National Research Foundation

STRATEGIC POSITIONING OF THE NATIONAL RESEARCH FACILITIES

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Dr G. Mazithulela, Dr D. Pillay, Mr P. Thompson, Mr B. Singh and Dr A. van Jaarsveld

Executive Summary

The Minister of Science and Technology has requested different stakeholders with an interest in the role and operation of the National Research Facilities (NFs) to offer input into a possible policy position to be developed. In different settings, the National Research Foundation has highlighted several problems that are symptomatic of the current state of affairs in the strategic and operating environment of the NFs. Therefore, this critical assessment of the role that NFs have played and can play in the National System of Innovation (NSI) provides a number of strategic considerations and perspectives, including:

- That NFs are an essential component of a healthy science system, particularly in areas where unique infrastructure, equipment or skills sets are required to create and sustain a national competence or science advantage;
- The current suite of NFs serve national strategic priorities to varying degrees in their different areas of scientific expertise and should be managed as a portfolio in order to take advantage of synergies and the opportunity for greater coordination;
- The suite of priority NFs will evolve over time as national strategic priorities shift and the science landscape develops. This means that no static suite of NFs, obdurate governance and management frameworks will serve the NSI optimally;
- The Life-Cycle Approach to managing the portfolio of NFs is hereby described and recommended;
- This approach is based on the realisation that the formation of new NFs is normally associated with initially broad strategic intent and this develops over time into more focused plans;
- Establishing the human resource base, investment in suitable equipment and infrastructure platforms, an operational culture that supports good governance and sustainability and the development of a stable cohort of local users, international collaborators and other stakeholders is a time-consuming process;
- This approach is based on the realisation that the formation of new NFs is normally associated with initially broad strategic intent and this develops over time into more focused plans;

- Establishing the human resource base, investment in suitable equipment and infrastructure platforms, an operational culture that supports good governance and sustainability and the development of a stable cohort of local users, international collaborators and other stakeholders is a time-consuming process;
- Therefore the development of NFs from proposal and establishment to sustainable operation with expected outputs requires situational management and governance frameworks that should evolve and become more sophisticated over time in line with maturity of, both, the strategic and operational environments;
- NFs, that are to be retained in the national interest, will always be in different stages of development and this should lead to customised levels of control on their individual strategic and operational environments;
- NFs that have reached a stage of development where the strategic environment that led to their declaration has become clear, the execution of the strategy is determined as being satisfactory, management and operational systems are stable, may be described as mature.
- Mature NFs may adopt a governance system that devolves more responsibility to a sector-specific environment, thereby enabling more attention to be expended on developing new capacity elsewhere in the NSI as government priorities evolve. This is particularly true in the context of a now distributed science vote and internationalisation of some NF's activities.
- However, creating new government agencies on maturity of particular NFs is considered inefficient, will bloat state agency overheads and set unmanageable precedents in respect of unrelated NFs and other government installations;
- A government agency with broad oversight on managing the investment in NFs provides an appropriate nurturing environment for the development of new NFs and competencies that need to be developed in response to emerging national strategic needs in a coordinated way;
- Periodic reviews should subsequently inform (a) further development within this environment; (b) devolution of strategic and operational control to sector specific bodies without forming new government agencies; (c) retention or placement; or (d) even decommissioning if appropriate;
- A life-cycle approach towards NFs may be strategically advantageous and appropriate to enable evolving government and NSI priorities to be served and to apply management systems and controls that are appropriate to the maturity and stakeholder composition of a NF;
- The country periodically invests in large capital projects which may become NFs in the future. The management principles and governance of such projects should differ from that of NFs that are in an operational mode and require more direct oversight by government;
- Those emerging large capital projects that are nearing completion should enter the management and governance system proposed in this document so as to ensure an orderly and successful commissioning into functional NFs which are then managed according to the life-cycle model to maturity;
- It is imperative that an appropriate policy framework and a legislative environment which supports the policy be created in the best interest of our government and the NSI.

The NRF executive hereby presents these points, with examples of areas of best practice which should be strengthened recommends some actions in an expanded form below, for consideration by the Minister of Science and Technology. This is in order to ensure the application of the logic presented above and provide the necessary regulatory environment for the portfolio of NFs to achieve their goals.

In summary, our main recommendations are:

1. Sustainability of NFs needs a suitable legislative environment in order to regulate for the success of NF strategies and ensure their outputs
2. Using a life-cycle approach, an agency of government is well placed to develop and manage NFs into maturity, as a portfolio, for the benefit of the NSI
3. The life-cycle approach is a tactic for the proactive establishment, nurturing and growth of critical human resource capacity in the country in response to the changing priorities of our society over time
4. Introducing strategic motion to the management of the NFs will ensure that current and emergent government priorities are served by the creation and nurturing of new NFs, whilst mature and relevant NFs can best serve the national interest in a setting with appropriately devolved management and governance frameworks
5. The creation of new state owned entities when NFs reach a certain stage of maturity should be avoided as this creates an unmanageable precedent for unrelated government installations

It is our view that the Minister, at her pleasure, may concur and the NFs may be better positioned to provide cutting-edge science platforms and contribute to the development of human capacity and the transformation the nation's science workforce.

