SCIENCE, TECHNOLOGY AND INNOVATION: RECENT POLICY DEVELOPMENT IN SOUTH AFRICA

The development of science, technology and innovation policy in South Africa has generally followed a similar path to that of most OECD countries in terms of a **"National System of Innovation" (NSI)** approach. However it must be noted that South Africa's first democratic government only came into power in the mid-1990's and the policy development phase ran through much of the 1996, 1997 years. The years (1998-1999) under review for assessment in meeting the **"Best-Practice in Innovation and Technology Policy"** recommendations of the OECD's "Technology, Productivity and Job Creation" report were effectively policy implementation years in South Africa. This is not to say that policy development in South Africa happens in a static environment or that new policy is generated in a vacuum. Implementation of the policy developed in the first half of the new democratic government's first term of office is "firming-up" the policy thinking of the White Paper with qualitative and quantitative inputs on the value and capacity of the science and technology base. Reference to recent policy development will therefore apply to the 1996 policy development phase as a point of departure.

The South African policy and institutional environment pre-NSI was one driven by such national objectives as military dominance (in a regional context), food security (in terms of national security) and energy self-sufficiency. State support for science and technology was not a transparent process and heavily skewed in favour of programmes and parastatal institutions designed to build up competencies in these areas. A Green Paper process, providing for broad public consultation on developing policy objectives and strategies, was initiated in 1995. This culminated in the White Paper on Science and Technology 1996, titled "Preparing for the 21st Century". A National System of Innovation approach was established as the framework within which Science and Technology policy would be developed and directed towards achieving national socio-economic targets.

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 South African society in particular and the implications and impact of 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.

The issues the White Paper addressed as systemic failures requiring concerted national action were spelt out as follows:

- A fragmented and inadequately co-ordinated Science and Technology system.
- The erosion of innovative capacity.
- Poor knowledge and technology flows from the science base into industry.
- Poor networking both within the region and in the global context.
- Inefficiencies and poor levels of investment in research and development.

- Imbalances created by past policies and actions.

- A poor competitive position within the global environment.

The new science and technology policy directions that were proposed within the NSI framework included the following:

- Creation of clear channels for capacity building, science and technology human resource development and inequity redress.

- Establishment of mechanisms to re-allocate government spending according to new priorities to promote innovative solutions, particularly related to problems of the disadvantaged.

- Processes that will challenge government research institutions to derive more support from competitive sources of funding.

- Processes that will contribute to achieving efficiencies in R&D spend by promoting the diffusion of research and technology development results.

- Introduction of processes allowing longer-term perspectives in planning and budgeting for R&D.

- Promotion of institutional changes and new management approaches to accommodate the above proposed mechanisms and processes.

Shifts in types of policy instruments used

Science and Technology Objectives

The NSI approach considers that the flow of knowledge and technologies is also affected by policies of other state departments other than that of science and technology. **The co-ordinating role** that the Department of Arts, Culture, Science and Technology (DACST) performs and the structured relationship between departments within the NSI (see figure 1 attached) facilitates the process of ensuring that issues related to financing, procurement, regulatory, governance, privatisation and competition policies are constantly under review in so far as they impact on the innovation process. What is also important to note is that the **process for identifying priorities** for science, technology and innovation takes place within the broader macro-development framework. Thus it was that the White Paper process **reviewed a number of policy documents** having application in the areas mentioned above to determine their relevance to, demands on and expectations of the science and technology system of South Africa. Six common themes emerged from the review of the policy documents, which constitute the six pillars of a globally competitive and nationally equitable South African economy:

- Promoting competitiveness and job creation.

- Enhancing the quality of life.

- Developing human resources.

- Working towards environmental sustainability.

- Promoting an information society.
- Producing more knowledge-embedded products and services.

Policy Strategies

Drawing on the approach of the TIP work on National Innovation Systems (DSTI/STP/TIP(98)6 a few examples of recent South African **policy responses** are set out below in terms of a "whole of government" effort. Those in italics reflect specific Department of Science and Technology initiatives.

Systemic and Market Failures	**Policy Response**
Informational failures	*Research and Technology Audit* Strategic Cluster studies *Research and Technology Foresight* Essential National Health Research – priority setting process
Institutional mismatches between (public) knowledge infrastructure and market needs	*Facilitating joint industry-research co-operation* *Science and technology human capital development* *Public-private partnering* *Support of pre-competitive research* *Technology transfer and diffusion programmes* Joint industry-research centres of excellence Skills development Life-long learning and outcomes-based approach to education
Inefficient functioning of markets	Competition policy and regulatory reform
Absence of a "demanding customer"	Public procurement reform (exploiting buying power to promote innovative behaviour and technology transfer)
Government failure	Privatisation Outsourcing Public consultation

