R'000	2018/19 R'000
Division 1: Natural Sciences, Technology and Engineering	3 258 392	3 414 985	3 517 520	3 819 642	4 109 105	4 800 742	5 486 847	5 889 463	6 112 974	5 314 694
Mathematical sciences	37 678	113 396	117 637	134 046	128 291	48 258	54 212	47 890	61 223	180 075
Physical sciences	87 221	97 922	120 267	123 267	129 568	263 302	418 648	444 274	502 615	410 797
Chemical sciences	49 462	8 074	20 972	14 078	18 166	63 775	71 024	66 188	77 952	48 685
Earth sciences	179 999	94 642	100 921	112 406	110 092	162 880	181 876	254 414	198 140	202 037

MAIN RESEARCH FIELD	2009/10 R'000	2010/11 R'000	2011/12 R'000	2012/13 R'000	2013/14 R'000	2014/15 R'000	2015/16 R'000	2016/17 R'000	2017/18 R'000	2018/19 R'000
Information, computer and communication technologies	265 191	161 282	168 115	181 521	182 402	780 044	977 891	999 538	1 124 366	852 856
Applied sciences and technologies	153 830	924 104	954 616	1 092 098	1 046 934	277 649	296 162	475 568	356 409	369 603
Engineering sciences	947 315	365 980	278 125	292 940	349 666	1 001 486	1 107 289	1 016 283	1 171 287	849 940
Biological sciences	200 625	437 938	425 036	485 673	482 728	148 268	144 341	138 673	169 717	87 630
Agricultural sciences	647 750	479 449	582 438	594 638	859 600	1 075 165	1 043 494	1 067 146	989 974	898 199
Medical and health sciences	440 895	428 642	443 156	426 520	430 472	596 600	775 858	836 967	1 021 905	984 580
Environmental sciences	112 327	273 283	284 116	330 667	326 122	228 909	240 075	343 218	267 495	212 887
Material sciences	106 411	23 199	15 462	22 905	35 093	113 457	133 231	122 130	143 684	114 491
Marine sciences	29 689	7 073	6 656	8 885	9 970	40 949	42 747	77 173	28 207	102 913
Division 2: Social Sciences and Humanities	199 682	181 038	212 160	206 356	195 452	203 927	254 050	246 721	200 370	129 191
Social sciences	182 431	164 954	190 845	186 132	173 407	179 456	223 966	239 011	192 200	123 414
Humanities	17 250	16 084	21 315	20 224	22 044	24 471	30 084	7 710	8 170	5 777
Total	3 458 074	3 596 023	3 729 680	4 025 998	4 304 556	5 004 669	5 740 897	6 136 183	6 313 344	5 443 885

Table C.120: Proportional science councils sector R&D expenditure by research field (2009/10 to 2018/19

MAIN RESEARCH FIELD	2009/10 %	2010/11 %	2011/12 %	2012/13 %	2013/14 %	2014/15 %	2015/16 %	2016/17 %	2017/18 %	2018/19 %
Division 1: Natural Sciences, Technology and Engineering	94.2	95.0	94.3	94.9	95.5	95.9	95.6	96.0	96.8	97.6
Mathematical sciences	1.1	3.2	3.2	3.3	3.0	1.0	0.9	0.8	1.0	3.3
Physical sciences	2.5	2.7	3.2	3.1	3.0	5.3	7.3	7.2	8.0	7.5
Chemical sciences	1.4	0.2	0.6	0.3	0.4	1.3	1.2	1.1	1.2	0.9
Earth sciences	5.2	2.6	2.7	2.8	2.6	3.3	3.2	4.1	3.1	3.7
Information, computer and communication technologies	7.7	4.5	4.5	4.5	4.2	15.6	17.0	16.3	17.8	15.7
Applied sciences and technologies	4.4	25.7	25.6	27.1	24.3	5.5	5.2	7.8	5.6	6.8
Engineering sciences	27.4	10.2	7.5	7.3	8.1	20.0	19.3	16.6	18.6	15.6
Biological sciences	5.8	12.2	11.4	12.1	11.2	3.0	2.5	2.3	2.7	1.6
Agricultural sciences	18.7	13.3	15.6	14.8	20.0	21.5	18.2	17.4	15.7	16.5
Medical and health sciences	12.7	11.9	11.9	10.6	10.0	11.9	13.5	13.6	16.2	18.1

MAIN RESEARCH FIELD	2009/10	2010/11	2011/12	2012/13	2013/14	2014/15	2015/16	2016/17	2017/18	2018/19
	%	%	%	%	%	%	%	%	%	%
Environmental sciences	3.2	7.6	7.6	8.2	7.6	4.6	4.2	5.6	4.2	3.9
Material sciences	3.1	0.6	0.4	0.6	0.8	2.3	2.3	2.0	2.3	2.1
Marine sciences	0.9	0.2	0.2	0.2	0.2	0.8	0.7	1.3	0.4	1.9
Division 2: Social Sciences and Humanities	5.8	5.0	5.7	5.1	4.5	4.1	4.4	4.0	3.2	2.4
Social sciences	5.3	4.6	5.1	4.6	4.0	3.6	3.9	3.9	3.0	2.3
Humanities	0.5	0.4	0.6	0.5	0.5	0.5	0.5	0.1	0.1	0.1
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Table C.121: Science councils sector R&D expenditure by socio-economic objective (2009/10 to 2018/19)

SOCIO-ECONOMIC OBJECTIVE	2009/10	2010/11	2011/12	2012/13	2013/14	2014/15	2015/16	2016/17	2017/18	2018/19
	R'000	R'000	R'000	R'000	R'000	R'000	R'000	R'000	R'000	R'000
Division 1: Defence	311 288	228 376	243 083	279 989	262 203	762 464	826 261	754 207	915 281	536 553
Defence	311 288	228 376	243 083	279 989	262 203	762 464	826 261	754 207	915 281	536 553
Division 2: Economic Development	1 834 253	2 111 033	2 191 098	2 400 747	2 686 504	2 306 795	2 529 244	2 471 163	2 625 282	2 140 026
Economic development unclassified	0	0	0	0	0	0	0	0	0	0
Plant production and plant primary products	485 470	478 437	448 531	473 133	624 675	413 737	396 612	396 536	368 829	339 896
Animal production and animal primary products	27 043	25 193	280 542	287 431	419 259	269 519	247 883	247 835	230 518	212 435
Mineral resources (excluding energy)	387 531	294 203	202 919	213 007	234 273	232 114	265 006	255 226	274 778	287 423
Energy resources	32 136	90 342	94 385	108 360	106 823	5 590	5 063	8 108	6 682	5 568
Energy supply	0	0	14 715	13 237	2 937	0	0	0	1 468	1 499
Manufacturing	262 443	366 380	351 021	400 864	393 152	88 746	146 395	170 040	179 215	138 141
Construction	129 922	222 124	220 595	256 024	245 333	31 034	60 828	67 003	70 943	65 389
Transport	45 848	0	0	0	0	0	0	0	0	0
Information and communication services	68 506	115 342	127 021	141 495	135 629	396 310	419 252	410 724	462 785	386 839
Commercial services	5 465	14 152	15 522	25 053	19 724	5 236	5 671	7 756	2 937	2 998
Economic framework	84 205	97 367	72 109	70 509	75 411	537 499	664 440	571 815	713 045	419 073
Natural resources	305 685	407 492	363 738	411 634	429 288	327 009	318 094	336 119	314 082	280 766
Division 3: Society	453 428	388 244	430 876	413 060	425 943	801 370	977 159	1 074 539	978 471	1 053 871
Society unclassified	0	0	0	0	0	0	0	0	0	0

SOCIO-ECONOMIC OBJECTIVE	2009/10 R'000	2010/11 R'000	2011/12 R'000	2012/13 R'000	2013/14 R'000	2014/15 R'000	2015/16 R'000	2016/17 R'000	2017/18 R'000	2018/19 R'000
Health	348 407	310 760	326 500	314 412	316 987	424 639	552 314	613 932	632 851	722 673
Education and training	65 761	50 676	68 852	64 941	72 216	335 946	374 704	145 215	98 348	70 575
Social development and community services	39 260	26 807	35 525	33 707	36 741	40 785	50 141	315 392	247 273	260 622
Division 4: Environment	355 484	52 334	31 241	39 169	46 559	422 650	455 404	852 597	782 034	610 761
Environment unclassified	0	0	0	0	0	0	0	0	0	0
Environmental knowledge	190 926	24 043	19 956	22 939	28 295	402 820	426 582	466 312	434 251	304 725
Environmental aspects of development	48 262	19 333	8 623	13 665	14 071	15 824	14 179	17 451	13 215	13 493
Environmental and other aspects	116 296	8 958	2 662	2 565	4 194	4 006	14 644	368 834	334 567	292 543
Division 5: Advancement of Knowledge	503 621	816 035	833 382	893 033	883 346	711 390	952 830	983 677	1 012 276	1 102 675
Advancement of knowledge unclassified	0	0	0	0	0	0	0	0	0	0
Natural sciences, technologies and engineering	381 098	674 421	694 254	760 107	746 397	422 429	620 283	692 258	708 020	723 871
Social sciences and humanities	122 523	141 614	139 127	132 926	136 949	288 961	332 547	291 419	304 256	378 804
Total	3 458 074	3 596 023	3 729 680	4 025 998	4 304 556	5 004 669	5 740 897	6 136 183	6 313 344	5 443 885

Table C.122: Proportional science councils sector R&D expenditure by socio-economic objective (2009/10 to 2018/19)

SOCIO-ECONOMIC OBJECTIVE	2009/10 %	2010/11 %	2011/12 %	2012/13 %	2013/14 %	2014/15 %	2015/16 %	2016/17 %	2017/18 %	2018/19 %
Division 1: Defence	9.0	6.4	6.5	7.0	6.1	15.2	14.4	12.3	14.5	9.9
Defence	9.0	6.4	6.5	7.0	6.1	15.2	14.4	12.3	14.5	9.9
Division 2: Economic Development	53.0	58.7	58.7	59.6	62.4	46.1	44.1	40.3	41.6	39.3
Economic development unclassified	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Plant production and plant primary products	14.0	13.3	12.0	11.8	14.5	8.3	6.9	6.5	5.8	6.2
Animal production and animal primary products	0.8	0.7	7.5	7.1	9.7	5.4	4.3	4.0	3.7	3.9

SOCIO-ECONOMIC OBJECTIVE	2009/10	2010/11	2011/12	2012/13	2013/14	2014/15	2015/16	2016/17	2017/18	2018/19
	%	%	%	%	%	%	%	%	%	%
Mineral resources (excluding energy)	11.2	8.2	5.4	5.3	5.4	4.6	4.6	4.2	4.4	5.3
Energy resources	0.9	2.5	2.5	2.7	2.5	0.1	0.1	0.1	0.1	0.1
Energy supply	0.0	0.0	0.4	0.3	0.1	0.0	0.0	0.0	0.0	0.0
Manufacturing	7.6	10.2	9.4	10.0	9.1	1.8	2.6	2.8	2.8	2.5
Construction	3.8	6.2	5.9	6.4	5.7	0.6	1.1	1.1	1.1	1.2
Transport	1.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Information and communication services	2.0	3.2	3.4	3.5	3.2	7.9	7.3	6.7	7.3	7.1
Commercial services	0.2	0.4	0.4	0.6	0.5	0.1	0.1	0.1	0.0	0.1
Economic framework	2.4	2.7	1.9	1.8	1.8	10.7	11.6	9.3	11.3	7.7
Natural resources	8.8	11.3	9.8	10.2	10.0	6.5	5.5	5.5	5.0	5.2
Division 3: Society	**13.1**	**10.8**	**11.6**	**10.3**	**9.9**	**16.0**	**17.0**	**17.5**	**15.5**	**19.4**
Society unclassified	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Health	10.1	8.6	8.8	7.8	7.4	8.5	9.6	10.0	10.0	13.3
Education and training	1.9	1.4	1.8	1.6	1.7	6.7	6.5	2.4	1.6	1.3
Social development and community services	1.1	0.7	1.0	0.8	0.9	0.8	0.9	5.1	3.9	4.8
Division 4: Environment	**10.3**	**1.5**	**0.8**	**1.0**	**1.1**	**8.4**	**7.9**	**13.9**	**12.4**	**11.2**
Environment unclassified	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Environmental knowledge	5.5	0.7	0.5	0.6	0.7	8.0	7.4	7.6	6.9	5.6
Environmental aspects of development	1.4	0.5	0.2	0.3	0.3	0.3	0.2	0.3	0.2	0.2
Environmental and other aspects	3.4	0.2	0.1	0.1	0.1	0.1	0.3	6.0	5.3	5.4
Division 5: Advancement of Knowledge	**14.6**	**22.7**	**22.3**	**22.2**	**20.5**	**14.2**	**16.6**	**16.0**	**16.0**	**20.3**
Advancement of knowledge unclassified	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Natural sciences, technologies and engineering	11.0	18.8	18.6	18.9	17.3	8.4	10.8	11.3	11.2	13.3
Social sciences and humanities	3.5	3.9	3.7	3.3	3.2	5.8	5.8	4.7	4.8	7.0
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Table C.123: Science councils sector R&D expenditure by province (2009/10 to 2018/19)

PROVINCE	2009/10	2010/11	2011/12	2012/13	2013/14	2014/15	2015/16	2016/17	2017/18	2018/19
	R'000	R'000	R'000	R'000	R'000	R'000	R'000	R'000	R'000	R'000
Eastern Cape	155 501	150 665	178 594	182 664	115 925	259 128	269 658	273 509	279 550	183 931
Free State	74 355	60 443	37 138	39 054	47 271	58 608	59 953	60 149	59 300	110 995
Gauteng	2 219 609	2 327 712	2 287 762	2 537 028	3 062 983	2 745 142	2 998 643	3 221 705	3 350 135	3 053 440
KwaZulu-Natal	235 432	249 137	292 246	307 302	239 387	484 142	575 016	477 823	540 084	427 585
Limpopo	78 662	66 250	99 104	105 150	7 286	117 270	111 649	114 852	107 457	80 249
Mpumalanga	66 881	55 690	100 476	103 468	62 349	124 613	122 432	128 883	118 267	171 535
North West	51 295	42 854	104 139	110 361	39 615	153 911	153 676	108 010	97 730	43 764
Northern Cape	35 253	64 774	81 998	78 714	122 454	148 387	218 317	223 524	236 797	601 757
Western Cape	541 086	578 497	548 223	562 256	607 285	913 468	1 231 555	1 527 729	1 524 025	770 631
Total	3 458 074	3 596 023	3 729 680	4 025 998	4 304 556	5 004 669	5 740 897	6 136 183	6 313 344	5 443 885

Table C.124: Proportional science councils sector R&D expenditure by province (2009/10 to 2018/19)