Contributions to this position paper from the following Directors of the National Research Facilities and other emerging scientific infrastructure are acknowledged:

Dr. Zeblon Vilakazi - iThemba Laboratory for Accelerator Based Sciences
Prof. Paul Skelton - South African Institute for Aquatic Biodiversity
Dr. Clifford Nxomani - National Zoological Gardens
Mr. Johan Pauw - South African Environmental Observation Network
Dr. Michael Gaylard - Hartebeeshoek Radio Astronomy Observatory
Prof. Bernie Fanaroff - The African Square Kilometre Array Project
Dr Lee-Anne Mckinnell - Hermunus Magnetic Observatory

Key Abbreviations

DACST	Department of Arts, Culture, Science and Technology
DST	Department of Science and Technology
HartRAO	Hartebeesthoek Radio Observatory
HMO	Hermanus Magnetic Observatory
OECD	Organisation for Economic Cooperation and Development
NFs	National Facilities
NRF	National Research Foundation
NSI	National System of Innovation
NZG	National Zoological Gardens
SAAO	South African Astronomical Observatory
SAEON	South African Environmental Observation Network
SANSA	(South African National Space Agency)

CONTENTS

1 HISTORY AND FORMATION OF THE NATIONAL RESEARCH FACILITIES

The National Research Facilities (NFs), under the management of the National Research Foundation (NRF) were formed as a result of a recommendation of a review sanctioned by the, then, Department of Arts, Culture, Science and Technology in 1997 (DACST, 1997). The recommendations of the DACST review defined the NFs in their context as contributors to the National System of Innovation (NSI). In particular, the NFs contributions in the strategic imperatives of human resource development, industrial interaction and international collaboration received the emphasis of the recommendations.

The review developed criteria for the selection and performance assessments of NFs and these were applied to many Science Engineering and Technology organisations that were in existence, including 3 that were under the management of the NRF at the time. Several management models and practices were recommended including the formal declaration of 6 NFs and their transfer to the NRF.

1.1 The Changing Strategic Context

The NFs have operated under a static framework that was proposed in 1997 and little strategic input has happened in terms of their positioning in a National System of Innovation (NSI) that has changed substantially since. It is important to note that the NFs need to define their ongoing contribution in new strategies like the National Research and Development Strategy (NRDS), the DST 10 year innovation plan and Government's 10 point Programme of Action. The nation's new strategic outlook makes it at least necessary for the NRF to interrogate the NFs alignment and therefore their continued status and contribution. It may also be necessary to define a dynamic life cycle and evolutionary approach for NFs in order for the changing priorities of NSI to be addressed on an ongoing basis. Recently the static model, especially relating to governance of the NFs that have a significant international stakeholder base, has been seen as inappropriate. Further, the development of large scale NFs (like the MeerKAT and perhaps the SKA) with expected governance models that are different from the present suite has given impetus to a more dynamic, flexible management framework. Finally the need for differentiating the management framework, in particular between so-called mega-projects during construction versus at a stage when they are commissioned and performing their intended role, needs clarity.

The role of government in taking firmer control during the development of strategic investments is expected worldwide and this reality must be accommodated in planning for strategic policy development, project management and evolution of NFs.

It has become clear that we need to revisit the strategic positioning of the NFs, consider an appropriate positioning within a changed NSI and then suggest solutions with appropriate strategic focus and relevance.

2 THE STRATEGIC ROLE AND IMPACT OF THE NATIONAL RESEARCH FACILITIES

The current suite of NFs has shown themselves to be unique and essential assets for the country in meeting the strategic challenges that were identified in the past. Indeed, many countries have such assets placed within similar organisational frameworks as in the NFs under the management of the United Kingdom National Facilities Science Council, the National Science Foundation in the USA, Council for Scientific and Industrial Research in India, the Commonwealth Scientific and Industrial Research Organisation in Australia and the National Council for Scientific and Technological Development in Brazil.

These national facilities across the world have similar contributions to science systems and the South African NFs play a direct role in meeting the 5 principal goals of the DST in:

- Developing the innovation capacity of the NSI and contribute to socio-economic development
- Enhancing South Africa's knowledge generation capacity
- Developing science and technology human capital
- Building world-class science and technology infrastructure
- Positioning South Africa as a strategic research and development partner

The Nfs are also in good alignment with the National Research and Development Strategy, including the DST 10 year Innovation plan, the associated grand challenges and the science missions as shown below:

