STI OUTOOK 2002 – COUNTRY RESPONSE TO POLICY QUESTIONNAIRE

SOUTH AFRICA

1. General framework and trends in science, technology, and industry policy

National System of Innovation perspective

South Africa operates its science and technology policy within the framework of the National System of Innovation (NSI). Policy development took cognisance of the nature and strength of the institutions/organisations within the NSI, their relationships with one another, their importance to the economy and impact on various other government policies. The focus sought a science and technology alignment with new thrusts in areas such as Education, Communication, Labour, Health, Trade and the Environment.

In preparation for the annual policy review in early 2002 a key policy paper proposes significant interventions to increase the investment in, governance of, and targeting of the national system of innovation. This will lead to a major policy shift that will emphasise the strategic importance of the S&T system in South Africa. This strategy will be published in the second quarter of 2002.

Since 1999 the major policy developments have been:

- **Strengthening different knowledge areas** within the system of innovation in order to enhance linkages to industry and ensure, in some cases, the protection of key national knowledge bases. Initiatives include the establishment of the National Laser Centre, the creation of a National Biotechnology Strategy (accepted by Cabinet in July 2001). Research programmes related to indigenous knowledge are now well established. Legislation is being drafted to support more effective promotion and use of indigenous knowledge as well as ensuring better protection of such knowledge and better linkages to international agreements on intellectual property. South Africa is also developing biodiversity legislation to ensure effective protection and management of South African bio-resources.

- **Strengthening diffusion mechanisms.** The focus here has been on the creation of a number of different institutional capacities in the field of technology demonstration, innovation support and business, and technology incubation. The major reason for this development, is a poor capacity to create new high-tech small enterprises from the university and research environment. A major initiative at the provincial level, is the creation of the Gauteng Innovation Hub, which is a significant science park and incubator capacity linked to the University of Pretoria and the CSIR.

- Significant attention has been paid to **strengthening initiatives to enhance public understanding of science and technology**. This has involved the re-design of the

Foundation for Education, Science and Technology to create an explicit mandate in respect of public understanding and the drafting of legislation to transform this organisation into the "Institute for the Promotion of Science". This has also involved increasing budgetary allocations and the stimulation of public/private partnerships in this field.

- In the domain of **governance**, research institutions now operate according to a single set of key performance indicators and performance is measured annually. The National Advisory Council on Innovation, which undertakes this process has also increased allocations to health research, science and technology agency funding to universities and the Innovation Fund (which is a competitive consortium based research fund). The major impact of these allocation changes has been the reduction of financing for core budgets for research councils in real terms over this period. A major feature of this period has been the development of both informal and formal networks of institutions (for example the Committee of Heads of Organisations in Research and Technology (COHORT), The Council of Trade and Industry Institutions (COTII) amongst others). This is evidence of the increasing recognition of the inter-connectedness of South Africa's system of innovation.

- In the area of **international relations in science and technology**, South Africa has very significantly increased bilateral and multilateral engagements. The key objective here has been to undo some of the effects of the isolation of South African science and technology from the rest of the world during the apartheid era. The New Partnership for African Development (NEPAD) is a major initiative in the African context to stimulate the development of Africa. Science and technology has a key role to play within this programme and planning is focused on the creation of sustainable centres of excellence in science and technology across the continent and the more effective use of indigenous knowledge as a platform for integration with other forms of scientific knowledge. The major current emphasis is on development of technology policies supportive of sustainable development as part of the preparation for the World Summit on Sustainable Development, which will take place in Johannesburg in 2002.

- The Department of Trade and Industry **towards an "integrated manufacturing" approach** recognises that the technological impact and consequent economic changes brought about by information and communication technologies (ICT). The shift introduces upstream value-added product enhancement by way of targeted development, improved design and improved integration with downstream activities such as marketing and sales. The new industrial strategy goes beyond a focus on production – it integrates the logistics and inter-firm linkages to ensure the knowledge about products and services creates value as much as the products themselves.