PROVINCE	2009/10	2010/11	2011/12	2012/13	2013/14	2014/15	2015/16	2016/17	2017/18	2018/19
	%	%	%	%	%	%	%	%	%	%
Eastern Cape	4.5	4.2	4.8	4.5	2.7	5.2	4.7	4.5	4.4	3.4
Free State	2.2	1.7	1.0	1.0	1.1	1.2	1.0	1.0	0.9	2.0
Gauteng	64.2	64.7	61.3	63.0	71.2	54.9	52.2	52.5	53.1	56.1
KwaZulu-Natal	6.8	6.9	7.8	7.6	5.6	9.7	10.0	7.8	8.6	7.9
Limpopo	2.3	1.8	2.7	2.6	0.2	2.3	1.9	1.9	1.7	1.5
Mpumalanga	1.9	1.5	2.7	2.6	1.4	2.5	2.1	2.1	1.9	3.2
North West	1.5	1.2	2.8	2.7	0.9	3.1	2.7	1.8	1.5	0.8
Northern Cape	1.0	1.8	2.2	2.0	2.8	3.0	3.8	3.6	3.8	11.1
Western Cape	15.6	16.1	14.7	14.0	14.1	18.3	21.5	24.9	24.1	14.2
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Table C.125: Science councils sector R&D personnel in headcounts and full-time equivalents by occupation (2009/10 to 2018/19)

YEAR	HEADCOUNTS				FULL-TME EQUIVALENTS (FTEs)			
	TOTAL	RESEARCHERS	TECHNICIANS	OTHER R&D PERSONNEL	TOTAL	RESEARCHERS	TECHNICIANS	OTHER R&D PERSONNEL
2009/10	**5 926**	2 669	1 381	1 876	**4 782.7**	2 251.5	1 179.4	1 351.8
2010/11	**4 923**	1 941	1 336	1 646	**4 312.4**	1 777.3	1 155.5	1 379.6
2011/12	**4 494**	1 803	1 333	1 358	**3 803.5**	1 634.9	1 172.4	996.1
2012/13	**5 399**	1 879	1 403	2 117	**4 748.5**	1 697.1	1 279.6	1 771.8
2013/14	**5 884**	1 956	1 396	2 532	**5 164.5**	1 781.3	1 247.3	2 136.0
2014/15	**4 836**	1 988	1 857	991	**4 180.4**	1 765.4	1 686.2	728.9
2015/16	**5 162**	2 072	1 839	1251	**4 361.2**	1 827.2	1 683.7	850.4
2016/17	**4 955**	2 189	1 818	948	**4 421.4**	1 940.5	1 676.0	804.9
2017/18	**4 866**	2 053	1 885	928	**4 294.9**	1 792.1	1 745.4	757.4
2018/19	**4 514**	1 951	1 728	835	3 941.8	1 697.0	1 579.6	665.2

Note: Headcounts include non-SA R&D personnel (from 2016/17). Non-SA personnel are classified as those that are not from South Africa but are undertaking research in South Africa for a period exceeding six months. They can be temporary or permanent residents as described by the SNA.

Table C.126: Science councils sector R&D personnel in headcounts and full-time equivalents by occupation and gender (2016/17 to 2018/19)

OCCUPATION	HEADCOUNTS			FULL-TIME EQUIVALENTS (FTEs)			
2016/17	**TOTAL**	**MALE**	**FEMALE**	**TOTAL**	**MALE**	**FEMALE**	**FTEs AS % OF HEADCOUNTS**
Researchers	**2 189**	1 235	954	**1 940.5**	1 084.8	855.7	88.6
Technicians directly supporting R&D	**1 818**	1 076	742	**1 676.0**	975.2	700.8	92.2
Other personnel directly supporting R&D	**948**	469	479	**804.9**	373.8	431.1	84.9
Total	4 955	2 780	2 175	4 421.4	2 433.8	1 987.6	89.2
2017/18	**TOTAL**	**MALE**	**FEMALE**	**TOTAL**	**MALE**	**FEMALE**	**FTEs AS % OF HEADCOUNTS**
Researchers	**2 053**	1 037	1 016	**1 792.1**	884.6	907.5	87.3
Technicians directly supporting R&D	**1 885**	1 012	873	**1 745.4**	914.1	831.3	92.6
Other personnel directly supporting R&D	**928**	623	305	**757.4**	507.6	249.8	81.6
Total	4 866	2 672	2 194	4 294.9	2 306.3	1 988.6	88.3
2018/19	**TOTAL**	**MALE**	**FEMALE**	**TOTAL**	**MALE**	**FEMALE**	**FTEs AS % OF HEADCOUNTS**
Researchers	**1 951**	1 059	892	**1 697.0**	911.9	785.1	87.0
Technicians directly supporting R&D	**1 728**	998	730	**1 579.6**	895.4	684.2	91.4
Other personnel directly supporting R&D	**835**	426	409	**665.2**	309.4	355.8	79.7
Total	4 514	2 483	2 031	3 941.8	2 116.7	1 825.1	87.3

Note: Headcounts include non-SA R&D personnel (from 2016/17). Non-SA personnel are classified as those that are not from South Africa but are undertaking research in South Africa for a period exceeding six months. They can be temporary or permanent residents as described by the SNA.

Table C.127: Science councils sector R&D personnel in headcounts by occupation, qualification, population group and gender (2018/19)

OCCUPATION AND QUALIFICATION	TOTAL	SUBTOTAL		AFRICAN		COLOURED		INDIAN/ASIAN		WHITE		NON-SA	
		MALE	FEMALE	MALE	FEMALE	MALE	FEMALE	MALE	FEMALE	MALE	FEMALE	MALE	FEMALE
Researchers	1 951	1 059	892	366	368	52	63	73	99	399	293	169	69
Doctoral degree or equivalent	881	520	361	131	94	21	29	28	39	205	153	135	46
Master's, honours, bachelor or equivalent	1 013	503	510	225	261	24	34	45	57	176	135	33	23
Diplomas	57	36	21	10	13	7	0	0	3	18	5	1	0
Technicians directly supporting R&D	1 728	998	730	561	466	83	42	48	72	284	141	22	9
Doctoral degree or equivalent	57	45	12	5	3	0	0	3	2	33	5	4	2
Master's, honours, bachelor or equivalent	963	507	456	271	289	32	22	39	61	149	78	16	6
Diplomas	708	446	262	285	174	51	20	6	9	102	58	2	1
Other personnel directly supporting R&D	835	426	409	292	242	48	69	29	29	44	57	13	12
Doctoral degree or equivalent	16	11	5	6	2	2	0	0	2	3	0	0	1
Master's, honours, bachelor or equivalent	394	170	224	108	154	17	12	15	19	22	35	8	4
Diplomas	425	245	180	178	86	29	57	14	8	19	22	5	7
Total	4 514	2 483	2 031	1 219	1 076	183	174	150	200	727	491	204	90

Note: Headcounts include non-SA R&D personnel (from 2016/17). Non-SA personnel are classified as those that are not from South Africa but are undertaking research in South Africa for a period exceeding six months. They can be temporary or permanent residents as described by the SNA.

Table C.128: Science councils sector overview (2017/18 and 2018/19)

SCIENCE COUNCILS	2017/18				2018/19			
	R&D EXPENDITURE	RESEARCHERS	BASIC RESEARCH	CAPITAL EXPENDITURE	R&D EXPENDITURE	RESEARCHERS	BASIC RESEARCH	CAPITAL EXPENDITURE
	R'000	FTEs	R'000	R'000	R'000	FTEs	R'000	R'000
Agricultural Research Council	922 073	482.0	184 415	89 370	849 740	470.0	169 948	65 114
Council for Scientific and Industrial Research	2 597 076	576.3	132 191	108 080	2 027 427	516.0	86 368	40 172
Council for Geoscience	146 839	97.8	22 026	29 375	149 921	97.8	22 488	30 701
Human Science Research Council	408 490	156.8	61 273	5 887	288 853	146.0	43 328	1 918
Medical Research Council	853 621	204.0	512 173	18 454	894 054	202.0	536 432	23 822
Mintek	363 281	150.4	72 656	51 466	380 458	150.4	76 092	53 900
National Research Foundation	1 021 965	124.8	365 213	521 305	853 433	114.8	309 597	244 677
Total	6 313 344	1 792	1 349 946	823 937	5 443 885	1 697	1 244 253	460 304

C.2.5. Higher education sector

Table C.129: Higher education sector R&D expenditure by type of research (2009/10 to 2018/19)

TYPE OF RESEARCH	2009/10	2010/11	2011/12	2012/13	2013/14	2014/15	2015/16	2016/17	2017/18	2018/19
	R'000	R'000	R'000	R'000	R'000	R'000	R'000	R'000	R'000	R'000
Basic research	2 459 733	2 634 722	3 290 328	3 843 906	3 785 149	4 601 453	5 395 693	6 679 585	7 243 562	7 463 879
Applied research	1 729 496	1 890 185	2 279 175	2 390 090	2 412 316	2 649 558	3 176 685	3 466 381	4 264 753	4 303 881
Experimental development research	911 994	899 695	1 039 712	1 099 157	1 095 388	1 126 565	1 304 245	1 513 291	1 501 561	1 415 358
Total	5 101 224	5 424 602	6 609 216	7 333 153	7 292 853	8 377 575	9 876 623	11 659 258	13 009 876	13 183 119

Table C.130: Proportional higher education sector R&D expenditure by type of research (2009/10 to 2018/19)

TYPE OF RESEARCH	2009/10	2010/11	2011/12	2012/13	2013/14	2014/15	2015/16	2016/17	2017/18	2018/19
	%	%	%	%	%	%	%	%	%	%
Basic research	48.2	48.6	49.8	52.4	51.9	54.9	54.6	57.3	55.7	56.6
Applied research	33.9	34.8	34.5	32.6	33.1	31.6	32.2	29.7	32.8	32.6
Experimental development research	17.9	16.6	15.7	15.0	15.0	13.4	13.2	13.0	11.5	10.7
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Table C.131: Higher education sector R&D expenditure by accounting category (2009/10 to 2018/19)

TYPE OF EXPENDITURE	2009/10 R'000	2010/11 R'000	2011/12 R'000	2012/13 R'000	2013/14 R'000	2014/15 R'000	2015/16 R'000	2016/17 R'000	2017/18 R'000	2018/19 R'000
Capital expenditure	376 057	393 758	564 179	602 116	706 336	779 789	1 141 349	1 092 704	1 386 695	683 592
Land: buildings & other structures	97 533	146 602	137 530	192 324	256 114	200 253	198 032	616 761	874 171	257 899
Vehicles, plant, machinery, equipment	278 524	247 156	426 649	409 792	450 222	579 536	943 317	475 943	512 524	425 693
Current expenditure	4 725 167	5 030 844	6 045 037	6 731 037	6 586 517	7 597 786	8 735 274	10 566 554	11 623 181	12 499 527
Labour costs	1 710 183	1 883 176	2 481 322	2 996 929	3 248 542	3 539 733	3 576 140	4 315 989	5 080 369	5 579 653
Total cost of R&D postgraduate students	581 140	756 930	1 074 207	1 186 653	1 224 611	1 579 088	1 926 301	1 928 108	1 889 065	1 938 984
Other current expenditure*	2 433 844	2 390 738	2 489 508	2 547 455	2 113 364	2 478 965	3 232 833	4 322 457	4 653 747	4 980 889
Total	5 101 224	5 424 602	6 609 216	7 333 153	7 292 853	8 377 575	9 876 623	11 659 258	13 009 876	13 183 119

*Includes specific categories of R&D personnel costs (from 2016/17).

Table C.132: Proportional higher education sector R&D expenditure by accounting category (2009/10 to 2018/19)

TYPE OF EXPENDITURE	2009/10 %	2010/11 %	2011/12 %	2012/13 %	2013/14 %	2014/15 %	2015/16 %	2016/17 %	2017/18 %	2018/19 %
Capital expenditure	7.4	7.3	8.5	8.2	9.7	9.3	11.6	9.4	10.7	5.2
Land: buildings & other structures	1.9	2.7	2.1	2.6	3.5	2.4	2.0	5.3	6.7	2.0
Vehicles, plant, machinery, equipment	5.5	4.6	6.5	5.6	6.2	6.9	9.6	4.1	3.9	3.2
Current expenditure	92.6	92.7	91.5	91.8	90.3	90.7	88.4	90.6	89.3	94.8
Labour costs	33.5	34.7	37.5	40.9	44.5	42.3	36.2	37.0	39.1	42.3
Total cost of R&D postgraduate students	11.4	14.0	16.3	16.2	16.8	18.8	19.5	16.5	14.5	14.7
Other current expenditure*	47.7	44.1	37.7	34.7	29.0	29.6	32.7	37.1	35.8	37.8
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

*Includes specific categories of R&D personnel costs (from 2016/17).

Table C.133: Higher education sector expenditure on multidisciplinary areas of R&D (2009/10 to 2018/19)

MULTI-DISCIPLINARY AREA OF R&D	2009/10 R'000	2010/11 R'000	2011/12 R'000	2012/13 R'000	2013/14 R'000	2014/15 R'000	2015/16 R'000	2016/17 R'000	2017/18 R'000	2018/19 R'000
Biotechnology	366 900	381 225	344 039	380 727	406 285	470 837	553 562	531 958	529 948	552 583
Nanotechnology	156 176	204 802	317 649	293 300	356 826	393 137	505 380	431 558	319 610	420 500
Total	523 076	586 027	661 688	674 028	763 111	863 974	1 058 942	963 516	849 558	973 083
Higher Education expenditure on R&D	**5 101 224**	**5 424 602**	**6 609 216**	**7 333 153**	**7 292 853**	**8 377 575**	**9 876 623**	**11 659 258**	**13 009 876**	**13 183 119**

Note: Data on these multidisciplinary areas of R&D were collected for the first time in the 2005/06 R&D survey.

Table C.134: Proportional higher education sector expenditure on multidisciplinary areas of R&D (2009/10 to 2018/19)

MULTI-DISCIPLINARY AREA OF R&D	2009/10 %	2010/11 %	2011/12 %	2012/13 %	2013/14 %	2014/15 %	2015/16 %	2016/17 %	2017/18 %	2018/19 %
Biotechnology	7.2	7.0	5.2	5.2	5.6	5.6	5.6	4.6	4.1	4.2
Nanotechnology	3.1	3.8	4.8	4.0	4.9	4.7	5.1	3.7	2.5	3.2
Total	10.3	10.8	10.0	9.2	10.5	10.3	10.7	8.3	6.5	7.4

Table C.135: Higher education sector R&D expenditure on selected areas of interest (2009/10 to 2018/19)

AREA OF INTEREST	2009/10 R'000	2010/11 R'000	2011/12 R'000	2012/13 R'000	2013/14 R'000	2014/15 R'000	2015/16 R'000	2016/17 R'000	2017/18 R'000	2018/19 R'000
Environment related	N/A	N/A	770 339	300 006	340 386	499 958	583 723	883 069	1 112 755	1 369 351
Open-source software	58 643	75 195	15 982	85 508	105 008	117 646	125 883	164 097	196 300	202 026
New materials	283 711	266 419	197 430	321 744	381 136	436 975	462 962	449 336	252 340	355 152
Tuberculosis (TB), HIV/AIDS, malaria	815 431	845 216	399 070	714 966	794 810	845 245	944 490	1 082 645	1 308 224	1 374 952
Space science	N/A	N/A	N/A	N/A	N/A	N/A	N/A	264 712	258 472	247 276
Total	1 157 785	1 186 830	1 382 821	1 422 224	1 621 339	1 899 823	2 117 058	2 843 859	3 128 090	3 548 757
Higher Education expenditure on R&D	**5 101 224**	**5 424 602**	**6 609 216**	**7 333 153**	**7 292 853**	**8 377 575**	**9 876 623**	**11 659 258**	**13 009 876**	**13 183 119**

N/A: Environment-related data were collected from the 2011/12 R&D Survey onwards. Space science data were collected for the first time in the 2016/17 R&D Survey.

