

# Review of the NRDS and TYIP

---

Prof Johann Mouton and team

28 August 2020

# Review fact sheet

## Review team

Johann Mouton, Tracy Bailey,  
Thomas Auf der Heyde, Nelius  
Boshoff, Jan Botha, Michael Kahn,  
Milandr  van Lill, Heidi Prozesky,  
Isabel Basson, Margaret Ward,  
Ntsane Moleleki, Garth Williams  
and David Walwyn

Study commenced January 2019.  
Final report submitted 15 May 2020  
Main report (341pp) + Annexure of  
individual strategy reviews (510pp)



System Governance

Intellectual Property

Technology Innovation Agency

Innovation Fund

R&D Tax Incentive

International Cooperation

DST/NRF Centres of Excellence Programme

South African Research Chairs Initiative

Human Capital Development Strategy for Research,  
Innovation and Scholarship

Astronomy

Palaeosciences Strategy

Marine and Antarctic Sciences

Indigenous Knowledge Systems

Resource Beneficiation and Advanced Manufacturing  
Technology Strategies

Information and Communication Technologies

National Nanotechnology Strategy

Bio-Economy Grand Challenge

Space Science and Technology Grand Challenge

Energy Security Grand Challenge

Global Change Grand Challenge

Human and Social Dynamics Grand Challenge

# Key review questions

---

The review of the National Research and Development Strategy (NRDS) and the Ten-Year Innovation Plan (TYIP) had to address two broad questions:

**To what extent has the NRDS/TYIP addressed the key system enablers (legislation, institutional change, financing and human capital development) of the South African STI system?**

**To what extent have the subsidiary strategies and interventions referenced in the NRDS and TYIP produced the outcomes and achievements as anticipated?**

These questions were addressed in detail in our review at two levels of assessment: (1) the outcomes and achievements of the NRDS and TYIP as system-wide policy (framing) documents; and (2) the outcomes and achievements of the individual strategies and interventions that were referenced in these two documents.

# Review of the NRDS and TYIP as policy-framework documents



# High-level outcomes of the NRDS and TYIP

---

The majority of the STI initiatives identified and referenced in the NRDS and TYIP were taken up and implemented. These included:

- Enacting essential legislation (e.g. relating to biodiversity, intellectual property, patents, taxation, geographic advantage)
- Establishing new institutions (e.g. Biotechnology Regional Innovation Centres, Technology Innovation Agency, South African National Space Agency, National Intellectual Property Management Office)
- Implementing or re-channelling funding instruments (e.g. R&D Tax Incentive, Sector Innovation Fund, THRIP, Innovation Fund)
- Making significant investments to strengthen the knowledge productive and human resources development capacity of universities (Thuthuka, Centres of Excellence, SARChI, New Generation of Academics Programme)

NRDS (2002)

TYIP (2008)

WP (2019)

## NEW LEGISLATION

National  
Environmental  
Management:  
Biodiversity Act  
(2004)

Patents  
Amendments  
Act (2005)

Astronomy  
Geographic  
Advantage Act  
(2007)

SANSA Act (2008)  
TIA Act (2008)  
IPR PFRD Act  
(2008)

Tax Laws  
Amendment Act  
No. 24 of 2011  
(and 2011)

Intellectual  
Property Laws  
Amendment  
Act 2013

## NEW INSTITUTIONS

SEDA (2004)  
SANBI (2004)  
BRICSs (2004)

National  
Indigenous  
Knowledge  
Systems Office  
(2006)

SANEDI  
(2008)

NIPMO (2010)  
TIA (2010)

## NEW FINANCING INSTRUMENTS

R&D Tax  
Incentive  
Scheme  
(2005)

Technology  
Localisation  
Fund (2006)

Sector  
Innovation  
Fund (2013)

SPII to dti  
(2015)

## HCD

Thutuka  
(2002)

CoE  
Programme  
(2004)

South African  
Reference Group on  
Women in Science  
and Technology  
(2003)

Youth into  
Science  
Strategy  
(2004)

Position Paper on a  
Decadal Strategy for  
HCD in Astronomy  
and Astrophysics  
(2009)

NGAP  
(2015)

Human Capital  
Development  
Strategy for  
Research,  
Innovation and  
Scholarship (2016)



# A first assessment

---

The Department of Science and Technology (DST) and other departments and agencies have in broad terms delivered on what the NRDS and TYIP – and by extension the 1996 White Paper on Science and Technology – identified as the strategic interventions to strengthen and transform the STI system.