POLICIES RELATED TO THE RECOMMENDATIONS OF THE TPJ

A. Reforms to and support of the science base

Major initiatives to reform universities and/or the role of public laboratories, including the creation of centres of excellence

One of the major initiatives of DACST in promoting the NSI was a **review of government-funded science, engineering and technology institutions** (excluding higher education institutions). Included were Science Councils, National Facilities and other parastatals such as the Atomic Energy Corporation. The system-wide review was completed in 1998 and the findings were synthesised for the purposes of **assessing infrastructural gaps, overlaps, funding mechanisms and state monitoring of scientific research and technological activities and output**. The recommendations arising from the review were adopted by Cabinet in 1998 for implementation by the relevant line-function departments and Boards of the institutions.

A National Research and Technology Audit (NRTA), a nation-wide initiative was commissioned by DACST to assess the strengths and weaknesses of the South African research and technology system. During 1998 eight final reports, including a synthesis report, resulting from the NRTA were released by the Department of Arts, Culture, Science and Technology (DACST). **Areas of survey covered science and technology infrastructure, a science and technology skills audit, an audit of equipment in research laboratories (public and private), research and development outputs and an overview of the small, medium and micro enterprise (SMME) sector.** The recommendations and findings from the NRTA (including an extensive database) are being used to inform the implementation of science, technology and innovation policy in the country.

The *Education White Paper 3: A Programme for the Transformation of Higher Education* (July 1997) and the Higher Education Act (Act 101 of 1997) provide the policy and legislative framework for transforming the higher education system and its institutions to be more responsive to societal interests and needs. Implementation of this framework began in 1998. The White Paper emphasises that successful policy must restructure the higher education system and its institutions to meet the needs of an increasingly technologically orientated economy. It must also deliver the requisite research, the highly trained people and the knowledge to equip a developing society with the capacity to address national needs and to participate in a rapidly changing and competitive global context. The White Paper recommends a focus on science, engineering and technology programmes to correct imbalances, particularly the shortage of trained personnel in these fields. All higher education institutions are currently undergoing transformation to redress past imbalances.

The major debate concerning the 21 universities and 15 technikons in South Africa has centred on the required, or ideal, size and shape of the higher education sector to best serve the needs of the country. Between the Council on Higher Education (CHE – established in 1998 as a statutory advisory body), the

Higher Education Quality Committee (established by the CHE in 1999) and the Department of Education, new policies for higher education are being implemented.

A national plan for promoting and establishing centres of excellence is still being debated. In the meantime, some progress has been made in creating such centres, mainly as a result of individual government departments, private sector and higher education partnerships. An initiative of the DACST has resulted in the development of a National Laser Centre that draws on infrastructure, expertise and other assets of state funded organisations such as a statutory research council, the Council for Scientific and Industrial Research (CSIR) and a parastatal, the Atomic Energy Corporation (AEC). Telkom, the national telecommunications provider, has also established twelve centres of excellence with different research and technology foci in the information and communications technology area. These centres are based on partnerships between historically "advantaged and disadvantaged" higher education institutions and private sector suppliers.

Changes in the funding of the basic science or changes in the criteria for public funding

A new funding mechanism, the *Innovation Fund*, has been introduced with the objectives of:

- Reallocating resources from the historical patterns towards the key issues of competitiveness, quality of life, environmental sustainability and information technology.

- Increasing the extent to which funds for the activities of government science, engineering and technology institutions are obtained via competitive processes.

- Promoting networking and cross-sectoral collaboration within South Africa's national system of innovation.

This funding mechanism was piloted in 1997 with a targeted focus on facilitating a science and technology contribution to South Africa's National Crime Prevention Strategy. Focal areas in (i) Information and Communication Technology (ICT), (ii) Biotechnology and (iii) Advanced manufacturing and new materials have since been opened.

The National Research Foundation Act (Act No 23 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.

The NRF was envisioned in the White Paper on Science and Technology and created with the aim of consolidating the agency (grant funding) function and promoting research in support of the NSI.

Major initiatives to involve stakeholders in the setting of research priorities

The National Advisory Council on Innovation (NACI) Act of 1997 was formed with the intention of creating a Council to advise the Minister (of Arts, Culture, Science and Technology), the Ministers' Committee on Science and Technology and Cabinet on the role of science, innovation and technology in

promoting and achieving national objectives. The 18 members of NACI, representing a wide variety of interests and sectors in South Africa, were announced in October 1998. One of the main functions of NACI is the identification of research and development priorities, in consultation with provincial departments and interested parties, and their incorporation in the process of government funding of research and development.