Table C.136: Proportional higher education sector R&D expenditure on selected areas of interest (2009/10 to 2018/19)

AREA OF INTEREST	2009/10 %	2010/11 %	2011/12 %	2012/13 %	2013/14 %	2014/15 %	2015/16 %	2016/17 %	2017/18 %	2018/19 %
Environment related	N/A	N/A	11.7	4.1	4.7	6.0	5.9	7.6	8.6	10.4
Open-source software	1.1	1.4	0.2	1.2	1.4	1.4	1.3	1.4	1.5	1.5
New materials	5.6	4.9	3.0	4.4	5.2	5.2	4.7	3.9	1.9	2.7
Tuberculosis (TB), HIV/AIDS, malaria	16.0	15.6	6.0	9.7	10.9	10.1	9.6	9.3	10.1	10.4
Space science	N/A	N/A	N/A	N/A	N/A	N/A	N/A	2.3	2.0	1.9
Total	22.7	21.9	20.9	19.4	22.2	22.7	21.4	24.4	24.0	26.9

N/A: Environment-related data were collected from the 2011/12 R&D Survey onwards. Space science data were collected for the first time in the 2016/17 R&D Survey.

Table C.137: Higher education sector R&D expenditure by research field (2009/10 to 2018/19)

MAIN RESEARCH FIELD	2009/10 R'000	2010/11 R'000	2011/12 R'000	2012/13 R'000	2013/14 R'000	2014/15 R'000	2015/16 R'000	2016/17 R'000	2017/18 R'000	2018/19 R'000
Division 1: Natural Sciences, Technology and Engineering	3 374 024	3 558 265	4 486 057	5 045 892	4 925 713	5 704 150	6 340 905	6 976 302	7 941 477	7 580 936
Mathematical sciences	168 689	283 942	311 572	342 093	278 183	333 587	458 068	512 534	614 391	540 054
Physical sciences	352 628	175 110	189 341	193 849	198 735	230 826	287 830	356 090	427 400	376 229
Chemical sciences	161 856	158 775	317 389	444 258	286 511	326 992	386 300	472 883	362 105	452 369
Earth sciences	84 777	157 781	174 141	190 744	207 261	260 862	271 814	327 638	349 553	356 360

MAIN RESEARCH FIELD	2009/10 R'000	2010/11 R'000	2011/12 R'000	2012/13 R'000	2013/14 R'000	2014/15 R'000	2015/16 R'000	2016/17 R'000	2017/18 R'000	2018/19 R'000
Information, computer and communication technologies	121 750	112 985	186 870	232 090	192 911	245 257	322 406	378 763	295 577	487 825
Applied sciences and technologies	306 195	90 761	245 611	251 278	280 310	274 283	272 429	139 046	76 434	155 627
Engineering sciences	305 953	461 980	741 462	768 810	855 529	918 494	891 532	926 463	907 241	1 082 308
Biological sciences	349 343	593 219	610 408	731 389	721 229	825 432	846 897	788 716	912 256	1 020 774
Agricultural sciences	179 309	205 311	268 834	276 857	311 355	354 949	326 296	440 433	644 885	535 299
Medical and health sciences	1 195 597	1 226 127	1 245 284	1 391 838	1 339 755	1 641 683	2 089 591	2 412 996	2 554 061	2 409 084
Environmental sciences	52 431	60 458	111 612	147 367	166 493	180 324	79 430	128 784	760 600	110 409
Material sciences	76 732	26 629	81 749	68 849	82 479	100 358	93 871	67 707	6 751	12 407
Marine sciences	18 764	5 186	1 783	6 469	4 961	11 105	14 441	24 249	30 223	42 192
Division 2: Social Sciences and Humanities	1 727 200	1 866 337	2 123 159	2 287 261	2 367 140	2 673 425	3 535 718	4 682 956	5 068 399	5 602 183
Social sciences	1 273 479	1 433 610	1 664 653	1 844 744	1 825 026	2 056 555	2 855 673	3 770 136	4 209 945	4 668 015
Humanities	453 721	432 727	458 505	442 517	542 114	616 870	680 046	912 820	858 454	934 167
Total	5 101 224	5 424 602	6 609 216	7 333 153	7 292 853	8 377 575	9 876 623	11 659 258	13 009 876	13 183 119

Table C.138: Proportional higher education sector R&D expenditure by research field (2009/10 to 2018/19)

MAIN RESEARCH FIELD	2009/10 %	2010/11 %	2011/12 %	2012/13 %	2013/14 %	2014/15 %	2015/16 %	2016/17 %	2017/18 %	2018/19 %
Division 1: Natural Sciences, Technology and Engineering	66.1	65.6	67.9	68.8	67.5	68.1	64.2	59.8	61.0	57.5
Mathematical sciences	3.3	5.2	4.7	4.7	3.8	4.0	4.6	4.4	4.7	4.1
Physical sciences	6.9	3.2	2.9	2.6	2.7	2.8	2.9	3.1	3.3	2.9
Chemical sciences	3.2	2.9	4.8	6.1	3.9	3.9	3.9	4.1	2.8	3.4
Earth sciences	1.7	2.9	2.6	2.6	2.8	3.1	2.8	2.8	2.7	2.7
Information, computer and communication technologies	2.4	2.1	2.8	3.2	2.6	2.9	3.3	3.2	2.3	3.7
Applied sciences and technologies	6.0	1.7	3.7	3.4	3.8	3.3	2.8	1.2	0.6	1.2
Engineering sciences	6.0	8.5	11.2	10.5	11.7	11.0	9.0	7.9	7.0	8.2
Biological sciences	6.8	10.9	9.2	10.0	9.9	9.9	8.6	6.8	7.0	7.7
Agricultural sciences	3.5	3.8	4.1	3.8	4.3	4.2	3.3	3.8	5.0	4.1
Medical and health sciences	23.4	22.6	18.8	19.0	18.4	19.6	21.2	20.7	19.6	18.3

MAIN RESEARCH FIELD	2009/10	2010/11	2011/12	2012/13	2013/14	2014/15	2015/16	2016/17	2017/18	2018/19
	%	%	%	%	%	%	%	%	%	%
Environmental sciences	1.0	1.1	1.7	2.0	2.3	2.2	0.8	1.1	5.8	0.8
Material sciences	1.5	0.5	1.2	0.9	1.1	1.2	1.0	0.6	0.1	0.1
Marine sciences	0.4	0.1	0.0	0.1	0.1	0.1	0.1	0.2	0.2	0.3
Division 2: Social Sciences and Humanities	33.9	34.4	32.1	31.2	32.5	31.9	35.8	40.2	39.0	42.5
Social sciences	25.0	26.4	25.2	25.2	25.0	24.5	28.9	32.3	32.4	35.4
Humanities	8.9	8.0	6.9	6.0	7.4	7.4	6.9	7.8	6.6	7.1
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Table C.139: Higher education sector R&D expenditure by socio-economic objective (2009/10 to 2018/19)

SOCIO-ECONOMIC OBJECTIVE	2009/10	2010/11	2011/12	2012/13	2013/14	2014/15	2015/16	2016/17	2017/18	2018/19
	R'000	R'000	R'000	R'000	R'000	R'000	R'000	R'000	R'000	R'000
Division 1: Defence	3 620	7 271	10 211	12 009	6 121	7 266	8 330	10 899	13 792	12 592
Defence	3 620	7 271	10 211	12 009	6 121	7 266	8 330	10 899	13 792	12 592
Division 2: Economic Development	1 738 239	1 542 453	2 072 624	1 996 497	2 547 254	2 472 831	2 850 018	3 375 098	4 044 376	4 344 693
Economic development unclassified	0	0	0	0	0	0	0	0	0	0
Plant production and plant primary products	178 033	188 513	277 764	234 309	534 417	220 024	282 188	358 551	551 241	473 094
Animal production and animal primary products	130 828	128 705	151 334	176 645	173 865	190 421	199 545	288 114	390 549	341 481
Mineral resources (excluding energy)	83 294	99 966	129 185	69 062	129 459	127 236	131 141	115 367	157 215	161 069
Energy resources	81 689	88 657	87 659	92 947	82 011	75 367	84 862	68 184	98 739	100 429
Energy supply	107 759	144 462	157 304	162 879	221 160	233 075	237 993	225 645	247 610	289 618
Manufacturing	297 303	245 037	272 287	348 845	340 630	329 083	380 258	444 203	478 631	557 911
Construction	23 858	73 340	116 141	74 322	79 775	96 642	111 437	177 750	223 367	257 483
Transport	30 456	24 045	53 043	31 830	32 503	38 549	47 577	72 250	101 938	47 056
Information and communication services	110 589	93 281	144 313	101 980	139 305	152 987	232 257	191 378	240 992	351 560
Commercial services	282 078	54 659	106 287	111 587	156 001	124 971	125 771	182 456	199 639	262 863
Economic framework	206 625	217 501	302 693	335 217	363 483	493 154	544 118	612 373	703 369	968 057
Natural resources	205 728	184 287	274 612	256 874	294 645	391 322	472 871	638 827	651 085	534 072
Division 3: Society	1 177 651	1 393 700	1 583 800	1 865 914	1 569 371	2 180 662	2 820 755	3 266 113	3 540 172	2 988 330
Society unclassified	0	0	0	0	0	0	0	0	0	0

SOCIO-ECONOMIC OBJECTIVE	2009/10 R'000	2010/11 R'000	2011/12 R'000	2012/13 R'000	2013/14 R'000	2014/15 R'000	2015/16 R'000	2016/17 R'000	2017/18 R'000	2018/19 R'000
Health	701 007	776 688	686 152	1 150 349	654 525	1 074 951	1 375 861	1 652 001	1 730 300	1 273 726
Education and training	187 291	294 482	359 897	402 285	547 108	739 611	925 245	912 877	1 041 714	1 057 301
Social development and community services	289 353	322 530	537 752	313 280	367 738	366 099	519 649	701 234	768 158	657 303
Division 4: Environment	346 483	377 151	509 533	554 758	456 619	629 133	614 011	737 262	780 436	1 070 418
Environment unclassified	0	0	0	0	0	0	0	0	0	0
Environmental knowledge	170 901	188 250	230 135	232 440	184 169	269 688	246 804	331 243	341 909	469 090
Environmental aspects of development	92 353	86 295	123 344	168 956	154 462	202 787	212 879	233 609	233 947	317 976
Environmental and other aspects	83 229	102 606	156 054	153 362	117 989	156 658	154 328	172 411	204 580	283 352
Division 5: Advancement of Knowledge	1 835 231	2 104 026	2 433 048	2 903 975	2 713 487	3 087 684	3 583 508	4 269 886	4 631 099	4 767 086
Advancement of knowledge unclassified	0	0	0	0	0	0	0	0	0	0
Natural sciences, technologies and engineering	969 079	1 263 802	1 443 913	1 731 540	1 633 257	2 006 195	2 262 831	2 887 227	3 269 179	3 373 533
Social sciences and humanities	866 152	840 223	989 135	1 172 435	1 080 231	1 081 488	1 320 677	1 382 659	1 361 920	1 393 552
Total	5 101 224	5 424 602	6 609 216	7 333 153	7 292 853	8 377 575	9 876 623	11 659 258	13 009 876	13 183 119

Table C.140: Proportional higher education sector R&D expenditure by socio-economic objective (2009/10 to 2018/19)

SOCIO-ECONOMIC OBJECTIVE	2009/10 %	2010/11 %	2011/12 %	2012/13 %	2013/14 %	2014/15 %	2015/16 %	2016/17 %	2017/18 %	2018/19 %
Division 1: Defence	0.1	0.1	0.2	0.2	0.1	0.1	0.1	0.1	0.1	0.1
Defence	0.1	0.1	0.2	0.2	0.1	0.1	0.1	0.1	0.1	0.1
Division 2: Economic Development	34.1	28.4	31.4	27.2	34.9	29.5	28.9	28.9	31.1	33.0
Economic development unclassified	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Plant production and plant primary products	3.5	3.5	4.2	3.2	7.3	2.6	2.9	3.1	4.2	3.6
Animal production and animal primary products	2.6	2.4	2.3	2.4	2.4	2.3	2.0	2.5	3.0	2.6

SOCIO-ECONOMIC OBJECTIVE	2009/10	2010/11	2011/12	2012/13	2013/14	2014/15	2015/16	2016/17	2017/18	2018/19
	%	%	%	%	%	%	%	%	%	%
Mineral resources (excluding energy)	1.6	1.8	2.0	0.9	1.8	1.5	1.3	1.0	1.2	1.2
Energy resources	1.6	1.6	1.3	1.3	1.1	0.9	0.9	0.6	0.8	0.8
Energy supply	2.1	2.7	2.4	2.2	3.0	2.8	2.4	1.9	1.9	2.2
Manufacturing	5.8	4.5	4.1	4.8	4.7	3.9	3.9	3.8	3.7	4.2
Construction	0.5	1.4	1.8	1.0	1.1	1.2	1.1	1.5	1.7	2.0
Transport	0.6	0.4	0.8	0.4	0.4	0.5	0.5	0.6	0.8	0.4
Information and communication services	2.2	1.7	2.2	1.4	1.9	1.8	2.4	1.6	1.9	2.7
Commercial services	5.5	1.0	1.6	1.5	2.1	1.5	1.3	1.6	1.5	2.0
Economic framework	4.1	4.0	4.6	4.6	5.0	5.9	5.5	5.3	5.4	7.3
Natural resources	4.0	3.4	4.2	3.5	4.0	4.7	4.8	5.5	5.0	4.1
Division 3: Society	23.1	25.7	24.0	25.4	21.5	26.0	28.6	28.0	27.2	22.7
Society unclassified	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Health	13.7	14.3	10.4	15.7	9.0	12.8	13.9	14.2	13.3	9.7
Education and training	3.7	5.4	5.4	5.5	7.5	8.8	9.4	7.8	8.0	8.0
Social development and community services	5.7	5.9	8.1	4.3	5.0	4.4	5.3	6.0	5.9	5.0
Division 4: Environment	6.8	7.0	7.7	7.6	6.3	7.5	6.2	6.3	6.0	8.1
Environment unclassified	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Environmental knowledge	3.4	3.5	3.5	3.2	2.5	3.2	2.5	2.8	2.6	3.6
Environmental aspects of development	1.8	1.6	1.9	2.3	2.1	2.4	2.2	2.0	1.8	2.4
Environmental and other aspects	1.6	1.9	2.4	2.1	1.6	1.9	1.6	1.5	1.6	2.1
Division 5: Advancement of Knowledge	36.0	38.8	36.8	39.6	37.2	36.9	36.3	36.6	35.6	36.2
Advancement of knowledge unclassified	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Natural sciences, technologies and engineering	19.0	23.3	21.8	23.6	22.4	23.9	22.9	24.8	25.1	25.6
Social sciences and humanities	17.0	15.5	15.0	16.0	14.8	12.9	13.4	11.9	10.5	10.6
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Table C.141: Higher education sector R&D expenditure by province (2009/10 to 2018/19)