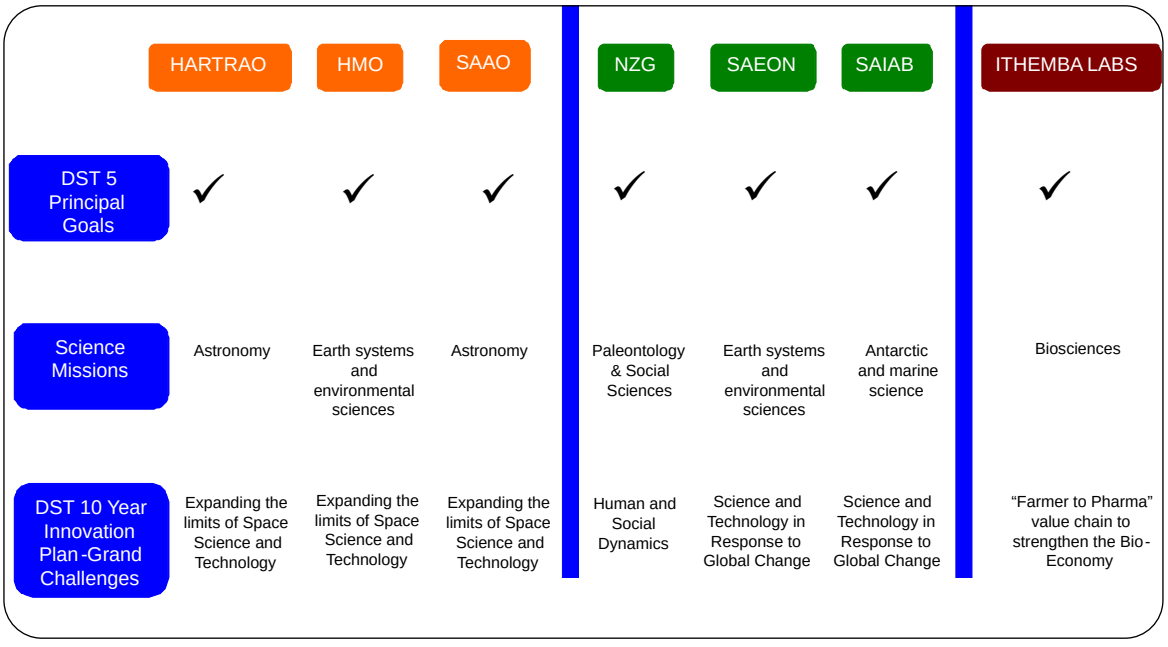

Figure 2.1 The strategic alignment of the existing NFs with the DST 5 principal goals, science missions and the grand challenges as described in the DST 10 year innovation plan.

A formal definition of the strategic role that the NFs should play is captured in the definition of a NF below:

"A National facility is centered on substantial instrumentation, equipment or skills base and is established to satisfy an identified national social, economic or technological need and which, because of expertise and capabilities, is justified on the basis of shared research and / or service use by external organisations. The facility is made available for research by internal or external researchers on the basis of merit of proposals as assessed by peer-group review while service work is commercially supplied to industry. The work programme of the facility is balanced to ensure an appropriate allocation of time to both research and service activities."

Review of the National Facilities DACST – 1997

We provide a synopsis of the historic roles, impacts and strategic relevance of the existing facilities:

2.1 Hartebeesthoek Radio Astronomy Observatory (HartRAO)

HartRAO is a radio astronomy and space geodesy facility with an aim of developing a strong South African competence in science and engineering through the provision of first class facilities in the fields of radio astronomy and space geodesy. Because of its expertise in radio astronomy and related engineering, the resources currently in the HartRAO will play a leading role in the operation and maintenance of the MeerKAT telescope and contributes to the bid for South Africa to host the Square Kilometre Array (SKA) telescope. HartRAO comes from a rich heritage of achievement as it was instrumental in enabling the NASA missions to the moon for the USA. HartRAO is the only reference point for the international network for Very Long Base Line Interferometry on the African continent. The expertise of its staff has been used in getting South Africa to the final stages of bidding for the SKA to be built in South Africa. They are also involved in the building and operation of the SKA precursor telescopes (KAT-7 to MeerKAT) in the Northern Cape. Space geodesy contributions have traditionally operated from HartRAO with some newer investments being situated in the Karoo (Matjiesfontein). This observatory is a critical contributor to the exploitation of South Africa's geographic advantage (the radio-quiet Karoo and the Southern skies) in line with DST 10 year plan. Together with the other astronomy-related instruments, it is a critical player in the proposed multi-wavelength strategy of studying astronomy and astrophysics.

2.2 Hermanus Magnetic Observatory (HMO)

HMO is the hub for earth-space science in Africa and a key player in the South African earth-space programme. Its objective is to create, maintain and operate a state-of-the-art terrestrial earth-space observational network in Southern Africa, Marion Island, Gough Island and Antarctica. HMO collects, processes, archives and distributes high-quality earth-space data and value-added data products nationally, across the continent and to the broader international community. HMO is also developing a significant space weather capability. The activities of HMO are very vital to the operational capabilities of the defence forces and the telecommunications industry of South Africa.

A flagship project that gives HMO a clear international identity and possible funding advantages is based on the emergence of the reverse flux patch at the core surface below Africa and its consequences in the loss of magnetic force - development of the South Atlantic magnetic anomaly, creating a hazard to near-Earth space operations. This is a natural focus because of the geographical location of the phenomenon, and also because it pulls together the different parts of research capabilities at the HMO. In addition to exploitation of the geographic advantage of access to the Southern Ocean and the maintenance of critical research and prediction of space weather from a base in the Antarctic, the grand challenge of expanding the limits of space science and technology is served, directly by this observatory. Through activities related to space weather and telecommunications infrastructure, HMO also contributes to the earth systems and environmental sciences science mission.

2.3 South African Astronomical Observatory (SAAO)

SAAO is the premier optical/infra-red research facility on the African continent, with global research and outreach collaborations, contributing to SET human capital development for South Africa. In the Southern African Large Telescope (SALT) and other small telescopes, the SAAO provides world-class astronomical research facilities for South Africa and our international partners in a protected astronomy reserve. The SALT is an instrument that has pushed the boundaries of knowledge in many aspects of its engineering and design, thereby creating new knowledge and capabilities for researchers and South African companies. It is currently being commissioned and will soon provide the impetus needed for the training of many students and technicians in physics and astrophysics.

This observatory also contributes directly to the exploitation of our geographic advantage of access to the Southern skies and the Astronomy science mission. Together with the other astronomy-related instruments, it is a critical player in the proposed multi-wavelength strategy of studying astronomy and astrophysics.

2.4 National Zoological Gardens (NZG)

The NZG is a wildlife biodiversity conservation and potential research facility that has a unique distinction of incorporating a living animal collection, a biomaterials bank and is visited by approximately 600 000 people per annum. Together these features give the NZG its status, and a unique character, as a National Facility that (i) generates scientific knowledge for conservation of wildlife; (ii) develops high quality human resources in the form of conservation scientists and biodiversity conservation practitioners; (iii) undertakes *ex-situ* conservation of wildlife and makes qualified contributions to *in-situ* conservation of threatened species and their habitats; (iv) serves as a science advancement platform: a place of learning and a source of inspiration to action for science and biodiversity; (v) enhances the quality of life of the community by providing a top class metropolitan ecotourism facility, a family attraction of first choice that inspires discovery, appreciation, care, knowledge and respect for nature.