Another initiative to involve stakeholders in the setting of research priorities is the DACST' National Research and Technology Foresight Project. It has been a nation-wide initiative aimed at twelve sectors, namely agriculture and agro-processing, business and financial services, health, environment, mining and metallurgy, tourism, biodiversity, energy, information and communication technologies, manufacturing and materials, safety of citizen and society, and youth. In addition, there are three cross-cutting focus areas – education and skills development, value adding and business development. The work spanned a period of some two years and involved some three hundred and fifty working group members and hundreds of other role players drawn from across the broader community. Scientists, engineers and technologists, social scientists, policy analysts, government officials, health practitioners, trade unionists, NGO staff and community activists have participated in this, the first South African research and technology foresight study. The results of the foresight exercise are likely to influence the priorities for research in both the public and private sector.

In another exercise, a total of 77 organisations, drawn from Provincial health departments, other government departments, universities, Science Councils, Non-Governmental Organisations, international funding agencies, and the private sector participated in a Congress that was convened in 1996 as an important consultative step in the prioritisation process that was to be followed in respect of health research. Earlier consultations had resulted in the adoption of the "*Essential National Health Research*" approach as a strategy in South Africa. The aims of the Congress were to:

- Identify health research areas that address priority health problems.
- Develop a process for consensus building.
- Facilitate the establishment of an "Essential National Health Research" Committee.

The National Science and Technology Forum (NSTF) is a stakeholder body which acts as Science, Engineering and Technology (SET) sounding board, communications channel and constructive watchdog at policy and implementation. Its membership base includes umbrella bodies representing:

- Government.
- Science Councils.
- Higher Education.
- State Corporations.
- Business, industry and commerce.
- Professional societies.
- Non-Governmental Organisations.
- Community based organisations.

- Organised labour.

Links between science and industry

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 "consortium relationships" as a selection criteria, and a technology diffusion programme (technikon-based) that targets small, medium and micro-enterprises (SMMEs) as well as improvements that have been effected in existing programmes that provide supply-side support to industry are all efforts geared to improving and strengthening the links between science and industry.

A recent development that empowers South African science councils to straddle both the science base and industry, is the right they have been awarded to engage in "high-tech" spin-offs – whether this is commercialisation of research results acquired from university laboratories or that of the science councils themselves.

The Department of Trade and Industry has in place a programme that supports joint industry-academic research initiatives. This is the Technology for Human Resources in Industry Programme (THRIP). It is administered by the National Research Foundation (NRF) and provides matching funding for joint industry-academic research projects.

A further development relates to "diversification" activities (focus on commercial utilisation of technologies originally developed for military application) supported by the Department of Defence (DoD), manifested in the White Paper on Defence, 1996 and actively effected through a dedicated budget for this. Another recent initiative of the DoD includes the declassification and publication of an extensive list of technologies/capabilities established by the DoD.

Incentives and support for R&D

Major changes in the tax treatment of R&D and/or changes in direct support for R&D

No recent major changes have occurred with regard to the manner in which tax is treated with respect to incentives and support for R&D;

No major changes with respect to levels of direct state support for R&D.

Measures to enhance the eficiency of support, to establish public/private partnerships in R&D or to introduce more competitive programmes for government funding

The DACST Review of Science, Engineering and Technology Institutions secured the following:

- Increased funding to the Innovation Fund.

The strategic implementation of the National System of Innovation approach has resulted in a shift of core funding away from the traditional institutions of research to the *"competitive realities"* of the globalised economic environment. The nature of the instruments used in these strategies are such that there is a strong incentive-driven (funding) push into forming new collaborative research relationships by means of consortium formation comprising universities, technikons, industry, non-government organisations and other science, engineering and technology institutions.

Key Performance Indicator (KPI) study on Science Councils.

Use of NACI (described above) to enhance the quality of the Parliamentary Grant allocation process.

Inclusion of R&D in offset contracts as a category in the Industrial Participation Funds/Programmes of the Department of Trade and Industry.

Changes in the balance of R&D support to different sectors, and initiatives to move from support to R&D to support for innovation, including changes to reflect the growing role of services in innovation

Recent changes include:

- Increased financial support to medical and health related R&D.
- Conscious move toward Information and Communication Technologies (ICT), Crime Prevention and Biotechnology sectors as service oriented sectors (through instruments such as the Innovation Fund).
- Continued reduction in defence spending.
- Increased support to manufacturing in SME area.

Technology diffusion and networking

Major initiatives to enhance commercialisation and technology diffusion, and to enhance business participation and cost-sharing with the private sector in diffusion programmes

There have been some initiatives in this area but it is so recent as to have no noticeable results at this time. Included are the technikon-SMME based *"Technology Station Programme"*, the Ntsika – *"Cocoon"* programme, incubators, technology demonstration centres, a National CAD/CAM Centre, a National Product Development Institute and science parks. The earlier mentioned "Centres of Excellence" in the area of information and communication technologies also addresses issues of technology diffusion.