Organisation and Governance of the Science, Engineering and Technology (SET) base

The establishment of the National Advisory Council on Innovation (NACI) to provide advice to the Minister on all matters related to science, engineering and resulted in an increased capacity to serve this requirement. NACI now has the capacity to undertake significant policy investigations and analysis.

The shift in national expenditure to a medium term (3year) planning cycle and the introduction of an integrated approach for the Heads of Government Departments to plan and execute their functions have contributed greatly towards bringing more coherence into the organisation and governance of the wide range of science, engineering and technology institutions (SETIs).

Commitment of funding for three-year period has provided a greater stability and confidence within the SET community. There is increased support for the co-ordination role played by the Department of Arts, Culture, Science and Technology (DACST) in terms of managing the budget function for the SETIs with line departments such as Health, Trade & Industry, Minerals & Energy and Agriculture. A research outputs and technology outcomes approach to the assessment of SETIs was introduced in the late 1990s. A substantial degree of institutional transformation and restructuring has taken place at the institutional level and within institutions.

There have been significant shifts of funding from the grant funding for core functions of SETIs to national strategic development imperatives. The redirected funds have been managed through new competitive modalities that seek to establish new research relationships across disciplines and to draw in participation from the broader research community.

Regulation and legislation

South Africa is currently preparing legislation and the regulatory frameworks in the area of biodiversity. The aim is to ensure the effective protection and management of the access to the rich bio-resource base. The research community will be impacted by a regulatory system for certain bioscience activities and an environmental management plan for designated conservation areas.

South Africa is developing legislation to support more effective protection of indigenous knowledge, promotion of indigenous knowledge and the creation of linkages with other knowledge systems and intellectual property protection systems.

Institutional platforms (SET infrastructure)

The South African Cabinet was presented (in 1998) with a number of institutional review reports that investigated the existing institutional SET infrastructure in terms of its relevance, the quality of the science and the "value for money" for South African society. The findings of these reviews have led to policy shifts in funding targets, such as a doubling of the funding to medical research administered through the Medical Research Council over a five-year period and a fifty percent increase in grant funding for research grants targeting the researchers in the higher education sector.

A focus on institutional platforms has resulted in the restructuring of institutions such as the Nuclear Energy Corporation of South Africa (NECSA), previously Atomic Energy Corporation. One the spin-offs of this exercise was the establishment of the National Laser Centre.

Other institutional developments have seen the establishment of the:

- National Advisory Council on Innovation.
- Academy of Science of South Africa.
- GODISA (national technology incubation programme).
- TSP (technikon based technology diffusion programme targeting small business).
- National Product Development Centre (focus on rapid prototyping technologies).

- Given the growing focus on earth and biosciences, institutional platforms under development include the South African Environmental Observatory Network, the South African node for the Global Biodiversity Information Facility (GBIF) and a strengthening of the considerable number of Biological Resource Centres.

- The establishment of the South African Weather Service as an agency outside the Department of Environment Affairs and Tourism.

In respect of the higher education sector the "National Plan for Higher Education" promises to change landscape of Universities and Technikons, including the way that research is funded, assessed and rewarded. The final outcome of this major process, which will see major changes in universities and research capacity will unfold during the course of 2002. The key proposals of the plan are as follows:

- The introduction of measures that will see the participation rate in higher education increased from 15% to 20% in the long-term, *i.e.* ten to fifteen years.

- The introduction of a shift in the balance of enrolments over the next five to ten years between the humanities, business and commerce and science, engineering and technology from the current ratio of 49%: 26%: 25% to 40%: 30%: 30% respectively.

- Institutions will be expected to establish student equity targets with the emphasis on the programmes in which black and previously disadvantaged students are currently under-represented and to develop strategies to ensure equity of outcomes.

- Institutions will be expected to develop employment equity plans with clear targets for rectifying race and gender inequities.

- Institutional diversity will be achieved through the approval of a distinct mission and academic programme profile for each university and technikon.

- The academic programme mix at each institution will be determined on the basis of its current programme profile, as well as the demonstrated capacity to add new programmes to the profile.

- The existing mission and programme differentiation between technikons and universities will be loosely maintained, at least until 2006.