But this positive assessment pertains to the ‘deliverables’ of the NRDS and TYIP; that is, to the enabling mechanisms and programmes that needed to be put in place to strengthen and transform the STI system. It is not as yet an assessment of whether these new initiatives have in fact produced the positive changes and impact as envisaged. This required an assessment of outcomes and impact at the individual subsidiary strategy or intervention level.

Subsidiary strategies and interventions



Science and knowledge generation

# Science and knowledge generation

## The core narrative

---

The core narrative related to the advancement of science in both the NRDS and TYIP is grounded in the geographic and historical advantage that South Africa has in a number of scientific fields. The underlying premise was simple: invest in and nourish and expand those scientific fields where South Africa has a comparative strength in terms of human resources, accumulated knowledge and scientific infrastructure. The most explicit set of interventions were reserved for astronomy, palaeoscience, biodiversity (environmental sciences including marine and Antarctic research and climate change), and IKS.

Our review has shown that the specific focus on and funding of these fields has produced demonstrable gains in scientific knowledge output, human resource capabilities and infrastructure.

# Science and knowledge generation

## Morphing into science missions

---

The initial formulation of the strategies for the four **science domains** included in the NRDS focused on developing these fields into world-class science domains as well as developing the future R&D capacity in these fields. However, the subsequent developmental trajectories for each of these four fields shows that it would be more appropriate to describe these as **science missions**, which increasingly incorporated other features under their remit. Each of these four scientific domains – in varying degrees – involved the establishment of new research centres (including CoEs) and research chairs, investment in building new and strengthening existing infrastructure (e.g. new telescopes, the Agulhas II research vessel), and the development of new technologies. This invariably led to the involvement of multiple agencies and stakeholders outside the science sector (various government departments, non-governmental organisations, museums, etc.), which in turn required increasing cross-departmental coordination of effort. In addition, under the all-pervasive regime of the imperative for science to address socio-economic goals, all of these ‘science missions’ have increasingly been required to contribute to innovation and socio-economic outcomes.

# Science and knowledge generation

## Key issues

---

This does not mean that the original intent of supporting excellence in science (and high level skills development) has been discarded. But it does mark a clear shift towards what Stokes would call ‘use-inspired’ basic research, or what others have referred to as ‘strategic research’. Our reviews of the science missions have raised at least three key issues:

- The sustainability of the current financing levels for these science missions going forward;
- The question of differentiation of purpose and mandate in the science system; and
- Whether the science mission approach can be applied more generally across other ‘strategic’ scientific fields.

# Science and knowledge generation

## The basic sciences platform

---

As a 'counterbalance' to the increasing 'appropriation' of scientific disciplines into science and innovation missions, strategic (SDG-led) research and grand challenges, one also has to reflect on how the basic sciences can be protected and strengthened. This led us to a discussion of the DSI's recent initiative to establish the South African Basic Sciences Platform. The main rationale for this initiative is found in the necessity of supporting the basic (natural and social) sciences because of their essential role in producing the required human capabilities and scientific knowledge that underpin key technologies, which ultimately result in innovation and socio-economic benefits.

We concluded that this initiative should be applauded as it sends an important signal to the scientific community that re-affirms the worth and importance of basic science. But we also recommended that the list of basic sciences included on the platform should be extended to include the basic health sciences disciplines.

From technology strategies to enabling  
and cross-cutting technology platforms

# Technology strategies

---

Four technology strategies – biotechnology, advanced manufacturing, resource-based technologies and ICT – were explicitly identified in the NRDS for support and development. Although the NRDS made reference to ‘technology for poverty reduction’, as far as we could establish no separate strategy was developed. Nevertheless, it was defined as a DSI programme and substantial monies were allocated to it. Owing to changing priorities, this programme eventually evolved into a new programme ‘Innovation for inclusive development’. The National Biotechnology Strategy (2001), which preceded the NRDS, was further given dedicated attention and funding, and would eventually become an integral part of the Bio-economy (Farmer to Pharma) Grand Challenge. As far as the other three technologies (advanced manufacturing, ICT and nanotechnology) are concerned, each of these subsequently followed a very different developmental trajectory.