PROVINCE	2009/10	2010/11	2011/12	2012/13	2013/14	2014/15	2015/16	2016/17	2017/18	2018/19
	R'000	R'000	R'000	R'000	R'000	R'000	R'000	R'000	R'000	R'000
Eastern Cape	536 792	556 496	608 815	592 861	557 292	612 239	975 099	1 002 978	1 017 383	1 027 996
Free State	246 298	281 889	323 335	356 177	449 852	491 203	523 782	625 646	894 118	803 727
Gauteng	1 537 166	1 600 783	2 028 145	2 118 817	2 233 696	2 733 330	3 305 576	4 105 237	4 269 020	3 730 236
KwaZulu-Natal	662 518	677 740	902 386	1 137 258	750 507	843 111	903 664	1 157 722	1 428 653	1 646 915
Limpopo	147 397	224 603	349 559	300 435	187 317	216 352	229 364	301 809	358 543	384 346
Mpumalanga	88 680	119 231	170 966	182 192	147 134	174 657	190 716	148 981	155 430	170 553
North West	190 570	184 514	275 088	311 325	405 963	404 575	444 135	469 171	449 196	833 635
Northern Cape	92 062	107 581	148 425	164 483	161 603	146 769	164 487	188 515	180 632	161 714
Western Cape	1 599 741	1 671 766	1 802 496	2 169 606	2 399 489	2 755 339	3 139 800	3 659 198	4 256 902	4 423 997
Total	5 101 224	5 424 602	6 609 216	7 333 153	7 292 853	8 377 575	9 876 623	11 659 258	13 009 876	13 183 119

Table C.142: Proportional higher education sector R&D expenditure by province (2009/10 to 2018/19

PROVINCE	2009/10	2010/11	2011/12	2012/13	2013/14	2014/15	2015/16	2016/17	2017/18	2018/19
	%	%	%	%	%	%	%	%	%	%
Eastern Cape	10.5	10.3	9.2	8.1	7.6	7.3	9.9	8.6	7.8	7.8
Free State	4.8	5.2	4.9	4.9	6.2	5.9	5.3	5.4	6.9	6.1
Gauteng	30.1	29.5	30.7	28.9	30.6	32.6	33.5	35.2	32.8	28.3
KwaZulu-Natal	13.0	12.5	13.7	15.5	10.3	10.1	9.1	9.9	11.0	12.5
Limpopo	2.9	4.1	5.3	4.1	2.6	2.6	2.3	2.6	2.8	2.9
Mpumalanga	1.7	2.2	2.6	2.5	2.0	2.1	1.9	1.3	1.2	1.3
North West	3.7	3.4	4.2	4.2	5.6	4.8	4.5	4.0	3.5	6.3
Northern Cape	1.8	2.0	2.2	2.2	2.2	1.8	1.7	1.6	1.4	1.2
Western Cape	31.4	30.8	27.3	29.6	32.9	32.9	31.8	31.4	32.7	33.6
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Table C.143: Higher education sector R&D personnel in headcounts and full-time equivalents by occupation (2009/10 to 2018/19)

YEAR	HEADCOUNTS				FULL-TIME EQUIVALENTS (FTEs)			
	TOTAL	RESEARCHERS*	TECHNICIANS	OTHER R&D PERSONNEL	TOTAL	RESEARCHERS*	TECHNICIANS	OTHER R&D PERSONNEL
2009/10	**20 850**	17 010	2 115	1 725	**5 018.0**	3 761.8	579.8	676.4
2010/11	**19 970**	15 553	2 123	2 294	**5 023.0**	3 613.7	534.9	874.5
2011/12	**21 458**	16 294	2 344	2 820	**6 091.2**	4 355.3	673.4	1 062.5
2012/13	**22 691**	17 441	2 344	2 906	**6 571.5**	4 700.6	737.3	1 133.5
2013/14	**23 543**	18 212	2 284	3 047	**7 005.7**	5 000.5	843.7	1 161.5
2014/15	**24 701**	18 625	2 496	3 580	**7 237.8**	5 097.7	857.3	1 282.8
2015/16	**25 612**	19 217	2 616	3 779	**7 147.1**	4 701.9	1 000.3	1 445.0
2016/17	**28 658**	22 302	2 227	4 129	**7 652.9**	5 220.4	804.2	1 628.3
2017/18	**31 467**	24 942	2 484	4 041	**8 459.4**	6 040.6	838.0	1 580.8
2018/19	**31 230**	24 618	2 272	4 340	**8 873.3**	6 007.2	924.5	1 941.6

Note: Headcounts include non-SA R&D personnel (from 2016/17). Non-SA personnel are classified as those that are not from South Africa but are undertaking research in South Africa for a period exceeding six months. They can be temporary or permanent residents as described by the SNA.

Table C.144: Higher education sector R&D personnel (*including and **excluding doctoral students and post-doctoral fellows) in headcounts and full-time equivalents by occupation and gender (2016/17, 2017/18 and 2018/19)

OCCUPATION	HEADCOUNTS			FULL-TIME EQUIVALENTS (FTEs)			
2016/17	**TOTAL**	**MALE**	**FEMALE**	**TOTAL**	**MALE**	**FEMALE**	**FTEs AS % OF HEADCOUNTS**
Researchers*	**46 028**	24 903	21 125	**19 628.8**	10 809.5	8 819.3	42.6
Technicians directly supporting R&D	**2 227**	1 237	990	**804.2**	497.1	307.1	36.1
Other personnel directly supporting R&D	**4 129**	1 338	2 791	**1 628.3**	519.3	1 109.0	39.4
Total	52 384	27 478	24 906	22 061.4	11 826.0	10 235.4	42.1
Researchers**	**22 302**	11 690	10 612	**5 220.4**	2 786.6	2 433.7	23.4
Technicians directly supporting R&D	**2 227**	1 237	990	**804.2**	497.1	307.1	36.1
Other personnel directly supporting R&D	**4 129**	1 338	2 791	**1 628.3**	519.3	1 109.0	39.4
Total	28 658	14 265	14 393	7 652.9	3 803.1	3 849.8	26.7
2017/18	**TOTAL**	**MALE**	**FEMALE**	**TOTAL**	**MALE**	**FEMALE**	**FTEs AS % OF HEADCOUNTS**
Researchers*	**50 549**	27 577	22 972	**20 996.2**	11 687.1	9 309.2	41.5
Technicians directly supporting R&D	**2 484**	1 352	1 132	**838.0**	514.6	323.4	33.7
Other personnel directly supporting R&D	**4 041**	1 341	2 700	**1 580.8**	501.1	1 079.7	39.1
Total	57 074	30 270	26 804	23 415.1	12 702.8	10 712.3	41.0
Researchers**	**24 942**	13 311	11 631	**6 040.6**	3 291.4	2 749.2	24.2
Technicians directly supporting R&D	**2 484**	1 352	1 132	**838.0**	514.6	323.4	33.7
Other personnel directly supporting R&D	**4 041**	1 341	2 700	**1 580.8**	501.1	1 079.7	39.1
Total	31 467	16 004	15 463	8 459.4	4 307.1	4 152.3	26.9
2018/19	**TOTAL**	**MALE**	**FEMALE**	**TOTAL**	**MALE**	**FEMALE**	**FTEs AS % OF HEADCOUNTS**
Researchers*	**51 187**	27 461	23 726	**21 590.6**	11 937.5	9 653.1	42.2
Technicians directly supporting R&D	**2 272**	1 307	965	**924.5**	569.9	354.7	40.7
Other personnel directly supporting R&D	**4 340**	1 469	2 871	**1 941.6**	615.5	1 326.2	44.7
Total	57 799	30 237	27 562	24 456.8	13 122.8	11 334.0	42.3
Researchers**	**24 618**	12 812	11 806	**6 007.2**	3 206.1	2 801.1	24.4
Technicians directly supporting R&D	**2 272**	1 307	965	**924.5**	569.9	354.7	40.7
Other personnel directly supporting R&D	**4 340**	1 469	2 871	**1 941.6**	615.5	1 326.2	44.7
Total	31 230	15 588	15 642	8 873.3	4 391.4	4 481.9	28.4

*Includes doctoral students and post-doctoral fellows. Also includes specific categories of R&D personnel (from 2016/17).
**Excluding doctoral and post-doctoral students. Also includes specific categories of R&D personnel (from 2016/17).
Note: Headcounts include non-SA R&D personnel (from 2016/17). Non-SA personnel are classified as those that are not from South Africa but are undertaking research in South Africa for a period exceeding six months. They can be temporary or permanent residents as described by the SNA.

Table C.145: Higher education sector R&D personnel in headcounts by occupation and gender, and full-time equivalents by occupation (2016/17 to 2018/19)

OCCUPATION	HEADCOUNTS			FULL-TIME EQUIVALENTS (FTEs)	
2016/17	**TOTAL**	**MALE**	**FEMALE**	**TOTAL**	**FTEs AS % OF HEADCOUNTS**
Researchers*	**22 302**	11 690	10 612	**5 220.4**	23.4
Technicians directly supporting R&D	**2 227**	1 237	990	**804.2**	36.1
Other personnel directly supporting R&D	**4 129**	1 338	2 791	**1 628.3**	39.4
Total	28 658	14 265	14 393	7 652.9	26.7
2017/18	**TOTAL**	**MALE**	**FEMALE**	**TOTAL**	**FTEs AS % OF HEADCOUNTS**
Researchers*	**24 942**	13 311	11 631	**6 040.6**	24.2
Technicians directly supporting R&D	**2 484**	1 352	1 132	**838.0**	33.7
Other personnel directly supporting R&D	**4 041**	1 341	2 700	**1 580.8**	39.1
Total	31 467	16 004	15 463	8 459	26.9
2018/19	**TOTAL**	**MALE**	**FEMALE**	**TOTAL**	**FTEs AS % OF HEADCOUNTS**
Researchers*	**24 618**	12 812	11 806	**6 007.2**	24.4
Technicians directly supporting R&D	**2 272**	1 307	965	**924.5**	40.7
Other personnel directly supporting R&D	**4 340**	1 469	2 871	**1 941.6**	44.7
Total	31 230	15 588	15 642	8 873.3	28.4

*Excludes doctoral students and post-doctoral fellows. Includes specific categories of R&D personnel.

Note: Headcounts include non-SA R&D personnel (from 2016/17). Non-SA personnel are classified as those that are not from South Africa but are undertaking research in South Africa for a period exceeding six months. They can be temporary or permanent residents as described by the SNA.

Table C.146: Higher education sector R&D postgraduates in headcounts by qualification and gender, and full-time equivalents by qualification (2016/17 to 2018/19)

OCCUPATION	HEADCOUNTS			FULL-TIME EQUIVALENTS (FTEs)	
2016/17	**TOTAL**	**MALE**	**FEMALE**	**TOTAL**	**FTEs AS % OF HEADCOUNTS**
Post-doctoral fellows	**2 471**	1 404	1 067	**2 335.8**	94.5
Doctoral students	**21 255**	11 809	9 446	**12 072.7**	56.8
Master's students (full research master's)	**23 183**	11 130	12 053	**12 654.1**	54.6
Master's students (coursework plus thesis with research component)	**32 022**	15 607	16 415	**10 884.9**	34.0
Total	78 931	39 950	38 981	37 947.4	48.1
2017/18	**TOTAL**	**MALE**	**FEMALE**	**TOTAL**	**FTEs AS % OF HEADCOUNTS**
Post-doctoral fellows	**2 741**	1 545	1 196	**2 597.6**	94.8
Doctoral students	**22 866**	12 721	10 145	**12 358.1**	54.0
Master's students (full research master's)	**24 769**	11 702	13 067	**12 348.9**	49.9
Master's students (coursework plus thesis with research component)	**30 272**	14 261	16 011	**10 740.1**	35.5
Total	80 648	40 229	40 419	38 045	47.2
2018/19	**TOTAL**	**MALE**	**FEMALE**	**TOTAL**	**FTEs AS % OF HEADCOUNTS**
Post-doctoral fellows	2 727	1 577	1 150	2 564.9	94.1
Doctoral students	23 842	13 072	10 770	13 018.6	54.6
Master's students (full research master's)	29 554	13 689	15 865	15 075.1	51.0
Master's students (coursework plus thesis with research component)	**30 272**	**14 037**	**16 235**	**10 262.9**	**33.9**
Total	86 395	42 375	44 020	40 921	47.4

Note: Master's students are separated into two categories (from 2016/17).

Table C.147: Higher education sector R&D personnel in headcounts by occupation, qualification, population group and gender (2018/19)

OCCUPATION AND QUALIFICATION	TOTAL	SUBTOTAL		AFRICAN		COLOURED		INDIAN/ASIAN		WHITE		NON-SA	
		MALE	FEMALE	MALE	FEMALE	MALE	FEMALE	MALE	FEMALE	MALE	FEMALE	MALE	FEMALE
Researchers*	24 618	12 812	11 806	3 806	3 270	701	806	957	1 234	4 568	4 994	2 780	1 502
Doctoral degree or equivalent	12 008	6 897	5 111	1 443	927	322	294	424	446	2 679	2 484	2 029	960
Master's, honours, bachelor or equivalent	10 780	5 053	5 727	2 006	1 983	329	442	463	690	1 620	2 165	635	447
Diplomas	1 830	862	968	357	360	50	70	70	98	269	345	116	95
Technicians directly supporting R&D	2 272	1 307	965	492	320	164	96	45	37	348	299	258	213
Doctoral degree or equivalent	209	98	111	16	12	7	5	2	8	36	53	37	33
Master's, honours, bachelor or equivalent	801	425	376	188	139	49	48	19	16	125	147	44	26
Diplomas	1 262	784	478	288	169	108	43	24	13	187	99	177	154
Other personnel directly supporting R&D	4 340	1 469	2 871	599	929	149	498	47	100	399	878	275	466
Doctoral degree or equivalent	308	138	170	43	36	10	27	5	5	56	76	24	26
Master's, honours, bachelor or equivalent	1 782	592	1 190	241	393	54	180	22	47	184	454	91	116
Diplomas	2 250	739	1 511	315	500	85	291	20	48	159	348	160	324
Total	31 230	15 588	15 642	4 897	4 519	1 014	1 400	1 049	1 371	5 315	6 171	3 313	2 181

*Excludes doctoral students and post-doctoral fellows. Includes specific categories of R&D personnel.
Note: Headcounts include non-SA R&D personnel (from 2016/17). Non-SA personnel are classified as those that are not from South Africa but are undertaking research in South Africa for a period exceeding six months. They can be temporary or permanent residents as described by the SNA.