Specific flagship projects for each of its three strategic objectives of Research, Ecotourism facility and Science Advancement platforms are, respectively (i) the establishment of a Centre for Conservation Medicine, (ii) Master plan development & modernization of zoo infrastructure and (iii) Establishment of a Life Science Centre. These flagship projects will enable the NZG to meet its core mandates as reflected by the three strategic objectives.

This facility directly addresses the Human and Social Dynamics grand challenge in that "As South Africa strives to become an innovative society, it is essential to support the public understanding of and engagement with science. Government's starting point is that the members of public are not merely passive recipients of science and technology, but are important players in processes that shape the focus and patterns of science, technology and development". Therefore, together with the South African Agency for Science and Technology Advancement (SAASTA), the NZG is an important contributor. In addition, the NZG has a clear contribution in the earth systems and environmental sciences science mission through their research of *ex-situ* conservation of wildlife.

2.5 South African Environmental Observation Network (SAEON)

The NRF was mandated in 2002 by the Department of Science and Technology (DST) to incubate and grow the South African Environmental Observation Network (SAEON). The SAEON has not yet been officially declared a National Facility by the Minister of Science and Technology but is logically included in this document as a potential National Facility.

SAEON is a comprehensive, sustained, coordinated and responsive *in situ* South African environmental observation network that delivers long-term reliable data for scientific research, and informs environmental decision-making for a knowledge society and improved quality of life. It has a mission to drive long-term environmental observation research, promote access to quality long-term environmental data and entrench environmental science in society for the promotion of environmental sustainability and improved quality of life of the people in South Africa.

Since the environment cannot be studied in one single place, Ridovhona is SAEON's flagship project to establish and maintain a comprehensive constellation of environmental observatories, an essential national asset for generations to come. Ridovhona is the national response to the need for a systematic framework for detecting slow-paced changes that take place in and across ecosystems, but which may be masked by the inherent variability of those systems. Ridovhona establishes and maintains nodes (environmental observatories, field stations or sites) linked by an information management network to serve as research and education platforms for long-term studies of ecosystems to provide for incremental advances in our understanding of ecosystems and our ability to detect, predict and react to environmental change. The core research strives to distinguish between anthropogenic and natural change as well as to unravel the relations between social change and ecosystem change. This facility therefore plays a direct role in contributing to the Global Change.

2.6 South African Institute for Aquatic Biodiversity (SAIAB)

SAIAB is a research platform that promotes research excellence for the sustainability of African aquatic environments. It is an interactive hub focused on serving the nation through generating, disseminating and applying knowledge to understanding and solving problems on the conservation and wise use of African aquatic biodiversity. SAIAB also hosts the national fish collection and has more than 85 000 accessioned lots, representing 6 600 species of fishes (this is about 25% of all described fish species in the world). The collection is the most comprehensive in the world for the Southern African region – and includes about 85% of both the freshwater and the marine fish species from the region.

The African Coelacanth Ecosystem Programme (ACEP) is a flagship research programme at SAIAB and it aims to scientifically explore the ecosystem defined by the Agulhas Current in which the African coelacanth exists. ACEP has had major impact at both the national and international levels. Internationally, ACEP directly stimulated and helped formulate the major UNEP-GEF Agulhas Somali Currents Large Marine Ecosystem (ASCLME) project. ACEP constitutes the South African component of ASCLME that has made a major contribution to the knowledge and understanding of the marine environments of the Western Indian Ocean, providing essential global insight into factors driving climate and global change. Initially ACEP and latterly the ASCLME have also integrated research communities in the region for the first time. This is leading to new synergies and collaborations between research institutions and researchers of major relevance to the African Union states. On a national level ACEP initiated large scale integrated oceanographic research on the East Coast for the South African research community for the first time. This platform also integrates the interest of at least four government departments including the DST which funds research programmes, Department of Agriculture, Fisheries and Forestry (DAFF) which provides ship time, DEA Department of Environmental Affairs provides equipment and the Department of Higher Education and Training from which researchers and students through Higher Education Institutions are drawn. ACEP's focus on East Coast marine ecosystems addresses directly the DST Grand Challenge of Global Change and is contributing new data and understanding of coastal marine environment and ecosystems along the African east coast. Together with SAEON, the activities of this NF also contribute directly to the Antarctic and marine sciences, science mission.

2.7 iThemba Laboratory for Accelerator Based Sciences (iTL)

iTL is the leading African organisation for research, training and expertise in accelerator based sciences and technologies and provides state of the art facilities and programmes for high quality research. The facility provides training and services in nuclear sciences and applications for the benefit of the people of South Africa and the continent in general. Using the facilities and in-house capacity, iTL is one of very few proton radiation therapy centres in the world and at the time of writing, together with the Nuclear Energy Corporation of South Africa; they are amongst the biggest producers of radioactive isotopes in the world. iTL is active in the fields of medium energy nuclear physics, materials science radioactive isotope production and clinical research. These activities have positioned iThemba LABS as a direct contributor to the grand challenges of; the search for energy security and in strengthening the bio-economy. Additionally through research efforts in nano-technology and cyclotron design, iTL directly contributes to the nation's scientific outputs in response to the nanotechnology, biotechnology and commercialisation of engineering advances.

2.8 Achievements of the National Research Facilities

In the last 5 years, the NFs have supported the mandate of the NRF by contributing to the building of human capital in South Africa. The statistics below show that they have positively impacted on many areas in support of various national strategies and imperatives.