# Technology as cross-cutting platforms

---

Already at the time that the TYIP was published, the focus had shifted from a discussion of the fore-mentioned technologies as clearly delineated and separate technology missions, to an emphasis on their role as cross-cutting enablers (together with HCD and knowledge infrastructure) for the five grand challenges. The shift in the narrative from the NRDS to the TYIP does not necessarily signify a change in importance. But it does demonstrate the difference between a more ‘technocratic’ – even ‘linear’ – approach to the role of technology in development (NRDS) to an approach where technology serves the demands for inclusive development in society (TYIP and the 2019 White Paper). This shift is analogous to the shift from defining technology in terms of clearly demarcated ‘technology push-missions’ to seeing technology as a cross-cutting and enabling platform in addressing societal challenges.

# Recommendation

A fundamental re-assessment of the current technology programmes need to be conducted

---

The original objectives of the technology-related strategies in the NRDS and TYIP – to contribute towards the transition to a knowledge-based economy, to improve the sector's competitiveness through advanced manufacturing and innovation, and to leverage resource-based industries – are still valid. What has changed over time is the introduction of new technological initiatives as in fluoride-based electrolytes, titanium powder, additive manufacturing and advanced materials. Technology changes are fast-moving and are often linked to new challenges resulting from fundamental shifts in social dynamics. It would thus be prudent for the DSI to revisit its current portfolio of technology programmes, in light of recent global developments as well as the recommendations of the Research Foresight exercise, going forward.

# The grand challenges

# The grand challenges

## Revisiting its meaning

---

The notion of a ‘grand challenge’ appears in the TYIP in 2008. Even a cursory inspection of the five grand challenges as outlined in the TYIP would show that most of them do **not** correspond to the notion of a ‘grand societal challenge’ as outlined in recent OECD documents and strategies. The seven societal challenges included in the European Union’s Research and Innovation programme, Horizon 2020, all refer very specifically to problems and deficiencies that are present and grounded in society: in healthcare (including the burden of disease), food security (such as hunger and malnutrition), safe and clean energy, the problems of pollution and high carbon-emissions, problems related to refugees and migration, poverty, inequality and so on. These are not **scientific** or **technological** problems – they are **human** problems. Whereas in traditional S&T missions, strategies were developed from the perspective of the science base or technological capabilities, ‘directionality’ in current STI policies has its origins in society and our diagnosis of key **societal challenges**.

# From grand challenges to societal challenges

---

Furthermore, despite being grouped together under the rubric of ‘grand challenges’, the individual grand challenges in the TYIP are in fact not very similar. Close inspection shows rather big differences in the underlying premises and logic. In a nutshell, we argue (1) that the grand challenges of global change and energy security – and to a lesser extent bio-economy – correspond best to current notions of ‘societal challenges’; (2) that the space science and technology grand challenge is better understood as an expanded S&T mission; and (3) that the thinking behind the human and social dynamics grand challenge was flawed from the outset as it conflated a substantive focus (on social issues) with the ideal of giving expression to the transversal nature of social, economic, legal and ethical dimensions in most science and technological interventions.

# The grand challenges: Recommendations

---

The DSI should pursue the notion of ‘grand societal challenges’ as a framing principle for the development of the high-level interventions in the next decadal plan

## New and reformulated grand societal challenges

- The current global (climate) change and energy security grand challenges should be included in the redesign of the societal challenges.
- The current bio-economy grand challenge should be reconceptualised with a focus on at least food security (a possible new societal challenge) and burden of disease (an essential addition to the grand challenges given current experiences with the coronavirus pandemic).
- The possibility of redesigning the current space S&T grand challenge as an expanded S&T mission (with sufficient funding) should be explored, as well as its possible integration with the astronomy/SKA/Meerkat mission.

Human resources for S&T



# Human resources for S&T

---

There are two key imperatives with regard to human capital development in the STI system: to grow and expand the human resources base for S&T, and to transform the human resource base to become more inclusive of (South African) black and women academics and scientists. Our review has shown that the strategies developed under this heading are based on three common strategies to achieve the end-goal of increasing the human capital base: (1) to attract local talent to science (especially the science, engineering and technology fields) through science awareness interventions; (2) to retain local talent through the reduction of attrition and drop-out over the course of the academic pipeline (from undergraduate to doctoral degrees) as well as subsequent (early careers) of academics and scientists; and (3) to attract foreign talent through various internationalisation strategies.

# Strategies to expand the human resources base

---

We discuss each of these strategies in some detail in our Main Report and assess the extent to which they have been successful. In brief, the evidence shows (1) that South Africa has not been very successful in attracting local talent to science (mostly because of persistent structural problems in our schooling system); (2) that we have made some progress in reducing attrition and drop-out rates in recent years, but the problem remains a big challenge; and (3) that we have been very successful – especially at the doctoral level – in attracting foreign talent to the country. Unfortunately, we also point out that the recently released NRF funding policy does not make provision for adequate support to foreign students which may impact negatively on the gains in doctoral enrolments, which have been witnessed in recent years.