Table C.148: Higher education sector overview (2017/18 to 2018/19)

	2017/18					2018/19				
	R&D EXPENDITURE	RESEARCHER HEADCOUNT*	RESEARCHER FTE*	POSTGRAD HEADCOUNT	POSTGRAD FTE	R&D EXPENDITURE	RESEARCHER HEADCOUNT*	RESEARCHER FTE*	POSTGRAD HEADCOUNT	POSTGRAD FTE
	R' 000					R' 000				
Private universities	85 055	249	105.5	325	175.3	86 081	274	107.6	317	176.5
Universities	11 918 281	21 314	5 252.9	23 471	13 625.7	11 710 118	20 585	5 034	24 244	14 130
Nelson Mandela Metropolitan University	386 627	690	103.6	655	338.1	392 213	717	109.3	694	355.6
North West University	611 634	1 564	391.1	1 765	1 286.8	691 107	962	378.0	1 831	1 163.2
Rhodes University	328 725	432	148.1	684	684.0	347 916	433	153.7	699	699.0
Sefako Makgatho Health Sciences University (SMU)	175 082	610	122.0	71	54.2	190 964	634	126.8	96	71.7
University of Cape Town	1 862 888	1 289	507.8	2 441	1 554.4	1 872 887	1 253	469.3	2 474	1 569.4
University of Fort Hare	176 633	451	90.2	844	532.8	168 721	356	71.2	857	540.6
University of Johannesburg	588 932	1 267	287.8	1 211	720.2	565 921	1 345	263.7	1 489	1 201.7
University of KwaZulu-Natal	874 633	2 209	499.0	3 556	1 725.8	961 572	2 406	549.8	3 687	1 685.8
University of Limpopo	181 035	597	174.9	306	209.8	226 660	2 140	495.2	2 522	1 269.1
University of Pretoria	1 194 050	2 643	662.1	2549	1 196.0	1 261 937	1 844	368.8	2479	1 756.7
University of South Africa	762 953	1946	389.2	2 358	1 682.7	899 839	1827	572.0	2 014	1 147.4
University of Stellenbosch	1 863 789	1 822	572.4	2 040	1 149.0	1 701 657	734	197.9	1 127	592.9
University of the Free State	472 591	706	193.1	1 123	643.0	415 392	559	159.3	370	250.4
University of the Western Cape	467 983	838	268.8	1 091	515.0	709 931	937	281.6	1 170	543.6
University of the Witwatersrand	1 764 923	3 955	598.8	2 367	1 041.6	1 117 959	4 118	645.6	2 424	1 060.8
University of Zululand	205 804	295	243.8	410	292.4	185 442	320	192.0	311	222.2

	2017/18					2018/19				
	R&D EXP-ENDITURE	RESEARCHER HEADCOUNT*	RESEARCHER FTE*	POSTGRAD HEADCOUNT	POSTGRAD FTE	R&D EXP-ENDITURE	RESEARCHER HEADCOUNT*	RESEARCHER FTE*	POSTGRAD HEADCOUNT	POSTGRAD FTE
	R' 000					R' 000				
Universities of (Science) and Technology	1 006 540	3 379	682.2	1 811	1 154.7	1 386 919	3 759	865	2 008	1 277.0
Cape Peninsula University of Technology	240 380	591	104.6	307	307.0	285 201	804	160.8	309	309.0
Walter Sisulu University of Technology and Science	62 460	586	87.9	65	48.2	70 795	619	92.9	69	48.3
Central University of Technology	270 453	345	241.6	164	71.6	257 798	431	273.6	204	96.4
Durban University of Technology	126 327	418	57.9	382	275.2	256 418	474	74.2	402	283.2
Mangosuthu Technikon	35 638	188	39.3	12	12.0	34 220	209	35.1	14	14.0
Tshwane University of Technology	125 654	329	35.3	443	129.0	324 947	402	127.9	499	166.7
University of Venda for Science and Technology	61 247	455	45.5	351	245.7	60 630	431	43.1	396	277.2
Vaal University of Technology	84 380	467	70.1	87	66.0	96 910	389	58.0	115	82.2
TOTAL	13 009 876	24 942	6 040.6	25 607	14 955.7	13 183 119	24 618	6 007.2	26 569	15 583.5

**Data for Sefako Makgatho Health Sciences University are only from the HEMIS database. Collected personnel data may differ from HEMIS data in some cases due to definitional differences in personnel categories.
*Excludes post-doctoral and doctoral students. Includes specific categories of R&D personnel.
Note: Headcounts include non-SA R&D staff from 2016/17. Non-South African personnel are classified as those that are not from South Africa but undertaking research for a period exceeding six months. They can be temporary or permanent residents as described by the SNA.

Table C.149: Gross Domestic Product (2018/19)

YEAR	GDP LEVEL (CURRENT VALUES)	GDP LEVEL (CONSTANT 2010 VALUES)
	R MILL.	R MILL.
1993/94	438 884	1 601 003
1994/95	496 233	1 652 235
1995/96	563 870	1 703 454
1996/97	634 611	1 776 702
1997/98	703 116	1 822 897
1998/99	761 660	1 832 011
1999/00	834 752	1 875 979
2000/01	946 324	1 954 771
2001/02	1 046 142	2 007 549
2002/03	1 217 264	2 081 836
2003/04	1 325 766	2 143 231
2004/05	1 476 624	2 240 846
2005/06	1 639 254	2 359 097
2006/07	1 839 401	2 491 296
2007/08	2 109 501	2 624 841
2008/09	2 369 063	2 708 601
2009/10	2 507 677	2 666 940
2010/11	2 748 008	2 748 008
2011/12	3 023 659	2 838 257
2012/13	3 253 852	2 901 078
2013/14	3 539 977	2 973 175
2014/15	3 805 350	3 028 090
2015/16	4 049 884	3 064 237
2016/17	4 359 060	3 076 465
2017/18	4 653 579	3 119 984
2018/19	4 873 899	3 144 539

Data source: Stats SA (2019a)

D. DESCRIPTION OF SURVEY METHODOLOGY

D.1. Survey design and planning

The South African National Survey of Research and Experimental Development (R&D Survey) forms part of the tools used to monitor and evaluate the performance of the national system of innovation (NSI).

The R&D Survey may be thought of as three survey instruments covering the four main sectors described in the Frascati Manual: business enterprise, government, private not-for-profit and higher education sectors. In South Africa, the science councils are extracted from the government sector and are reported separately, thus comprising a fifth South African sector.

The scope of the survey includes all units performing R&D, either continuously or occasionally. Output tables are agreed in advance of the survey between CeSTII and the DSI as a standard.

The survey collects data in accordance with the guidelines recommended by the OECD in the Frascati Manual (OECD, 2002, 2015). This helps to maintain coherence and international comparability. The System of National Accounts (EC, IMF, OECD, UN and the World Bank, 2009) and the NSI differ on the identification of target units and definitions.

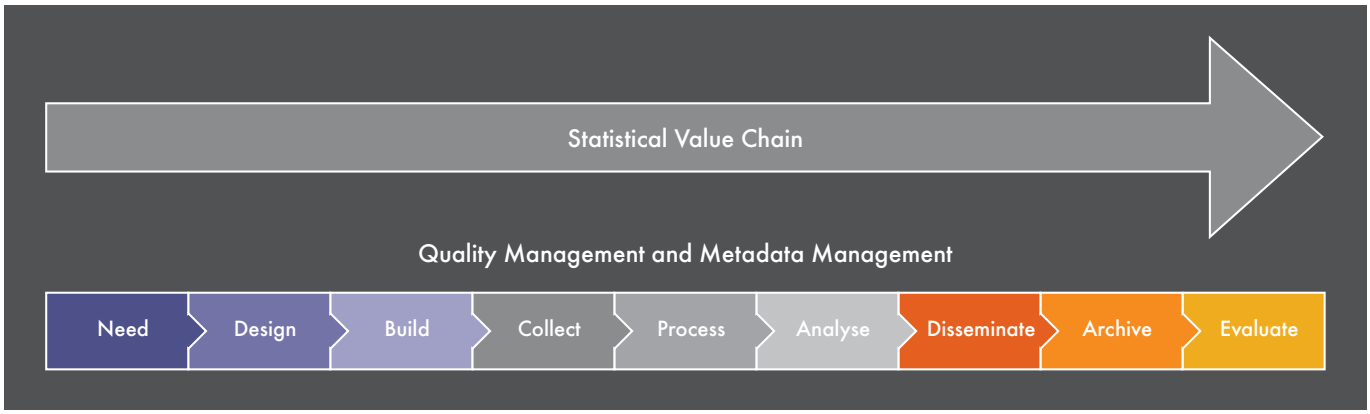
In the interests of coherence of its data with other South African economic survey data, the South African R&D Survey takes care to use standards and methods applied or recommended by Statistics South Africa. Concepts and definitions are aligned as far as possible with those in use by the National Statistical Organisation (NSO) (Stats SA, 2010a). Indicators that use external data are sourced from Stats SA surveys. These are:

- Gross domestic product values for the 2018 annual reference period taken from the quarterly Stats SA GDP statistical release P0441 (Stats SA, 2019a); and
- Employment level value for the fourth quarter of 2018 obtained from the Stats SA Quarterly Labour Force Survey statistical release P0211 (Stats SA, 2019b).

The survey also uses the Standard Industrial Classification (Stats SA, 2004) codes for business sector industrial classifications employed by Stats SA.

Overall, HSRC-CeSTII performs quality management in line with practices recommended by Stats SA in the South African Statistical Quality Assessment Framework (SASQAF) (Stats SA, 2010b). The survey was conducted according to a project plan aligned with the phases of the Statistical Value Chain (SVC) illustrated in Figure D.1, which is modelled on practice at Stats SA.

Figure D.1: Statistical Value Chain used in quality and metadata management



D.2. Frame, sample selection and fieldwork

Three questionnaires were used in the survey for the business sector, the higher education sector, and government departments, research institutes, museums, science councils and not-for-profit organisations.

R&D performers in sectors were taken to be any units that had R&D expenditure, or were likely to have had R&D expenditure, in 2018/19. Table D.1 describes each of the fieldwork periods employed by sector, and provides their respective reference periods.

Table D.1: Description of sectors, respective reference periods, sampling methods and fieldwork periods

SECTOR	DESCRIPTION	REFERENCE PERIOD	METHOD OF SURVEYING	FIELDWORK AND FOLLOW-UP PERIOD
Business	Large, medium and small (micro) business enterprises, including state-owned enterprises.	Financial year 1 March 2018 to 28 February 2019 (or the closest complete financial year)	A purposive design was used for the survey of the business sector, and the frame was constructed from the business register developed and maintained by HSRC-CeSTII since 2002. All known and likely R&D performers were targeted.	25 October 2019 - 31 July 2020
Not-for-profit	Non-governmental and not-for-profit entities. Those registered as Section 21 companies.	Financial year 1 April 2018 to 31 March 2019 (or nearest complete financial year)	All known and likely R&D performers were surveyed following an investigative process using a list of registered non-governmental and not-for-profit organisations including those that were on the current frame.	11 October 2019 - 31 July 2020
Government	National and provincial departments, local government, museums, research institutes and other research units with an R&D component.	Financial year 1 April 2018 to 31 March 2019 (or nearest complete financial year)	Government departments were surveyed using a census approach. All national government departments, associated research institutions and museums performing R&D at national, provincial and local levels were included in the government sector.	25 October 2019 - 31 July 2020
Science councils	The seven science councils established through acts of parliament.	Financial year 1 April 2018 to 31 March 2019 (or nearest complete financial year)	Seven statutory science councils were surveyed, using a census approach.	25 October 2019 - 31 July 2020
Higher education	All public higher education institutions as well as private higher education institutions that performed R&D. Teaching hospitals were also included in this sector.	Calendar year (ending 31 December 2018)	Higher education institutions, namely universities, universities of science and technology, institutes of education and private higher education institutions were included in the higher education sector frame. All public higher education institutions were surveyed, using a census approach.	13 October 2019 - 31 July 2020

D.3. Fieldwork

The R&D data were collected by means of questionnaires that were sent to the units in each sector by electronic mail. All five sectors were surveyed between 1 October 2019 and 31 July 2020.

A unit was considered as a response if:

- The unit completed and returned a questionnaire with non-zero in-house R&D expenditure;
- If the unit's in-house R&D expenditure, headcounts, and sources of fund data were reported by the respondent without a completed questionnaire; or,
- If data were confirmed by the respondent after being imputed based on secondary data sources.

The data sources used for imputation included previous R&D Survey responses as well as other private and public data sources such as the Higher Education Management Information System (HEMIS) and Support Programme for Industrial Innovation (SPII). For each sector, a list of R&D-performing units was identified from existing lists and intelligence-gathering operations. These units were verified as R&D performers to determine the units to be surveyed before collection began.

Changes made to the 2016/17 R&D Survey collection instruments on the R&D personnel tables for all sectors were maintained in the 2018/19 R&D Survey. This was done in an effort to report on foreign employees that could not be categorised by population group during previous surveys. The R&D personnel changes included an additional classification of the population group of R&D personnel, as non-South African personnel.

Business sector

CeSTII has developed a register of known or likely R&D performers in the business sector from several information sources, including the JSE Top 100 Companies, Technology Top 100, SPII and Technology and Human Resources for Industry Programme [THRIP]. A total of 546 business sector units were selected for the 2018/19 survey period. Of this cohort, 241 units were reported as in-scope units and 52 as out-of-scope.

Increased levels of non-response during the 2018/19 survey is attributed to several issues including resistance from respondents to participate in the survey and newly appointed individuals assigned to R&D activities within their companies. Negative outcomes of R&D tax incentives were also considered as a contributor to resistance to participation in the survey.

The 2018/19 survey cycle response has also been affected immensely by the national lockdown that was implemented due to the COVID-19 global pandemic. Working remotely has resulted in delayed responses. It was difficult to make contact with respondents who were working remotely. Whilst COVID-19 may not have had a direct impact on the financial and human resource data for the 2018/19 period under review, its impact on the survey responses resulted in an increase in imputed data of known or likely to perform R&D players. This is discussed further in section D.4.

Science councils sector

Seven R&D-active science councils responded to the survey questionnaire. One of these science councils was surveyed at the level of its constituent units. In the 2018/19 financial period two science councils merged into a new science council, and a third science council merged with a government research institute resulting in a total of 11 reporting units surveyed in the science councils sector.

Two science councils (Hartebees Radio Astronomical Observatory and SKA) merged into a new unit called the South African Radio Astronomical Observatory. The South African National Zoological Gardens of South Africa merged with a Government Research Institute, SANBI (South African National Biodiversity Institute).

Not-for-profit sector

Improvement in the coverage of the not-for-profit sector has been an ongoing process through investigation of registered NPOs. These investigations drew from a list of 345 registered NPOs who were identified as possible R&D performers for the 2018/19 period. Finalisation of the frame maintenance process identified 69 units that were selected as likely R&D performers for the 2018/19 survey period. Of these, only five new units were identified through the investigation process as likely R&D performers and added to the frame. A higher number of out-of-scopes (14 units) were recorded at the end of the 2018/19 survey period compared to the 2017/18 survey period which yielded only two out-of-scopes. The increase in out-of-scopes was caused by various issues: some units indicated a unit death (closed down) as well as a change in focus from research to non-research activities. Furthermore, respondents noted the challenge they experienced in retaining researchers and the inability to start new research projects due to lack of funding.

Government sector

The government sector team investigated a list of 164 units consisting of national and provincial departments, municipalities, research centres and museums. Ninety-six possible R&D performing units were selected for surveying.

Higher education sector

In the 2018/19 R&D Survey, the survey frame for the higher education sector was 31, which consisted of seven private universities and 24 public universities. Two private universities were removed as no response was ever obtained and they are more likely to be involved in teaching activities only.

The funding of research chairs is included in these estimates.

Further amendments to the collection instrument included specific categories of R&D personnel relevant to higher education only — these are emeritus professors, research fellows, honorary research associates or equivalent. They do not incur a salary at the university but there are time and costs associated with them, therefore the separate headcount and FTE category. The Frascati guidelines classify specific categories of R&D personnel as researchers and recommends they be included for reporting R&D activity.

Costs incurred by the specific categories of R&D personnel are included as "specific categories of R&D personnel costs" and are included in the other current expenditure (Q8 of the HE questionnaire; see section F).

From the 2016/17 survey onwards, the master's student category was split into two types: master's students (full research master's) and master's students (coursework plus thesis with research component).

D.4. Methodological note on the impact of COVID-19 on the R&D survey 2018/19

The R&D Survey 2018/19 went into field in October 2019. December/January closures usually slow down survey returns, so that the period between February and May is essential for data collection. Within this period, from February 2020, the COVID-19 pandemic began to impact significantly on South Africa. The country went into a hard 'lockdown' period on 26 March 2020, which meant respondents were forced to work remotely with very little preparation time. The CeSTII team prepared to work from home and finalise the 2018/19 R&D Survey working online. The potential impact on survey returns was not known, but it was expected that it could be severe.