Facilities Statistics

	2005/06	2006/07	2007/08	2008/09	2009/10	Total
PEER REVIEW JOURNAL ARTICLES	119	164	264	180	200	927
CONFERENCE PROCEEDINGS	165	174	121	94	100	654
POST-GRAD USING FACILITIES	291	319	570	411	450	2041
POST-GRADS SUPERVISED BY NFs STAFF	146	167	203	217	205	938
RESEARCHERS FROM SA HEI's USING THE NFs	334	357	409	467	481	2048
NO OF IN-SERVICE TRAINEES	213	436	315	315	320	1599
NO OF INTERNATIONAL COLLABORATORS	161	187	220	238	250	1056

Table 2.1 National Facilities Statistics

3 MANAGING THE NATIONAL FACILITIES AS A PORTFOLIO ENABLES STRATEGIC-LEVEL INTERVENTIONS TO BE MADE

The NFs are seen as an important research infrastructure component within the NSI. It is therefore an important objective to ensure that this component is made available to the university research community, the Science Councils and other stakeholders to conduct quality research while simultaneously addressing human capital development requirements. The portfolio approach or a neutral and strategic approach to ensuring their viability individually and collectively is desirable. The value of a government agency in pursuing this goal may be exemplified by recent NRF interventions described below. Since 2007 the NRF has introduced a number of strategic interventions/incentives/programmes for the NFs to increase their impact and performance. The programmes aim to improve research quality in the NFs and move them beyond the frontiers of research excellence by supporting research capacity development both in terms of human resources and providing appropriate training platforms. The four most important recent interventions are:

3.1 Budget Deficit Support

The core parliamentary grant for the NFs has hardly changed since the NFs were established and this has caused a depressed financial situation where inflation has overtaken the NFs funding in real terms as shown on the next page.

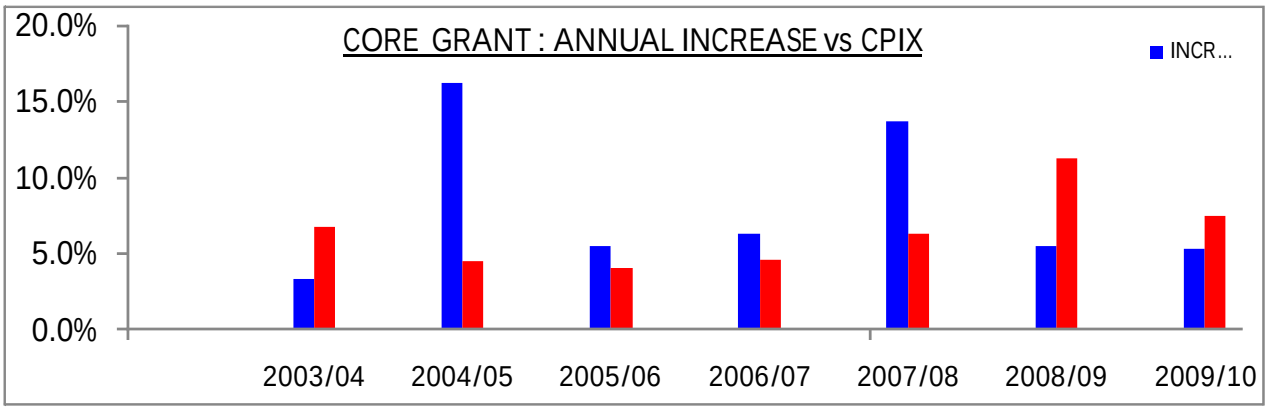

Table 3.1 The percentage increase of NFs funding versus rate of inflation since 2003

In addition, the graph below shows the funding situation discounted to 2010 money, in that there has been virtually no increase but the total turnover of the NFs is much higher. The gap between the two has been funded by the NRF and other contracts.

Considering that at the launch of the NFs, it was acknowledged that most have no chance of gaining contract income from the market, the situation below is unsustainable.

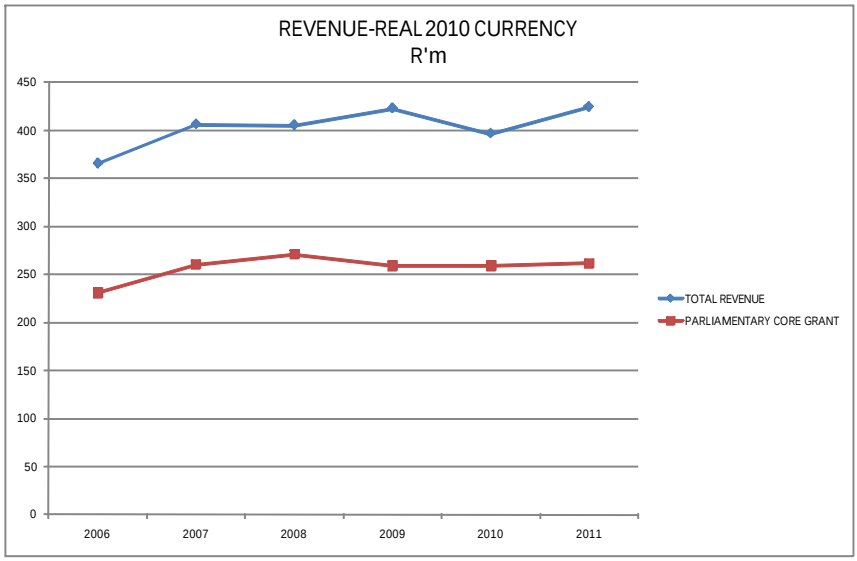

Table 3.2 Revenue of the NFs, discounted to 2010 rands

The table above shows that the core grant (red) has hardly increased since 2007. However, the total turnover (blue) is higher and the difference has been met by NRF and other funds. The NRF has been instrumental in maintaining the NFs during this funding crisis and the strategic interventions mentioned below have helped fill this gap.