- Redress for historically black institutions will be linked to agreed missions and programme profiles, including developmental strategies to build capacity.

- A single dedicated distance education institution will be established through the merger of the University of South Africa and Technikon South Africa and the incorporation of the distance education centre of Vista University into the merged institution.

- Research will be funded through a separate formula based on research outputs, including, at a minimum, masters and doctoral graduates and research publications.

- Earmarked funds will be allocated to build research capacity, including scholarships to promote postgraduate enrolments.

- The institutional landscape will be restructured to create new institutional and organisational forms. This will be achieved through collaboration at the regional level in programme development, delivery and rationalisation, in particular, of small and costly programmes.

- A National Working Group has been established to investigate the feasibility of consolidating higher education provision through reducing the number of institutions, but not the number of delivery sites, on a regional basis.

Funding and steering of research

Since 1999 the National Advisory Council on Innovation (NACI) has played a stronger role in evaluating the allocation of resources to public research organisations and university funding agencies. With the concept of the "knowledge economy" driving much of these considerations the portfolio approach to distributing the Science Budget (one third of South Africa's Gross Expenditure on R&D) focused on the following areas:

- Core grant funding to the major public research institutions.

- Competitive grant funding accessible by the broader research community in directed research thrust areas.

- Agency funds for research capacity building (human capital formation) primarily in the higher education sector.

- National Facilities such as the astronomical observatories.

- Standards development activities (underpinning technology transfer within industry).

Initially the steering was across these broad areas but has increasingly shifted into specific thrust areas. The National Biotechnology Strategy is the most recent example of this targeted approach.

The Science Budget is administered by the Department of Arts Culture Science and Technology as a strong integrative mechanism for public expenditure in S&T. The attached table gives the distribution of the science vote over the policy review period. The currency used in the table is SA Rands. The amounts are in nominal units (not adjusted for inflation)

Table 1: Distribution of science vote allocation[1]

Department/Institution	Main estimate of expenditure (R'000)			Medium-term expenditure estimate (R'000)			
	1997/98	1998/99	1999/00	2000/01	2001/02	2002/03	2003/04
Department of Agriculture	–	–	–	–	–	–	–
Agricultural Research Council	316 220	284 001	279 237	265 275	262 146	261 552	271 640
Department of Arts, Culture, Science and Technology	–	–	–	–	–	–	–
Human Sciences Research Council	89 774	93 253	64 419	61 198	65 492	65 087	67 413
Africa Institute of South Africa	2 901	3 184	5 321	7 321	8 178	8 981	9 351
National Research Foundation	162 591	210 416	250 570	271 714	304 479	336 275	342 042
Equipment Placement/Infrastructure	–	–	–	10 000	14 000	20 000	30 000
National Laser Trust	–	–	–	11 000	9 000	9 000	9 000
Technology Stations Programme	–	–	–	4 300	7 000	9 000	9 000
International Lead Programme	–	–	–	15 000	20 000	24 000	24 000
GODISA Programme	–	–	–	3 200	5 200	9 000	9 000
Regional Science and Technology Programme	–	–	–	3 000	3 000	9 000	11 000
Indigenous Knowledge System	–	–	–	–	3 000	8 000	10 000
Innovation Fund	–	30 000	75 000	125 000	132 916	136 726	158 000
Department of Arts, Culture, Science and Technology special projects	13 981	36 930	45 458	21 994	20 200	24 101	26 004
Department of Health	–	–	–	–	–	–	–
Medical Research Council	66 277	76 434	79 566	108 211	127 221	145 498	152 270
Department of Trade and Industry	–	–	–	–	–	–	–
Council for Scientific and Industrial Research	316 420	313 500	315 649	299 867	302 877	301 251	312 652
South African Bureau of Standards	67 074	75 020	77 724	78 724	81 369	85 000	88 825
Department of Minerals and Energy	–	–	–	–	–	–	–
Council for Geosciences	64 615	65 822	63 794	60 604	65 946	66 384	68 687
Council for Mineral Technology	82 994	83 108	81 773	77 684	76 872	76 410	79 363
Total	1182847	1271668	1338511	1424092	1508896	1595265	1678247

[1] ***The amounts quoted in the table relate to the core funding of the various science councils and do not include ad hoc departmental allocations.***

The Department of Trade and Industry has introduced a range of supply-side support measures targeting the manufacturing industry with a strong technology development focus. These include a matching-grant scheme for product development and sector partnership funds and competitiveness funds with a bias towards promoting exports.