The CeSTII team initiated a process of consultation with global and national experts to determine how the pandemic was impacting their work, and to engage on responses and strategies that could be implemented to protect the R&D time series data. Expert consultations were held with:

- The OECD's Working Party of National Experts on Science and Technology Indicators (NESTI)
- Statistical agencies responsible for conducting national R&D surveys in other countries
- Statistics South Africa

NESTI convened a global community of practice to discuss the "Statistical monitoring and analysis of Science, Technology and Innovation in time of crisis", on 15 and 16 June 2020. Sessions covered a wide range of aspects regarding the impact of the pandemic that were useful to inform the South African approach:

- STI policy perspectives on the crisis and implications for measurement
- STI measurement resilience during the crisis
- How to monitor the impact on business R&D and innovation
- Monitoring personal and societal STI engagement and trust during the crisis
- Measurement of STI resources and outputs devoted to fighting COVID-19 and building pandemic preparedness
- Monitoring institutional responses to the crisis

Statistical agencies in a range of countries that conduct national R&D surveys were consulted in a more focused manner through emails requesting them to share their responses and strategies for intervention as examples of emerging practice. Agencies included the Australian Bureau of Statistics (ABS); the Nordic Institute for Studies in Innovation, Research and Education (NIFU) in Norway; the National Science Foundation (NSF), USA; Statistics Canada; OECD and UNESCO.

One option considered initially was that the 2018/19 survey should be abandoned and resumed at a more conducive time. This option was rejected, given uncertainty about the trajectory and duration of the pandemic over the medium-term, and given that there had been significant returns in most of the institutional sectors by that point. The business sector was the most impacted and had the lowest response rate at the original closure date for the survey.

The quality assessment of the R&D Survey is based on a range of indicators. A preliminary review indicated that the required quality levels could likely be obtained, taking into account performance across all the institutional sectors, based on a wider range of indicators.

Therefore, based on the practice emerging from these global and national consultations, a multi-stranded strategy was devised to ensure as high quality dataset as possible, informed by the Frascati Manual and the SASQAF requirements.

The mitigation strategy to avoid a low response rate and hence, a potential break in series, included:

1. **Extending fieldwork**: The period of field work was extended from 31 March to 31 July, particularly to focus effort on improving the rate of returns in the business sector. This meant that fieldwork continued during lockdown levels 5 and 4, when only entities identified as essential services were allowed to operate. Most businesses, universities, government entities and not-for-profit entities were closed, and only those who were able to do so, operated online. The resulting delay on the release of the survey results was communicated to stakeholders via the CeSTII and DSI websites, as well as a dedicated mail out to all respondents and stakeholders.

2. **Target top 200 firms**: The Frascati Manual recommends that all size classes be covered in an R&D survey, but considering that large firms contribute significantly to R&D, every effort must be made to ensure coverage of large firms (FM 2015, Chapter 7). In addition to the units already in field, a list of the top 200 South African firms was identified to guide more focussed fieldwork effort in the business sector.

3. **Advised commutes**: Many respondents reported that the data required to complete the survey was stored in offices that could not be accessed during lockdown. To facilitate responses, a strategy of advised commutes was adopted. Firms were sent a completed questionnaire based on the previous return and adjusted by a statistically produced GDP inflation factor, for amendment or confirmation. This strategy was implemented for all sectors with outstanding units. If no response or adjustment was received, the commute would be recorded as a regular commute/estimated value.

4. **Continuous recording/monitoring of metadata**: There was a strong likelihood of a high rate of imputations for the 2018/19 survey, given the fieldwork challenges. International R&D survey practitioners advised that they also anticipate higher levels of imputation due to the pandemic. The discussions with Stats SA in particular focused on what would be an acceptable imputation rate. Hence, a process of monitoring the metadata on an ongoing basis during the extended fieldwork period was instituted. We observed and monitored quality indicators such as response and collection rates and measured the levels of unit and GERD imputation rates. These were presented to Stats SA for observation and input.

5. **Evidence of COVID-19 impact from Stats SA business survey**: To gain contextual information on the impact of COVID-19 on R&D activity in general, CeSTII partnered with Stats SA on their third survey of the business impact of the COVID-19 pandemic, covering lockdown level 4, the period 1 to 31 May 2020 (Stats SA, 2020)[3]. Dedicated questions were added to the survey instrument, to assess the impact of lockdown on firms' R&D and innovation activities. These questions were adapted from studies of similar international rapid response surveys, such as that undertaken by Statistics Canada (2020), and by adapting items from the South African national R&D and business innovation surveys, to allow for comparability. Note that this data refers directly to the 2019/20 reference period, and may be useful in future surveys for triangulation purposes. For the present survey period, it provides an indication of the severity of the impact of COVID-19 on the firms' ability to respond to the survey. Of the 1 079 enterprises in the sample, 439 reported intra-mural R&D expenditure. The nature of the rapid response survey allowed for the collection of variables that did not require access to detailed records. For example, the precise value of R&D expenditure or turnover was not requested. However, respondents could provide turnover values within range classes. The focus on imprecise values was crucial, because the survey relied on respondents who were working from home, who would only have access to a selection of records on their laptops, or documents available to them at home.

[3] Stats SA. 2020. *Business Impact Survey of the COVID-19 Pandemic in South Africa*. Report no. 00-80-01 (1 – 31 May 2020). Retrieved from: http://www.statssa.gov.za/publications/Report-00-80-01/Report-00-80-01June2020.pdf

As expected, compared to the 2017/18 survey, the questionnaire response rate, collection rate and proportion of unit imputations showed a decline. The business sector in particular was the most affected. These declines were expected due to the impact of COVID-19. The R&D Survey's data is subject to an assessment of a wider range of quality indicators as per the SASQAF framework and held against stringent quality requirements. The mitigation strategies applied as a result of COVID-19, enabled the conclusion of the 2018/19 survey data. The larger imputation rate employed is reported in Table D.2 and as such data users are advised to apply caution when analysing the data. Users are also advised to be cautious of the extraordinary circumstances that impacted the data collection for the 2018/19 R&D Survey.

D.5. Quality indicators of survey coverage, fieldwork and analysis

The summary set of quality indicators for the collection and imputation phases of the survey processes in Table D.2 reflects an overall questionnaire response rate of 50.4% for 2018/19, compared to 63.4% in 2017/18.

The 2018/19 survey period returned a higher rate of out-of-scopes. A partial reason for the relatively high number of out-of-scopes in the business sector may be attributed to the nature of the scope of R&D surveys conducted according to Frascati standards, where the units selected for surveying include likely R&D performers in addition to known R&D performers. The nature of R&D is such that there may be a very small number of projects active in the R&D-performing business unit of a firm in any given year. These projects typically last for around three years, according to reports from the field. Upon termination of the project, the R&D expenditure of a firm would thus be nought for a particular reference period, which with the existing CeSTII operational procedures would classify it as an out-of-scope unit, even though it might very well perform R&D again in the future. For this reason, the R&D Survey uses collection rates as well as questionnaire response rates as key quality indicators of the collect phase of the SVC.

Non-response[4] was defined as failure to obtain a measurement on one or more variables for one or more units selected for the survey. These include out-of-scope units.

Out-of-scope units are defined as units that should not be included in the survey frame because they did not belong to the target population in the reference period. Entities that returned a questionnaire stating nil in-house R&D expenditure for the survey reference period were counted as out-of-scope for the 2018/19 R&D Survey.

In-scope units[5] were defined as units performing in-house R&D or with likely in-house R&D activity.

Questionnaire responses were defined as those units that were not classified as non-responses within the set of all questionnaires sent out. The questionnaire response rate was calculated using the following formula:

$$\text{Questionnaire response rate} = \frac{\textit{Responses}}{\textit{(Responses+Non-response)–(Out-of-scope)}}$$

Collection rate was defined as the proportion of completed questionnaires received for the survey compared to the total number of actively-reporting sample units on the sample registry.

$$\text{Collection rate} = \frac{\textit{Responses+Out of scope+Refusals}}{\textit{Active reporting units}}$$

The *weighted response rate* is a measure of the fraction of R&D expenditure collected from responses. It was calculated as:

$$\text{Weighted response rate} = \frac{\textit{R\&D expenditure obtained from responses}}{\textit{(R\&D expenditure from responses + Unit imputations)}}$$

The *survey unit imputation rate* was defined as the number of eligible non-responding units that had all data imputed as a fraction of eligible units. It was calculated using the following formula:

$$\text{Survey unit imputation rate} = \frac{\textit{Unit imputations}}{\textit{(Response+Non-response)–(Out-of-scope)}}$$

[4] Adapted from Sarndal, Swensson, & Wretman (1992).

[5] This is the HSRC-CeSTII operational definition.

Table D.2: Quality indicators of survey coverage by sector (2018/19)

SECTOR	NUMBER OF UNITS INVESTI-GATED	NUMBER OF UNITS SELECTED TO COMPILE STATISTICS	NON-RESPONSE	OUT-OF-SCOPE	RESPONSES	QUESTION-NAIRE RESPONSE RATE	COLLECTION RATE	UNIT IMPUTATION RATE	WEIGHTED RESPONSE RATE
Business	689	546	305	52	241	48.8%	59.3%	15.6%	54.9%
Not-for-profit	345	69	36	14	33	60.0%	71.0%	9.1%	98.2%
Government	164	96	56	1	40	42.1%	57.3%	8.4%	90.8%
Science councils	13	12	1	0	10	90.9%	90.9%	9.1%	97.2%
Higher education	31	31	9	0	22	71.0%	74.2%	25.8%	86.5%
HE: Public	24	24	7	0	17	70.8%	70.8%	29.2%	86.5%
HE: Private	7	7	2	0	5	71.4%	85.7%	14.3%	95.9%
Total	1 242	754	407	67	346	50.4%	61.2%	14.4%	76.4%

Table D.3: Quality indicators of survey coverage by sector (2017/18)

SECTOR	NUMBER OF UNITS INVESTI-GATED	NUMBER OF UNITS SELECTED TO COMPILE STATISTICS	NON-RESPONSE	OUT-OF-SCOPE	RESPONSES	QUESTION-NAIRE RESPONSE RATE	COLLECTION RATE	UNIT IMPUTATION RATE	WEIGHTED RESPONSE RATE
Business	483	483	198	47	285	65.4%	88.0%	13.3%	78.9%
Not-for-profit	127	65	29	2	36	57.1%	65.1%	6.3%	98.7%
Government	164	100	52	3	48	49.5%	67.0%	2.1%	96.7%
Science councils	13	13	0	0	13	100.0%	100.0%	0.0%	100.0%
Higher education	33	33	8	0	25	75.8%	75.8%	18.2%	86.5%
HE: Public	24	24	6	0	18	75.0%	75.0%	25.0%	86.4%
HE: Private	9	9	2	0	7	77.8%	77.8%	0.0%	100.0%
Total	820	694	287	52	407	63.4%	82.1%	10.9%	86.6%

The decline of the questionnaire response and data collection rates between 2017/18 and 2018/19 was evident and largely influenced by the COVID-19 pandemic and the lockdown period (see Tables D.2 and D.3.). Sectoral analysis shows the unit imputation rate for all sectors increased. This was expected due to the revised fieldwork strategy to impute outstanding units due to the effect the pandemic had on data collection.

D.6. Imputation

Imputation is a procedure for entering a value for a specific data item where the response is missing or unusable. The R&D Survey strives to keep the rate of imputation as low as possible, while striving to include all likely sources of R&D activity in the final estimates. Since 2012/13, the rates of imputation employed have been reported, along with the age of the data used to impute (Table D.4). Imputations are only used upon verification from respondents or where available information confirms continued R&D activity within a specific unit of measure. The survey mostly employs a commutation procedure which is data based on a previous return and adjusted by a statistically produced GDP inflation factor. A unit is selected for imputation only if sector leaders have convinced themselves of the existence of R&D activity in those units. Where it was not possible to obtain company confirmation, individual fieldworkers were responsible for providing evidence of ongoing R&D activity to qualify units for imputation. The survey employed varying degrees of imputation. In some cases, a total R&D expenditure figure reported by the respondent (by email or telephone) was used to impute the remaining data items using a model employing available sector R&D profiles. In other cases, publicly available data was used. Lastly, a R&D profile for a unit was generated based on its known historical R&D profile adjusted by an inflation factor. In the latter case, financial data on R&D were increased by a GDP inflation value of 4.734% in 2018/19.

Table D.4: Number of units and age of data used in the imputation models by sector

AGE OF DATA	BUSINESS	NPO	GOVERNMENT	SCIENCE COUNCILS	HIGHER EDUCATION
Imputed (data from current reference period)	0	0	0	0	0
Imputed (data from previous year)	0	0	0	0	0
Imputed (data more than one year old)	0	0	0	0	0
Commuted (data from previous year)	42	4	2	0	2
Commuted (data more than one year old)	35	1	6	1	6
Total	77	5	8	1	8

Personnel data for non-responding higher education institutions were imputed from personnel data obtained from HEMIS. R&D expenditure for these units was imputed from a mathematical model or left unchanged from previous estimates.

Details of the imputation methods are available on request.

D.7. Data processing and analysis

Once the individual responses to the questionnaires, including summation and percentage calculations, had been checked by the relevant fieldworker, the data were manually entered on the R&D Survey Management System (RDSMS). Summary data was drawn from the system, and anomalies were identified by cross-checking results and returned to sector leaders for verification and correction, when necessary.

Data tables were drawn from the data in the form of outputs agreed upon by HSRC-CeSTII and the DSI at the start of the survey project process. These included time-series data that were added from previous surveys for the purpose of multi-year comparison. Final data quality checks were performed using the time-series data, by looking for consistency with expectations, checking other sources of data, and also taking into account the economic environment.

Tables on the state-owned enterprises (SOEs) were produced by selecting known SOEs from the enterprises in the business sector. The list of SOEs was developed by CeSTII over several years as part of the register-building process in the business sector and was checked against the Treasury list (National Treasury, 2015).

D.8. Dissemination

The 2018/19 R&D Survey reports will be disseminated to all respondents as well as to other users of the R&D statistics. This report is available on request from HSRC-CeSTII and the DSI.

The report can be downloaded from the HSRC-CeSTII website http://www.hsrc.ac.za/en/departments/CeSTii/reports-cestii or the DSI website http://www.dst.gov.za/index.php/resource-center/rad-reports. Care is taken to ensure the confidentiality of respondent information, and the data presented in the report are therefore anonymised.

D.9. Storage and archiving

The data from the R&D Survey series is archived according to established HSRC-CeSTII procedures. Hard copies of the data from the two most recent surveys are kept in safe storage at HSRC-CeSTII, while the data from older surveys are kept in safe storage off site. All data are stored electronically on secure servers, and daily back-ups of databases are generated.

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F. R&D SURVEY QUESTIONNAIRE
(HIGHER EDUCATION SECTOR)

STRICTLY CONFIDENTIAL

NATIONAL SURVEY OF RESEARCH & EXPERIMENTAL DEVELOPMENT INPUTS TO HIGHER EDUCATION [PUBLIC]
2018 ACADEMIC YEAR

UNIT	Please modify address label if necessary

AUTHORITY
The Centre for Science, Technology and Innovation Indicators (CeSTII), within the Human Sciences Research Council (HSRC), conducts the Survey of Inputs into Research and Experimental Development (R&D) for the Department of Science and Technology (DST). **The Survey is conducted in terms of the Statistics Act No. 6 of 1999.** Organisations are therefore legally required to respond to this request for data and is required to provide accurate information about R&D performance. All data gathered for this survey is confidential. The HSRC and DST will not disseminate any information identifiable with an organisation without their consent.