3.2 Incentive Funding for Rated Researchers

This programme has as its main objective to incentivise research excellence and as such attempts to assist rated researchers in the research community, including those at the NFs, to maintain and/or improve their research standing in the national and international community. A small incentive funding base is provided to all rated researchers for the duration of their rating period to deal with short-term gaps that may arise in their own competitive funding applications.

3.3 Research and Innovation Reward Programme

The NFs Research and Innovation Reward Programme is aimed at improving the quality and quantity of research outputs from the researchers at the NFs, by making monetary awards for quality research outputs generated by work undertaken at the NFs. This programme introduces an incentive scheme for quality research outputs similar to the incentives offered by the Department of Higher Education and Training for research at universities but focuses on ISI outputs, graduated Masters and PhD students and patents produced. The ISI framework is appropriate for these largely natural science facilities.

3.4 National Facilities Collaboration Research Programme

This programme is aimed at improving Higher Education researcher access to research platforms and equipment that are located at, and managed by the NFs. This access is facilitated through collaborative research projects between researchers at HEIs and NFs. The grants are made to researchers at Higher Education Institutions and Science Councils. This Programme has been established as the research equipment and research platforms at the NFs are highly specialised and require significant financial and HR investment to establish. Their optimal utilisation by the Higher Education community is therefore of the utmost importance to the NRF.

3.5 National Facilities Recapitalisation Strategy

The NRF has developed a comprehensive NFs recapitalisation strategy. The objective of the strategy is to ensure that the NFs each regain their original strategic prominence or to establish such prominence where it did not exist historically. The initiative focuses on competitive infrastructure but is closely linked with ensuring the required science competence is developed or maintained. This initiative is not yet funded but we are pursuing funding options through the DST.

3.6 Strategic Infrastructure Support Programme

This programme, funded under contract by DST, supports the most urgent upgrading and refurbishment of research infrastructure at the NFs in order to benefit the services provided by the NFs to the research community. Such urgent research infrastructure upgrades are defined by the NFs on a priority needs basis. In the past 2 years, the NRF has negotiated approximately R37 million and invested the funds in emergency infrastructure on a needs basis across the NFs. Recently, a further R50 million has been made available by DST to comprehensively end the problem of crumbling infrastructure. The NFs are now in a more acceptable state in terms of their previous problem of ageing infrastructure and equipment and major capital investments may now be considered as the platforms now form a solid infrastructure base.

3.7 Good Governance as a Strategic Asset

There is a significant risk of the NFs' operations being destabilised due to the lack of adequate funding and by committing to contracts that do not meet the bar of good corporate governance. In the past, some NFs have come under criticism for overspending their allocated budgets, not adequately addressing internal audit findings, entering into risky business ventures, etc. Operating under tight budgets often leads to a strategic drift as organisations increasingly tend towards focussing on activities that ensure survival. During 2009/10, the NRF Corporate Executive made various corrective interventions and implemented several remedial measures to foster good corporate governance and financial sustainability of the NFs.

3.8 The Value of Budget Prudence and Good Financial Management

Upon realising that unsustainability was developing in many NFs, the NRF implemented several decisions in line with good corporate governance and improved financial management. Budgeted deficits were disallowed by the NFs at the start of the 2009/10 financial year. Tighter control of the business planning process was introduced through new planning templates that facilitated monitoring and evaluation. The implementation of new financial planning, management and monitoring tools appropriate for the commercial transactions found in the operating environment of some NFs. These included:

- Detailed budgeting templates;
- Detailed income statements with financial and operational sensitivity ratios; and
- Electronic dashboards to track financial and operational performance.

The roles of NF managers were also strengthened to include:

- Defining their deliverables and corporate obligations within the NFs management teams; and
- Defining a corporate NF relationship that assists the Directors with respect to their roles;
- Design an appropriate shared services model for those business functions that are generic and which can receive stronger assistance from the corporate organisation;
- Addressing training needs of Directors of NFs with respect to their roles as administrative, business and strategic heads of the NF; and
- The development of a custom designed NRF shared services structure to attend to the generic, transactional business activities at the NFs (HR, Finances etc.).

The implementation of most of the measures has gone smoothly across most NFs and overall, the NFs have returned better internal audit profiles and have demonstrated more sustainable financial profiles as shown on the next page.