The Technology for Human Resources in Industry Programme (THRIP) provides matching funding for joint industry-academic research projects, mobility grants and support to SMMEs that wish to work more closely with Universities. The programme has doubled in size over the past four years and continues to enjoy strong support from industry and the University sector in particular

A number of funding instruments operated by Government Departments is shown below in Table 2.

Table 2: Funding Instruments operated by Government Departments

Department / Institution	Funding Instrument	Expenditure (R'000)			
		97/98	**98/99**	**99/00**	**2000/01**
Department of Minerals & Energy	SIMRAC[2]	38 000	39 400	40 900	42 400
Department of Water Affairs & Forestry	Water Research Commission	42 684	52 885	70 189 (for 15 months *i.e.* 01/01/1999-31/3/2001)	
Department of Trade & Industry	THRIP[3]	49 384	98 688	109 906	139 999
	SPII[4]	-	-		11 652

Performance measurement

One of the key policy directions for science and technology in South Africa has been to ensure that the governance system includes adequate arrangements for the evaluation of performance against international best practice and that output measures are in place to indicate the nature of the contributions being made by public research institutions to South Africa's development. The last two years have seen the development of a Key Performance Indicator (KPI) framework for SETIs. A set of indicators that can have generic application for research institutions and have relevance in terms of Treasury criteria based on benefits to the economy and improvements in the quality of life for South Africans have been developed and implemented. The set of KPIs outlined below include both quantitative and qualitative indicators used to measure, monitor and manage the organisations effectiveness, efficiency and sustainability.

[2] Safety in Mines Research Advisory Committee

[3] Technology for Human Resources & Industry Programme

[4] Support Programme for Innovation in Industry (merger of different funds therefore comparable figures for earlier years not available)

GENERIC KPIs FOR SCIENCE COUNCILS	
1.	**FINANCIAL AND INVESTMENT PERSPECTIVE**
➢	Investment is well targeted and managed
➢	Investment in knowledge generation / savings to the state & society
➢	Soundness of market /user relationships
➢	Competitiveness (first, second or last port of call)
➢	Effective and efficient management of costs
➢	Effective and efficient management of technology
➢	Effective and efficient management of assets (*e.g.* capital equipment, reserves, etc.)
2.	**STAKEHOLDER/CUSTOMER PERSPECTIVE**
➢	Support of the NSI goals
➢	Sustained democratisation & transformation
➢	Promoting macro-economic goals & objectives
➢	Ensuring access to knowledge infrastructure/customer satisfaction
➢	Technology diffusion/dissemination of information and research results
➢	Ensuring quality of policy decision making
➢	Promoting networks & linkages
3.	**ORGANIZATIONAL PERSPECTIVE**
➢	Closeness to operational best practice
➢	Quality of science and technology base
➢	Quality of science and technology services and products
➢	Relevance of the research portfolio
➢	Profile i.r.o partnerships/ joint ventures/ co-operation agreements
➢	Corporate culture
4.	**INNOVATION AND LEARNING PERSPECTIVE**
➢	Contribution to knowledge stock
➢	Development of human resources in science and technology (knowledge capital)
➢	Support for a knowledge-based economy
➢	Nature & extent of Foresight capacity engagement in new core technology areas
➢	Nature and degree of commitment to promoting public understanding of science and technology
5.	**HUMAN RESOURCES AND TRANSFORMATION**
➢	Training and Development
➢	Employment Equity
➢	Remuneration Equity
➢	Democratisation

A South Africa/OECD seminar was held in March 2001 on science, technology and innovation indicators. This has significantly strengthened the integrated use of indicators in evaluating the performance of the system of innovation. An international benchmarking review is currently underway on the financing, pricing and cost of agricultural research and agricultural research institutions.