PURPOSE AND SCOPE OF SURVEY
The R&D survey collects data on the inputs into R&D activities performed **IN-HOUSE** in South Africa by all organisations (including Business, Government, Science Councils, Not-for Profit and Higher Education). The data is used for planning and monitoring purposes and to support decisions about strengthening South Africa's competitiveness. Previous survey results may be viewed at http://www.hsrc.ac.za/en/departments/CeSTii/reports-cestii. This survey covers the **Academic Year 1 January to 31 December 2018.**

DUE DATE
Kindly complete and return this form as soon as possible, but no later than **1 DECEMBER 2018.**

Return address: R&D Survey, PO BOX 15200, Vlaeberg, 8018. **Or:** E-mail to addresses listed below.

PLEASE KEEP A COPY OF THIS QUESTIONNAIRE FOR YOUR RECORDS

ASSISTANCE
To assist you with queries kindly contact one of the survey managers:

Name	Contact Number	E-mail
Ms Natalie Vlotman	021 466 7826	nvlotman@hsrc.ac.za

Dr. Neo Molotja
Senior Research Specialist
nmolotja@hsrc.ac.za
Tel: 021 466 7818

Details of person completing this questionnaire (Please print)

Name (With title)		**Tel**		
Designation		**Fax**		
Date		**Cell**		
Signature		**E-mail**		

Details of person who has verified the data provided in this survey form, and is authorised to sign off on behalf of the institution (e.g. Dean/Director/DVC of Research)

Name (With title)		**Tel**		
Designation		**Fax**		
Date		**Cell**		
Signature		**E-mail**		

THE FOLLOWING DEFINITIONS ARE IMPORTANT IN THE COMPLETION OF THE SURVEY QUESTIONNAIRE: WHAT IS R&D?

Definition
This survey follows the approach of the Organisation for Economic Co-operation and Development (OECD), which defines Research and Experimental Development (R&D) as:

- **Research** is creative work and original investigation undertaken on a systematic basis to gain new knowledge, including knowledge of humanity, culture and society.
- **Development** is the application of research findings or other scientific knowledge for the creation of new or significantly improved products, applications or processes.

The basic criterion for distinguishing R&D from related activities is the presence in R&D of an appreciable element of novelty and the resolution of scientific and/or technological uncertainty, i.e. when the solution to a problem is not readily apparent to someone familiar with the basic stock of commonly used knowledge and techniques in the area concerned.

Scope of survey
The survey requests data performed IN-HOUSE by your organisation on the national territory of South Africa. Part five asks some questions on "out-sourced R&D".

R&D in Higher Education Institutions
Any activity classified as R&D is characterised by originality; it should have investigation as a primary objective and should have the potential to produce results that are sufficiently general for humanity's stock of knowledge (theoretical and/or practical) to be recognisably increased.

Most research work in higher education institutions would qualify as R&D.

R&D Includes – but is not limited to:
Activities of personnel who are obviously engaged in R&D. In addition, research activity includes:

- The provision of professional, technical, administrative or clerical support and/or assistance to personnel directly engaged in R&D
- The management of personnel who are either directly engaged in R&D or are providing professional, technical or clerical support or assistance to those R&D activities of students undertaking postgraduate research courses
- Supervision and monitoring of postgraduate research courses, including students
- Software development where the aim of the project is the systematic resolution of a scientific uncertainty
- Research work in the biological, medical, engineering, physical and social sciences and the humanities
- Social science research, including economic, cultural, educational, psychological and sociological research
- R&D carried out as a participant in any unincorporated joint venture
- R&D projects performed on contract for other legal entities, such as businesses
- "Feedback R&D" directed at solving problems occurring beyond the original R&D phase, for example technical problems arising during initial production runs

R&D Excludes:
The following specific activities are excluded, except where they are used primarily for the support of, or as part of, R&D activities performed in this reporting unit:

- Preparation for teaching
- Academic development activities
- Scientific and technical information services
- Engineering and technical services
- General purpose or routine data collection
- Standardisation and routine testing
- Feasibility studies (except into R&D projects)
- Specialised routine medical care, for example routine pathology services
- The commercial, legal and administrative aspects of patenting, copyrighting or licensing activities
- Routine computer programming, systems work or software maintenance where there are no technological uncertainties to be resolved.

The Classification of Borderline Institutions
Research institutes (such as specialised healthcare clinics or "attached" research institutions) that are not directly concerned with third level teaching, but whose activities, R&D or otherwise, are all the same closely associated with the Higher Education sector should be carefully considered:

- Entities initiated by a Higher Education Institution (HEI) but subsequently becoming a not-for-profit or business entity should be classified as such and surveyed by Not-for Profit or Business sectors, even if there are close links with a Higher Education Institution.
- Staff and R&D expenditure should be reported where it was incurred
- Staff members on the payroll of the HEI Institution (e.g. department heads) should be reported by the HEI concerned.
- Staff that appears on the payroll of the "borderline" institution' should be reported by the institution concerned and not the HEI.
- The same applies to equipment and running costs.

It would be appreciated if we were informed of all such institutions to ensure that they are surveyed by the appropriate sectors and to minimise double counting.

Provincial/Academic Hospitals
Higher Education Institutions are requested to report on all academic and technical staff performing R&D, with joint appointments between provincial/academic hospitals and the HEI. This includes headcount, FTE's, labour costs, equipment and running costs.

It is understood that some of these costs may not be reflected in the HEI's HEMIS data or financial statements, but we request that a best estimate be included where necessary.

PART 1: GENERAL INFORMATION

1. **Name of Higher Education Institution**

2. **Name of reporting unit e.g. Faculty**

3. **Did the reporting unit perform any IN-HOUSE R&D during the 2018 academic year?**

- In-House R&D refers to R&D performed by the reporting unit on its own behalf or on behalf of others.
- It excludes R&D projects funded by this organisation but carried out by others using their own facilities.
- In-house R&D must be distinguished from outsourced R&D which should be reported under Part 5.
- Only R&D performed **in South Africa** should be recorded.

Please tick as appropriate

Yes **No**

If your reporting unit does *not* do any In-House and/or Outsourced R&D, please check the box below and return the questionnaire as a NIL response.

NIL response

PART 2: R&D PERSONNEL AND STUDENTS

R&D PERSONNEL

Report against the categories listed below for all personnel employed directly in R&D or providing direct R&D services/support for at least 5% of their time. Do not count any staff NOT supporting research. Please include permanent, temporary, full-time, part-time and contract staff, as well as joint appointments for provincial hospital staff.

1. Researchers
Researchers are professionals engaged in the conception or creation of new knowledge. They conduct research and improve or develop concepts, theories, models, techniques instrumentation, software or operational methods

INCLUDE:

- Academic staff engaged in the conception or creation of new knowledge, products, processes, methods and systems and also in the direct management of the projects concerned.
- Managers and administrators engaged in the planning and management of the scientific and technical aspects of a researcher's work. Their rank is usually equal or superior to that of persons directly employed as researchers and they are often former or part-time researchers.
- Academic staff involved in research and also studying towards a Masters or Doctoral degree should be included as research staff (not students).

EXCLUDE:

- Managers and directors concerned primarily with budgets and human resources, rather than project management or content (include in Other personnel directly supporting R&D).
- Post-graduate students enrolled to be reported separately.

2. Technicians directly supporting R&D
Persons doing technical tasks in support of R&D, normally under the direction and supervision of a researcher. They participate in R&D by performing scientific and technical tasks involving the application of concepts and operational methods and the use of research equipment, normally under the supervision of researchers.

3. Other personnel directly supporting R&D
Other supporting staff includes skilled and unskilled craftsmen, and administrative, secretarial and clerical staff participating in R&D projects or directly associated with such projects.

3.1 Executive and managerial level
Executives and directors concerned primarily with budgets and human resources in support of research, rather than project management.

3.2 Administrative and support staff
Skilled and unskilled crafts workers supporting research. Secretarial, administrative and clerical personnel supporting/working on, or directly associated with, R&D activity.

EXCLUDE:
Persons providing *indirect* services such as security and maintenance personnel, staff of central libraries, IT departments or head offices, should be excluded here but the relevant proportion of their labour costs should be included under "Other Current Costs" in Question 8D.

Specific categories of R&D personnel:
A specific type of external R&D personnel can be identified (almost exclusively) in the HE sector, namely that of a "professor emeritus". These individuals are retired professors who continue to research and collaborate in the academic activities of a university – without receiving any compensation (although, they may receive some logistical support for their activities). The relevant proportion of the costs linked to them should be included under "Other Current Costs" in Question 8D.

NOTE: ALL FOREIGN HEADCOUNTS TO BE REPORTED IN NON-SA CATEGORY.

R&D STUDENTS

- All Post-doctoral fellows in whichever capacity they are appointed by the institution.
- Doctoral students.
- Students undertaking a Masters degree with at least a 40% research component in 2018.

4. HEADCOUNTS OF R&D PERSONNEL

Provide the Headcounts of all R&D personnel in this reporting unit according to the categories below
(Consult NOTE A on page 6 on how to extract the researcher headcount from HEMIS)
(Consult NOTE B on page 6 on how to calculate the Headcount and FTE data for Technicians and Other Support Staff)

Personnel Categories and Highest Qualification	African		Coloured		Indian/ Asian		White		Non-SA		Sub-total		TOTAL
	M	F	M	F	M	F	M	F	M	F	M	F	
Researchers													
Doctorates											-	-	-
Masters/Hons/Bachelors or equivalent											-	-	-
Diplomas and other qualifications											-	-	-
Researcher total													
Technicians/Technologists													
Doctorates											-	-	-
Masters/Hons/Bachelors or equivalent											-	-	-
Diplomas and other qualifications											-	-	-
Technician total													
Other personnel directly supporting R&D													
Doctorates											-	-	-
Masters/Hons/Bachelors or equivalent											-	-	-
Diplomas and other											-	-	-
Other direct support total													
Specific categories of R&D personnel													
Professors Emeritus, research fellows, honorary research associates or equivalent											-	-	-
Volunteers											-	-	-
Specific R&D personnel total											-	-	-

CARRY TOTALS TO Q5

5. RESEARCH FULL-TIME EQUIVALENTS (FTE's) AND COST-TO-COMPANY

Using the Male and Female Headcounts of all R&D personnel reported for in Question 4, provide the Research Full-Time Equivalents (time devoted to Research and Development). Then calculate the total labour costs of R&D using the average annual full cost-to-company for full-time staff (including annual wages and salaries and all associated costs or fringe benefits such as bonus payments, contributions to pension and medical aid funds, payroll tax, UIF and all other statutory payments) per category below.

(Consult the appendix provided on how to calculate Research FTE's for researchers using HEMIS data)
(Consult NOTE B on page 6 on how to calculate Research FTE's for technicians and support staff)

Personnel Categories	Headcounts (From Q 4)			Research Full Time Equivalents (FTE's)			Average annual labour cost per full-time person R'000 Excluding VAT (B)	Calculated labour cost of R&D R'000
	M	F	Total	M	F	Total (A)		(A x B)
Researchers *	-	-	-			-		R -
Technicians directly supporting R&D	-	-	-			-		R -
Other personnel directly supporting R&D	-	-	-			-		R -
Specific categories of R&D personnel								
TOTAL LABOUR COST OF R&D								-

* *Use the median annual labour cost (cost-to-company as explained above) of FULL-TIME senior lecturers*

Carry over total calculated labour cost of R&D personnel to Question 8C

NOTE A: CALCULATION OF RESEARCHER HEADCOUNTS AND FTE'S USING HEMIS DATA
HEMIS data for the 2018 academic year should be used to calculate researcher headcounts and FTE's. To extract this data from HEMIS use the SFTE final table structure and the Staff Programme Classification (element number/name: 044/staff programme) Classification Code 020 (Research) as the primary filter. We suggest that the data be opened in Microsoft Access or Excel. Create a table with the following variables present:

- *Gender* — *Element 012*
- *Race* — *Element 013*
- *Personnel Category* — *Element 039*
- *FTE Value* — *Element 043*
- *Qualification Type* — *Element 046*

- Only report on data pertaining to instruction/research professionals (Classification Code: 01).
- Please capture all staff, namely: permanent/temporary status, part-time/full –time and joint appointments. The number of records present should provide the headcount, while the total of the FTE values will provide the FTE value for Research that is required.
- Should you wish to extract this information at Faculty level, extract the data using CESM categories as a filter, and then divide these CESM's according to Faculty.

NOTE B: CALCULATION OF TECHNICIAN AND OTHER SUPPORT STAFF HEADCOUNT AND FTE'S
Unfortunately HEMIS data only reports on technicians and other staff DOING research and not SUPPORTING research. Technicians and other staff DOING research should be included under the Researcher category. HEMIS data as such could therefore not be used to calculate the headcount and Research FTE's of technicians and other staff supporting research. This information should rather be obtained from Management Information, Faculty Officers and/or Faculty Deans.

Please note: Total FTE's should only include such staff members that support research for at least 5% of their time, NOT ALL Technicians, Executive/Managerial or Administrative staff.

CALCULATING RESEARCH FULL-TIME EQUIVALENTS:
For the purpose of this survey, a person can work a maximum of 1 FTE in a year. This is why the Research FTE is not defined by specifying the maximum number of working hours in a month or year. The following equation can be used to calculate person years of effort on R&D: (Full time equivalent) x (Portion of the year the person spent on R&D) x (Portion of their job spent on R&D) = Person years of effort on R&D

For example:

-a full time employee who devotes 100% of their time to R&D
1 x 1 x 1 = 1 person years on R&D
-a full time employee spending 40% of his/her time on R&D during half of the survey year:
1 x 0.4 persons x 0.5 years = 0.2 person years of R&D effort
-a part-time employee working 40% of a full time year doing only R&D
0.4 x 1x 1= 0.4 FTE to the R&D effort.
-20 full-time male researchers spending 40% of their time on R&D during the survey year:
20 x 0.4 x 1= 8
NOTE: please calculate FTEs for all R&D personnel

Indirect Services:
The labour costs of persons providing indirect services such as security and maintenance personnel, staff of central libraries, IT departments or head offices, should be **excluded** here but the relevant contribution included under "Other Current Costs in Question 8D.

6. HEADCOUNT OF POSTGRADUATE STUDENTS

Provide the Headcount of all R&D post-doctoral fellows and postgraduate students (full-time and part-time students) in this reporting unit according to the categories below.

Postgraduate student categories	South African								Non-South African All Races		Sub-total		TOTAL
	African		Coloured		Indian/ Asian		White						
	M	F	M	F	M	F	M	F	M	F	M	F	
Post-doctoral fellows											-	-	-
Doctoral Students											-	-	-
Masters Students (research Master's)											-	-	-
Masters students (course work plus thesis with research component)													
TOTAL											-	-	

Carry sub-totals over to Q7

7. PERCENTAGE TIME ON RESEARCH AND TOTAL COSTS

Using the headcounts of all R&D post-doctoral fellows and postgraduate students reported in Q6, provide the Research Full Time Equivalents (time spent on Research and Development) according to the categories below. Then provide the total value of salaries, stipends and all bursaries (both internal and external) from all available records.