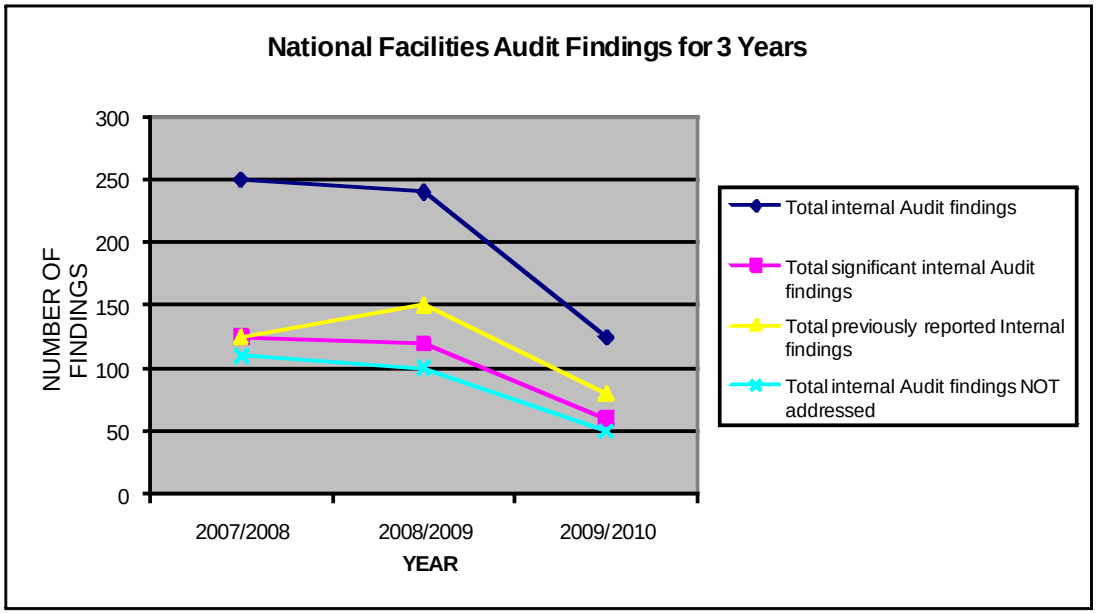

Figure 3.1 The improving internal audit profiles of NFs.

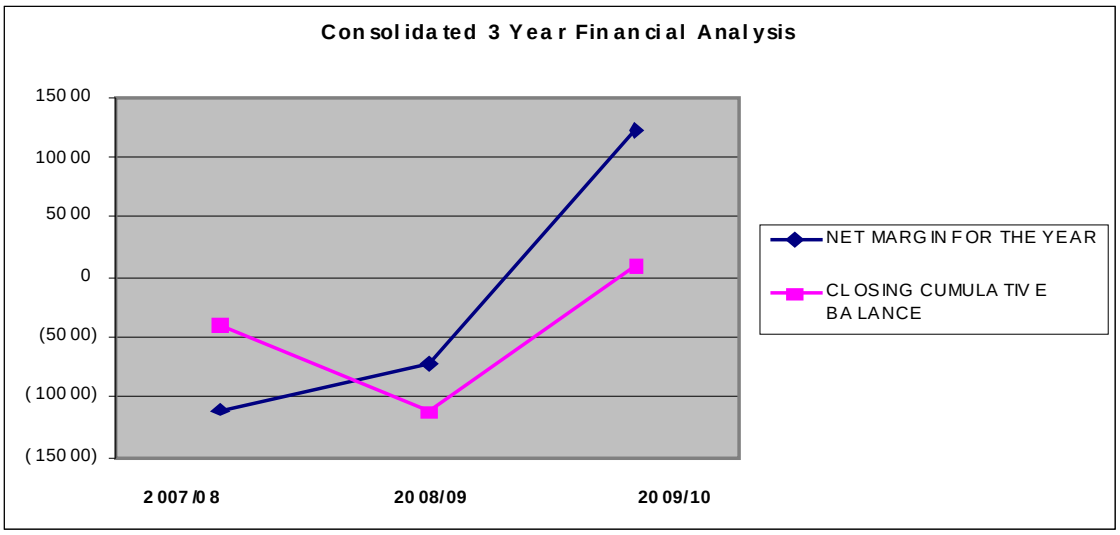

Figure 3.2 Recovery of the financial health profile of the NFs.

Indications from the recently concluded internal audits of the NFs show that these positive trends are continuing and are being accelerated by a very welcome return to strategic investment by the DST. Therefore, underlying problems of low morale and despondency in the future caused by ageing infrastructure are changing very quickly. Investment in infrastructure in the last 2 years and the recent mid-year boost of R50m for infrastructure are relieving pressure from baseline funding with positive outlooks for sustainability.

4. 0 NATIONAL RESEARCH FACILITIES SERVING AN EVOLVING NSI

The debate around the relevance and strategic positioning of the NF's seems to be for the search of or a need to renew and reaffirm their purpose in the NSI. It is therefore expected that the questions of why they exist, who they are meant to serve and how they generate added value, to whom, need to be answered. It is also important that, whilst answering these questions, the debate moves beyond current horizons and explores future opportunities, challenges and the evolution of the NFs to underpin the efforts of the modern South African government in meeting certain strategic challenges and science needs.

4.1 Alignment of National Research Facilities to their Purpose

The purpose of the NFs was set in a statement as shown in section 2, above, and has been the guiding principle over the years. It is imperative to consider whether this statement still holds support of the stakeholders and whether the NFs are operating strategically as was intended.

The analysis in figure 4.1, below, demonstrates that the alignment of the NFs to the original facility expectations discussed in the DACST review (1997) is good. Moreover, as a national asset, they are also positioned to support other government departments which would benefit from a strategic partnership with them. It also shows the possible areas of strategic growth (blue boundary highlight) of some NFs as they are not currently involved in those areas of their prospective mandates that are highlighted. Additional areas for potential alignment are the HMO with the Departments of Defence and the Department of Telecommunications, iThemba LABS with the Department of Health and the Department of Energy, SAIAB with Department of Agriculture Forestry and Fisheries for marine and coastal management, and SAEON with the Department of Water and Environmental Affairs.