# Transforming the human resources base

---

With regard to the transformation imperative, a recent report by CREST on The state of the SA research enterprise has shown that the trends towards a transformed STI system – especially with regard to race – are now well-established. The picture with regard to gender is slightly more complicated as women's participation in the science system has increased significantly in some areas (e.g. in benefitting from NRF funding or in enrolments and graduations at university), but less so in other areas (such as contribution to scholarly publication). In addition, and not surprisingly, we have found differences in the 'transformation rates' of blacks and women according to age, rank, scientific field and discipline, and institution. However, what is not being investigated in any depth is how these trends are exhibited within individual institutions (universities, science councils and national facilities). Neither, as far as we are aware, has there been any assessment of how the different funding instruments of the NRF, Medical Research Council and the Water Research Commission, as well as other interventions aimed at establishing a more inclusive higher education and STI system, have contributed to the trends that we witness.

Other key recommendations

# Human Resources for S&T

## An integrated and updated strategy for S&T

---

The omission of a dedicated human resources strategy for S&T in the NRDS, and especially the TYIP, was in our view an oversight. Even though various initiatives were being planned and implemented, none of these were driven directly by the DST. The need for an HRD strategy had already been raised in the White Paper of 1996, but it would only be 13 years later that this was given effect when, in the revised version of the national HRD Strategy (2009), a clear division of labour between DST and the DHET regarding strategies and programmes related to HRD was made.

Our recommendation thus is that a revised human resources strategy for S&T be developed. Such a revised strategy must ensure proper alignment with other existing strategies such as the University Capacity Development Programme of DHET and the new funding policy of the NRF.

# Knowledge production

## The need for a quality assurance framework

---

In two recent reports CREST has identified a significant increase in perverse consequences as the DHET publication system is not being adequately monitoring and evaluated:

- The salience of questionable publication practices (from predatory publishing to editors publishing excessively in their own journals)
- Inadequate controls on the quality of SA journals
- Increase gaming of conference proceedings
- Clear emergence of publication cartels that lead to increases in extreme numbers of submissions (50+ articles by individual authors per year)

We therefore recommend that a rigorous and comprehensive quality assurance framework be developed and implemented to protect the quality and integrity of publications funded under the DHET publication subsidy fund.

# System governance and coordination: Recommendations

---

- We re-affirm the findings of previous reviews regarding the necessity of a strong, central STI governance body such as the proposed ministerial-level STI structure.
- We re-affirm previous recommendations regarding the necessity of policy coordination, and hence support the proposed establishment of a national STI plenary. The mandate, authority and functioning of such a plenary will require careful consideration and planning.
- The 2019 White Paper proposal to establish three policy nexuses should be subjected to further scrutiny and investigation; in particular, with regard to how cross-cutting issues are addressed under this model, and how these nexuses align with initiatives to expand and deepen the framework of societal challenges.



# Financing of research and innovation: Recommendations

---

- Institutionalise private sector cooperation and agreement when designing interventions to increase financing of innovation
- Continue and strengthen the R&D Tax Incentive scheme
- Undertake an in-depth review of existing funding instruments targeting business and innovation in order to achieve optimal coordination and efficiency
- A study should be conducted to assess the extent and possible synergy between the investments of the universities, funding agencies (NRF, MRC, WRC) and government departments (DHET, Department of Water Affairs and Forestry, Department of Health) in building the next generation of scientists and scholars in the country

# Strategy design and MEL Recommendations

---

- Institutionalise good practice in appropriate strategy design and implementation and such strategies and plans must meet the criteria of feasibility and risk assessment
- Strategic plans must adhere to good practice in the setting of targets and the construction of appropriate performance and outcome indicators
- Implement an explicit, system-wide monitoring, evaluation and learning framework for the STI system
- Institutionalise (continuous) professional development in research evaluation

Thank you

The background of the slide is a solid light green color. It features several thin, flowing, wavy lines in a slightly darker shade of green and a few thin blue lines. These lines are scattered across the lower half of the slide, creating a sense of movement and depth. The lines are most concentrated in the bottom right area, where they form a series of overlapping, curved shapes that resemble stylized waves or a modern logo.