2. Public sector research and public research organisations

Government clearly signalled in the policy development phase that science, engineering and technology institutions (SETIs) should derive increasing levels of external funding, primarily from the private sector. This move meant that individual SETIs had to develop internal policies to guide their business negotiations with industrial partners. It also meant that on government's side funding strategies had to be designed and implemented that encouraged effective and productive linkages between SETIs for the production of knowledge and the application of technologies. New programmes like the Innovation Fund that assesses not only the R&D content but "consortium relationships" and commercialisation strategies as selection criteria are some of the efforts geared to improving and strengthening the links between science and industry.

R&D Expenditure by Socio Economic Objective and Sector - 97/98 survey (as percentage of GERD)

Sector	Business %	PRO & Non Profit %	Education %	Total %
Defence	**11.5**	**1.9**	**0.1**	**13.5**
Economic Development	**33.7**	**20.8**	**2.4**	**56.9**
Society	**4.5**	**4.9**	**2.9**	**12.3**
Environment	**1.5**	**3.2**	**0.6**	**5.3**
Advancement of Knowledge	**2.8**	**3.2**	**6.0**	**12.0**
TOTAL	**54**	**34**	**12**	**100**

R&D Expenditure by Research Field and Sector - 97/98 survey (as percentage of GERD)

Sector	Business %	PRO & Non Profit %	Education %	Total
Agriculture	**2.6**	**6.9**	**0.5**	**10.0**
Engineering	**23.5**	**12.7**	**1.1**	**37.3**
Medical Health	**4.3**	**1.9**	**2.4**	**8.6**
Natural Sciences	**23.2**	**9.7**	**3.0**	**35.9**
Social Sciences and Humanities	**0.4**	**2.7**	**5.1**	**8.2**
TOTAL	**54.0**	**33.9**	**12.1**	**100**

3. Government support for private-sector R&D and innovation

The South African policy currently does not provide any tax credits or other fiscal benefits for the undertaking of research and development. Similarly public procurement policies do not offer incentives related to research and development or indigenous innovations.

The Innovation Fund is a specific R&D grant funding intervention designed to encourage greater participation in the new core technology areas of information & communication technologies (ICT), biotechnology and advanced manufacturing and new materials.

South Africa's bio-resources create potential for technology applications that will deliver both economic gains and quality of life improvements. Biotechnology is one of the technologies that can be widely applied in various fields such as health, agricultural and agro-processing, minerals and their processing,

criminal justice and defence and environmental management. Most important is that the developments in biosciences are driving an economic revolution that could shape the future of human endeavour. Against this background the South African national Biotechnology Strategy was produced in 2001.

The strategy addresses the means by which government can influence the development of biotechnology. These include the legal framework, the funding mechanisms, the creation of new infrastructure and institutional arrangements and the construction of research capacity through appropriate human resource development.

The recognition of the importance of ICT and biotechnology and the newly instituted instruments such as the innovation fund and the biotechnology strategy are changing the make up of the scientific infrastructure in the country.

4. Enhancing collaboration and networking among innovating organisations

At present in South Africa, there are a very large number of disparate initiatives in this domain. These include the initiatives and networks described above, new service infrastructure for firms such as The Manufacturing Advisory Centres, The National Product Development Centre and range of sectoral participation initiatives operated by the Department of Trade and Industry.

The Industrial Development Corporation with the support of the Department of Trade and Industry has created three venture capital operations that complement a growing private sector venture capital and private equity capability in South Africa. At present, this sector is not yet financing pre-seed, seed and higher risk early stage opportunities and attention will have to be paid to this over the next period.

South Africa has a relatively open system relating to licensing of public research results. This has not, however, led to a strong institutional capacity for technology transfer and the management of intellectual property. During the course of the last year, this has been an area of active review by a number of key institutions and the ability to manage and commercialise intellectual property is being actively strengthened. In addition, the rate at which universities and public research organisations are creating spin-offs has increased very significantly. At present, there are not significant policy or institutional barriers that limit these developments.