Efforts to promote technology diffusion for services or to open existing programmes to service firms

The "Centres of Excellence" programme of Telkom has rolled out 12 centres with different research and technology foci in the information and communications technology area. These centres are based on partnerships between historically advantaged and disadvantaged higher education institutions and private sector suppliers. This work is carried out in close collaboration with the NRF, which also has a focus on strengthening the research and technology development capabilities of technikons and other previously disadvantaged institutions.

A research resource centre has recently been jointly established by DACST and the Department of Safety and Security to focus on the utilisation of available technologies/research results to contribute to the national strategy on crime prevention.

Policy initiatives towards cluster formation, including initiatives to use public procurement in promoting innovative behaviour

The existing *Sector Partnership Funds* and the *Spatial Development Initiatives* (SDIs) have major elements of clustering.

The use of the revised policies on public procurement will lead to a promotion of innovative behaviour.

The Gauteng provincial industrial strategy will also promote innovative behaviour with clusters and the corridors as the drivers.

The Industrial Development Corporation (IDC) and recent policy (Department of Trade and Industry) also support clustering.

Changes in competition policy to enable networking and co-operation in pre-competitive research

No specific shift towards this focus as yet.

Technology-based firms and new growth areas

Major programmes to strengthen the creation of high-tech firms, covering fiscal and financial incentives, regulatory reforms to promote entry, changes to bankruptcy laws and initiatives to promote venture capital markets

There are very few initiatives in this area and they are so recent as to have no noticeable results. Examples include an Incubator Programme, a Venture Capital initiative under development and recent Cabinet approval for Science Councils to create high-tech companies.

Specific policy initiatives aimed at new growth areas, such as information technology, biotechnology or knowledge-intensive services

DACST through its policy development processes such as Foresight had identified new growth areas. DACST has established the "Innovation Fund" as a specific policy initiative to encourage greater participation in the new core technology areas of information and communication technologies (ICT), biotechnology, advanced manufacturing and new materials.

Labour-related measures

Policies to change the status of scientific personnel, to enhance mobility of university researchers and scientific personnel, and to increase financial and non-financial incentives for scientific personnel

There have been no major initiatives in this area.

Changes in the support for scientific training and education programmes, policies to enhance the supply of skilled personnel

In 1998 the Skills Development Act (Act No 97) was passed, followed by the Skills Development Levies Act (Act No 9) in 1999. The latter becomes effective on 1 April 2000, requiring every employer to pay a levy at a rate of 0,5% of the 'leviable amount' of staff payrolls. In 2001 the rate will be increased to 1%. The Act is part of the government's strategy to finance training initiatives and to promote skills development in South Africa in an effort to overcome the apartheid legacy of a poorly trained population and largely unskilled workforce. The skills development envisaged will have a peripheral effect on improving the science base, particularly in technical training and in strengthening the human resource infrastructure.

Changes in policies towards the international migration of scientific and high-skilled personnel

The challenges that international migration brings is the draining of human resources from developing countries. For example, doctors trained in South Africa are now working in the United Kingdom and Australia. The South African government, in the health care arena, is utilising government to government agreements such as the initiative that brought Cuban doctors to South Africa.

Globalisation

Policies to promote and reduce obstacles to international co-operation in science, technology and innovation and measures to enhance access of foreign firms to technology programmes

The multiple requests received to formalise and promote bilateral Science and Technology (S&T) co-operation since South Africa's re-entry into the international S&T community, highlighted the need to create a policy framework to proactively guide South Africa's participation in S&T co-operation. The framework guides the governance of S&T co-operation at the political level, the State administrative level and the executing level.

A very recent development is the support for the establishment of a technology "hotline" – SATTBA, to facilitate access to technologies developed in other countries and those developed in South Africa.

New (major) cross country collaborative research programmes

A few worth mentioning include an HIV/AIDS vaccine development programme, a collaborative programme on Malaria and a programme (*LEAD Programme*) designed to encourage Science Councils into collaborative research with international partners in the following targeted areas:

- Biotechnology: Food production, agriculture, health.
- Development of new materials and manufacturing.
- Information technology and systems, and the information society.
- The sustainable management of environmental issues and of natural resources: energy, water, coastal resources, etc. through environmentally friendly technologies.

- Mapping and exploitation of natural resources and minerals.

Policy evaluation

South Africa has a fairly new government in office and has just come through what is commonly termed the “transitionary phase” of a new democracy. Much of this phase has been characterised by activities focussing on policy development and government at all levels is currently engaged in implementing that policy. With the various consultative/advisory instruments that have been designed and established to support policy development and implementation there is a growing debate developing around the need to assess the suite of policies that the country has put in place.