Postgraduate Student Categories	Headcount (From Q6)		Full-Time Equivalents (FTE's)		Total value of salaries, stipends & bursaries R'000 Excluding VAT
	M	F	M	F	
Post-doctoral fellows	-	-			
Doctoral students	-	-			
Masters Students (research Master's)					
Masters students (course work plus thesis with research component)					
TOTAL COST OF STUDENTS					R -

Carry over total value of salaries, stipends and bursaries to Question 8C

PART 3: IN-HOUSE R&D EXPENDITURE

8. IN-HOUSE R&D EXPENDITURE

Compile expenditure on IN-HOUSE R&D during the academic year 2018. Include expenditure funded from all sources: internal and external (contracts and grants) and undertaken by the reporting unit on its own behalf or for other parties.

***PLEASE NOTE:* Outsourced R&D should be reported under Part 5.**

CAPITAL EXPENDITURE ON R&D

(See NOTE C on page 8 regarding the definition of capital expenditure and how to calculate capital expenditure on R&D)
Purchase of equipment can, in theory, be classified as either capital or current expenditure. A distinction can therefore be made between "major" and "minor" equipment (to be included in "capital" and "current" expenditures respectively) by establishing some kind of monetary limitation. Please provide us with this limitation as used by your institution:
R

		R'000 Excluding VAT
Vehicles, plant, machinery and equipment	**A**	
Land, buildings and other structures	**B**	

LABOUR COSTS OF R&D		**R'000 Excluding VAT**
Total cost of R&D personnel (carried over from Question 5)		-
Total cost of R&D postgraduate students (carried over from Question 7)		-
TOTAL	**C**	-

OTHER CURRENT EXPENDITURE ON R&D
(See NOTE D on page 8 regarding the definition of current expenditure and how to calculate current expenditure devoted to R&D)

		R'000 Excluding VAT
Other Current Expenditure	**D**	
Specific categories of R&D personnel costs		

		R'000 Excluding VAT
TOTAL R&D EXPENDITURE (A + B + C + D = E)	**E**	-

Carry over Total R&D Expenditure (E) to Question 9

THE DEFINITION AND CALCULATION OF IN-HOUSE R&D EXPENDITURE

NOTE C: CAPITAL EXPENDITURE

- The full cost of capital expenses must be reported in the year of purchase (Do not depreciate)

Including – but not limited to:

- Expenditure on fixed assets used in the R&D projects of this reporting unit
- Acquisition of software, including license fees, expected to be used for more than one year
- Purchase of databases expected to be used for more than one year
- Major repairs, improvements and modifications on land and buildings

Excluding:

- Other repairs and maintenance expenses
- Depreciation provisions
- Proceeds from the sale of R&D assets

- Where a capital item is used solely for R&D, allocate the full cost of the item
- If the capital item is used for more than one activity, include only an estimate of the portion used for R&D
- Only where such an estimate of the portion used for R&D is not available, apply the percentage time that Researchers in the reporting unit spent on R&D, to the cost of the item.

NOTE D: CURRENT EXPENDITURE

Including - but not limited to:

- Direct project costs, project consumables and running costs linked to research such as materials, fuels and other inputs, including telephone and printing
- Subsistence and travel expenses
- Repair and maintenance expenses
- Payments to outside organisations for use of specialised testing facilities, analytical work, engineering or other specialised services in support of R&D projects carried out by this reporting unit
- Commission/consultant expenses for research projects carried out by this reporting unit
- The relevant % of indirect and institutional costs and utility costs such as rent, space charge, leasing and hiring expenses, furniture, water, electricity any other overhead costs
- The relevant % of labour costs of persons providing indirect services such as the Head Office, HR, Finances, security and maintenance personnel, staff of central libraries, IT departments

Excluding:

- Contract R&D expenses where the research project is carried out elsewhere by others on behalf of this reporting unit
- Payments for purchases of technical know-how (goodwill)
- Licence fees
- Depreciation provisions

- Where current expenses such as direct project costs and consumables are used solely for R&D, allocate the full cost of the items
- If these current expenses are used for more than one activity, include only an estimate of the portion used for R&D
- Only where such an estimate of the portion used for R&D is not available, such as indirect and utility costs, and labour costs of staff providing indirect services, it is advised that respondents apply the percentage time that researchers in the reporting unit spent on R&D to the total of these current expenditures.
- So if a Faculty income and expenditure statement shows that the current expenditure for indirect and utility costs and labour costs of staff providing indirect services for the year was say R1,700,000 and that researchers on average spent 22% of their time to R&D, then this component of R&D current expenditure may be estimated as 0.22 x R1,700,000 = R374,000.

9. SOURCES OF IN-HOUSE R&D EXPENDITURE (as reported in Question 8)

Provide a breakdown of the total R&D expenditure according to the sources of funds listed below
(NOTE: Only the proportion of the money actually SPENT is required, not the total income per source.)

EXTERNAL SOURCES SPENT ON R&D		**R'000 Excluding VAT**
National, Provincial and Local Government excluding the HE Vote		
Government Research Institutes e.g. Water Research Commission, KwaZulu Natal Wildlife, Natal Sharks Board, National Health Laboratories Service, Nuclear Energy Corporation of South Africa (NECSA), SA National Botanical Institute etc.		
Agency Funding e.g. all funding administered by NRF and its National Facilities (HartRAO, SAIAB, iThemba Labs, SAAO, HMO, Zoological Gardens); THRIP funds from DTI; Innovation Fund; MRC Agency funding Note: Report only the component of funding spent by **your** institution		
Science Council Funding i.e. CSIR, HSRC, MRC (Non-agency), ARC, Geosciences, SABS, Mintek, Africa Institute of SA		
Domestic Business including industry funds for THRIP projects		
Other South African Sources		
• Other Higher Education Institutions		
• Not for Profit Organisations		
• Donations and bequests from Individuals		
Foreign Sources		
SUB-TOTAL EXTERNAL SOURCES	**F**	-

NOTE F: THE CALCULATION OF GENERAL UNIVERSITY FUNDS

- To calculate General University Funds please subtract the subtotal of all external sources listed above (F) from the total in-house R&D expenditure reported in Q8. General University Funds will therefore comprise components of the Higher Education Vote and the HEI's own funds (e.g. income from endowments, shareholdings, property, student fees, and subscriptions to journals).
- In order to enable us to classify the source of these funds more accurately, please provide your best estimate of the split of these General University Funds that can be attributed to the Higher Education Vote and the University's Own Funds. You may use a percentage distribution to calculate the split.

Total R&D EXPENDITURE (carried over from Q8)	**E**	-
SUB-TOTAL (EXTERNAL SOURCES) (carried over from F above)	**F**	-
GENERAL UNIVERSITY FUNDS (See NOTE F above) (Including the Higher Education Vote and the HEI's Own Funds)	**E - F**	-
Higher Education Vote	%	
Own Funds	%	

10. FOREIGN SOURCES OF FUNDS (in R000's) FOR IN-HOUSE R&D

Provide a breakdown of the foreign funding expenditure (as reported in Q9) according to the categories listed below.

10a. If your organisation received no R&D funding from foreign sources kindly tick N/A here and move to question 11:

NA

Category	Category (Sub-Total)	SUB TOTAL (R000's) made up of : Africa (outside SA)	Middle East	Europe	USA / Canada	Central & South America	China	Rest of Asia	Other
Business	**0**								
Not-for-Profit Organisations / Individuals**	**0**								
Foundations	**0**								
Government	**0**								
Higher Education	**0**								
TOTAL	**0**								

** **Including affiliated company, trade associations** (Affiliated denotes parent or subsidiary organisation)*
*** NPO's serving households only. Funding from non-profit organisations primarily serving by Business, Higher Education or Government should be allocated to these sectors.*

11. PROVINCIAL EXPENDITURE ON R&D

State the locations where the reporting unit carries out R&D activities and the percentage of the total R&D expenditure.

- Specify where R&D is actually performed, rather than where it is managed from.

Eastern Cape		Mpumalanga	
Free State		Northern Cape	
Gauteng		North-West	
KwaZulu-Natal		Western Cape	
Limpopo		**TOTAL**	**100%**

PART 4: CATEGORIES OF R&D EXPENDITURE

12. IN-HOUSE R&D CURRENT EXPENDITURE BY TYPE OF R&D

Specify the percentage of IN-HOUSE R&D LABOUR COST AND OTHER CURRENT EXPENDITURE by type of R&D.

Basic Research

Work undertaken primarily to acquire new knowledge of the underlying foundations of phenomena and observable facts, without a specific application in view.

The analyses of properties, structures and relationships with a view to formulating and testing hypotheses, theories or laws.

Research providing the broad base of knowledge necessary for the solution of recognised practical problems.

The results of basic research are usually published in scientific journals.

%

Applied Research

Original investigation to acquire new knowledge with a specific application in view.

To determine the possible uses for the findings of basic research.

To determine new methods or ways of achieving specific and pre-determined objectives

The results of applied research are intended primarily to be valid for a single or limited number of products, operations, methods, or systems.

Applied research develops ideas into operational form.

The knowledge or information derived from it is often patented but may also be kept secret.

%

Experimental Development

Systematic work using existing knowledge gained from research and/or practical experience for the purpose of creating new or improved materials, products, processes or services, or improving substantially those already produced or installed.

%

TOTAL **100%**

13a. RESEARCH FIELDS (RF)

Classify R&D according to Research Fields (see Codes book) and provide the associated % of the <u>Total</u> R&D Expenditure per research field

- The RF Codes are based on recognised academic disciplines and emerging areas of study.
- RF Codes per institution may exceed the number of rows provided for in the questionnaire - please feel free to provide an expanded list of RF Codes on a separate sheet if applicable.

	RF Codes	Percentage		RF Codes	Percentage
RF			RF		
RF			RF		
TOTAL					100%

13b. Multi-Disciplinary R&D

- Multi-disciplinary R&D combines several research fields or disciplines. If your organisation performs such R&D, as described below, please provide the applicable % of total R&D Expenditure.
- Note that the percentages will most likely not total 100%.

DEFINITIONS

- **Biotechnology** is application of science and technology to living organisms as well as parts, products and models thereof, to alter living or non-living materials for the production of knowledge, goods and services.
- **Nanotechnology** is the understanding and control of matter at dimensions of roughly 1 to 100 nanometers, where unique phenomena enable novel applications. Encompassing nanoscale science, engineering and technology, nanotechnology involves imaging, measuring, modelling, and manipulating matter at this length scale.

Please estimate the percentage of R&D expenditure allocated to the following areas:

Multidisciplinary Area of R&D	% of R&D expenditure
Biotechnology	
Nanotechnology	

No Multi-Disciplinary R&D ☐ ← TICK if no such R&D is done

13c. Specific Areas of R&D

- National R&D Strategies emphasize the importance of certain areas of R&D.
- Some of these areas are listed below. If your organisation performs R&D in these areas, please provide the applicable % of total R&D Expenditure.
- Note that the percentages will most likely not total 100%.

Please estimate the percentage of R&D expenditure allocated to the following areas:

Specific Areas of Interest	% of R&D expenditure
Open source software	
New materials	
Tuberculosis (TB), HIV/AIDS, Malaria	
Environment/ Environmental issues	
Space science	
No R&D in these areas	

TICK if no such R&D is done

14. SOCIO-ECONOMIC OBJECTIVES (SEO)

Classify R&D according to Socio-Economic Objectives (see Code book) and provide the associated % Expenditure

- The SEO classification provides an indication of the sector of the national economy which will be the main beneficiary of the R&D you are practicing.
- SEO Codes per institution may exceed the number of rows provided for in the questionnaire - please feel free to provide an expanded list of SEO Codes on a separate sheet if applicable.

	SEO Codes	Percentage		SEO Codes	Percentage
S			S		
S			S		
S			S		
S			S		
S			S		
TOTAL					**100%**

15. COLLABORATIVE R&D

15a Does your institution collaborate on R&D with persons / organisation outside your own institution?
YES ☐ **Continue with Question 15.b** **NO** ☐ **Go to Question 16**

15b. With whom is R&D conducted in partnerships, alliances or collaboration?

NOTE: In the table below a single collaborative R&D project with several partners may be ticked in several places. Collaborative R&D may be in-house or out-sourced. R&D collaboration can occur without expenditure – please note zero expenditure in such cases.

	South Africa	Foreign	Foreign consisting of . . . (tick as appropriate)							
			Africa (outside SA)	Middle East	Europe	USA / Canada	Central & South America	China	Rest of Asia	Other
Higher Education Institutions										
Science Councils (e.g. CSIR, Mintek, MRC, ARC etc)										
Government Research Institutes										
Members of own organisation / Affiliated* organisations										
Business enterprises (specialist consultants and trade associations)										
Not-for-profit organisations**										
NO COLLABORATION										
	R 000s Excl VAT	**R 000s Excl VAT**								
TOTAL (in-house & outsourced) R&D collaboration expenditure										

** Affiliated denotes parent or subsidiary organisation*
*** NPO's serving households only. Funding from non-profit organisations primarily serving by Business, Higher Education or Government should be allocated to these sectors*

PART 5: R&D OUTSOURCED / CONTRACTED OUT

Outsourced R&D refers to:

- Outsourced or extramural expenditures being the amounts a reporting unit paid or committed to pay to another organisation for the performance of R&D during a specific period.
- This includes acquisition of R&D performed by and/or grants given to other organisations for performing R&D.

If your organisation does not outsource any R&D kindly tick N/A.

N/A

16. State the value of R&D outsourced INSIDE South Africa

R'000 Excluding VAT

17. State the value of R&D outsourced OUTSIDE South Africa

R'000 Excluding VAT

THANK YOU FOR YOUR TIME AND EFFORT!

G. USER SATISFACTION SURVEY

SOUTH AFRICAN NATIONAL SURVEY OF RESEARCH AND EXPERIMENTAL DEVELOPMENT: STATISTICAL REPORT 2018/19

In order to improve the quality and relevance of the R&D statistics, it would be useful to receive the views of users of this publication. It would therefore be appreciated if you could complete the following questionnaire and return by fax to +27 (0)21 461 1255 or by e-mail to RnDSurvey@hsrc.ac.za.

1. Name and address of respondent:

Name and title _____

Designation/occupation _____

Name and address of organisation or enterprise _____

_____

_____

2. Which of the following describes your area of work? Mark with 'X'.

- ☐ Government
- ☐ Private enterprise
- ☐ Public enterprise
- ☐ Academic or research institution
- ☐ International organisation
- ☐ Media
- ☐ Not-for-profit organisation
- ☐ Other, specify _____

_____

_____

3. In which country do you work?

_____

4. What is your assessment of the contents of this publication?

☐ Excellent ☐ Good ☐ Average ☐ Satisfactory ☐ Poor

5. How useful is this publication for your work?

☐ Extremely useful ☐ Very useful ☐ Useful ☐ Partly useful ☐ Not at all useful

6. How accurate is the picture of R&D in your sector or research field/s as presented in this publication?

☐ Very accurate ☐ Fairly accurate ☐ Unsure ☐ Not very accurate ☐ Not at all accurate

7. How easy was it to find specific information that you required in the publication?

☐ Extremely easy ☐ Very easy ☐ Easy ☐ Not very easy ☐ Not at all easy

8. What information (i.e. tables, text or figures) were of most interest to you? Please be as specific as possible e.g. provide table, page or figure numbers.

9. What did you like best about the publication?

10. Provide any comments or recommendations for the improvement of the publication.

Thank you for completing the survey.

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