5. S&T human resources

Currently there is less than one researcher for every thousand members of the workforce. Although there has been some progress in developing black managers in the science and technology system (up from 4% in 1994 to 30% today), there are far too few black researchers. The National Research Foundation (NRF) is funding increasing numbers of black postgraduates through its university grant financing programmes and scholarships for post-graduate study.

The National Research Foundation Act of 1998 led to the launch of the National Research Foundation (NRF) on 1 April 1999. The NRF effectively brought together the previous Foundation for Research Development (FRD), which traditionally funded research in the areas of science, engineering and technology and the Centre for Science Development (CSD), which funded research in the social sciences and humanities. The object of the NRF is to support and promote research through funding human resource development and the provision of the necessary research facilities in order to facilitate the creation of knowledge, innovation and development in all fields of science and technology, including indigenous knowledge, and thereby to contribute to the improvement of the quality of life of all the people of South Africa.

South Africa has serious structural problems at school level, which leads to a very low level of university entrants who have mathematics and science matriculation. At present, about 19 000 matriculants have qualifications at a level which would permit them to enter natural science and engineering programmes. University output of engineers and scientists has not increased significantly over the last few years. The proportion of scientists and engineers relative to total graduates is significantly below OECD levels and far too low for the requirements of the knowledge economy. As indicated above, significant interventions are being planned for the higher education sector. However, school level interventions, systematic public understanding programmes and targeted attraction of skills from abroad will all be necessary to address the very serious deficits in S&T human resources. At present, there is a significant net shortage in nearly all engineering disciplines with very significant shortages in ICT related disciplines.

There are a large number of interventions to address under represented populations in science and engineering and to ensure greater participation by women in disciplines where they are currently under-represented. Many of these interventions are related to the broad changes in education policy that resulted from the establishment of South Africa's new democracy in 1994.

DACST currently has a dedicated support programme for promoting "mobility of researchers". It is scoped very much in terms of optimising the opportunities for research collaboration identified within multilateral and bilateral international agreements. With South Africa's re-entry into the global arena post-apartheid, this programme has trebled over the past three years and looks set to grow much more rapidly.

6. International co-operation and globalisation

South Africa attempts actively to integrate its economy and its scientific and technological infrastructure in the international community.

The scale of South African participation in international research collaboration expanded rapidly from 1994, although such collaborative measures were fairly new to most South African higher education institutions, particularly those without a strong culture of research.

A number of programmes that we outlined above aim to link South African scientists and institutions with their counterparts abroad. Examples include the LEAD Programme, the Industrial Participation Programme and the South African Large Telescope (SALT).

South Africa is focussing its international science efforts on the creation of large-scale long-term research programmes where South Africa has particular geographical or locational advantages. Four key focus areas are:

1. Astronomy.
2. Palaeontology.
3. Biodiversity.
4. Ocean, Island and Antarctic research.

These programmes are associated with attracting multilateral funding and strengthening bilateral research relationships.

In the technological arena, a number of sectors are areas of greater activity. These include:

- The automotive sector (including the establishment of the Automotive Industry Development Centre and specialist engine testing capabilities to reduce potential technical barriers to trade).

- The National Laser Centre, which is participating in the development of an African laser consortium.

- The biotechnology strategy involves key relationships with countries that have technological resources and potential partnerships that would allow South Africa to address, amongst other things, the need for low cost vaccines and the development of low cost medical diagnostics.

- In the ICT area South Africa will be developing a more coherent approach including Open Source software and computing.

South Africa is developing major policy initiatives relating to the new partnership for Africa's development and the World Summit on Sustainable Development. The policy approach that informs both these initiatives, is related to increased science and technology spending by developing countries, the development of centres of excellence associated with universities and research institutes of developing countries, the reduction of prices for public domain information in textbooks and journals, the increased use of ICT to stimulate technology transfer and uptake and a more effective intellectual property system that addresses issues relating to bio-resources, indigenous knowledge and national risks.