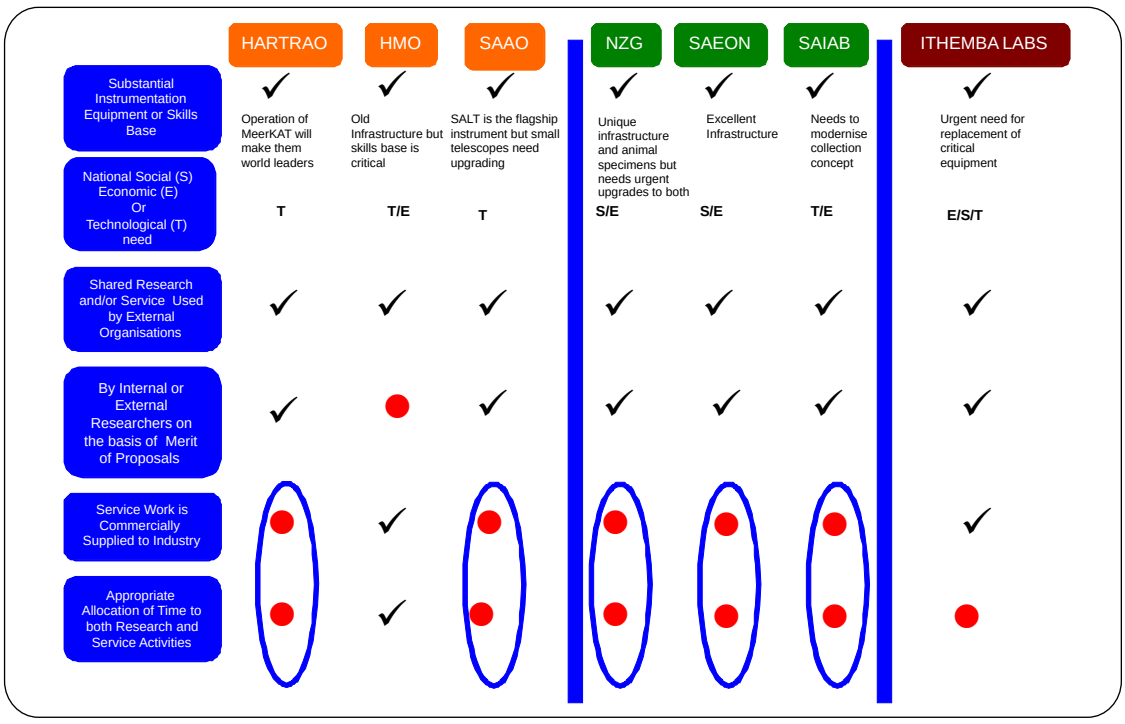

Figure 4.1 Indicating the strategic alliance of the existing NFs with the original DACST national facility expectations.

In the figure 4.1, above, the highlighted areas show possible areas of strategic growth of specific NFs into activities allowed by their mandate but not currently serviced.

These strategic partnerships should also ideally come with diversification of income streams through funding by the departments concerned. Where the strategic partnership is vital, such as the HMO – Department of Defence and Military Veterans link being a strategic national security matter, perhaps it should be regulated by inclusion in the legislative provisions proposed above.

This may indicate possible areas where new NFs may be contemplated to drive research agendas in line with Government's efforts. Similar gaps from the National R&D strategy (2002) or the DST 10 year Innovation plan may be explored, including the Southern Oceans, Palaeontology, Rapid Biodiversity identification technologies (iBOL) etc.

4.1.1 Alignment to the 10 point action plan

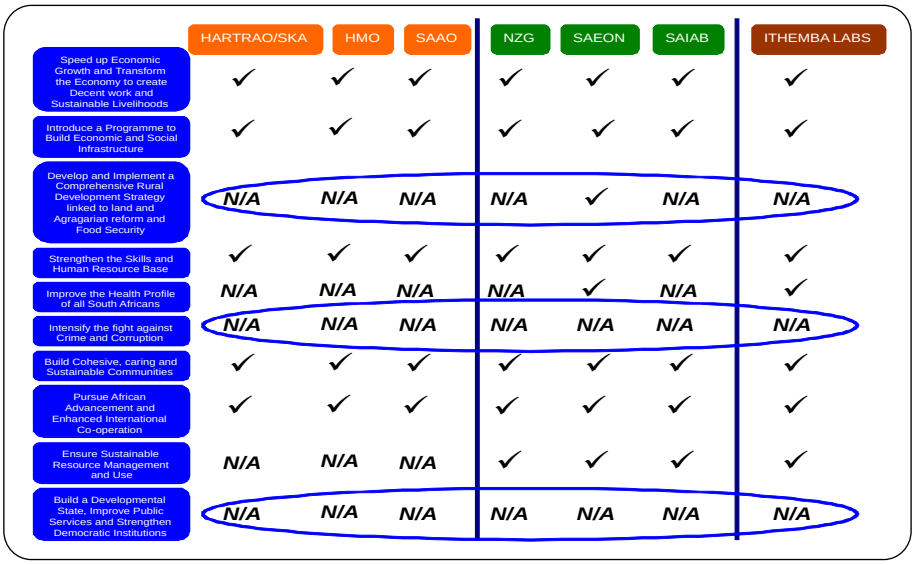

Figure 4.2 NF alignment with Government's 10 point action plan.

Although there is fairly indirect link to speeding up economic growth via the activities of the NFs, from the analysis in figure 4.2, it seems that the NFs are well aligned to most of the 10 points of the Government's programme of action. The highlighted areas of lack of coverage are:

- The development and implementation of a comprehensive rural development strategy linked to land and agrarian reform;
- Improving the health of all South Africans;
- Intensifying the fight against crime and corruption; and
- Building a developmental state, improving public services and strengthening democratic institutions.

This may indicate possible areas where new NFs may be contemplated to drive research agendas in line with Government's efforts. Similar gaps from the National R&D strategy (2002) or the DST 10 year Innovation plan may be explored, including the Southern Oceans, Palaeontology, Rapid Biodiversity identification technologies.

4.2 Strengthening Human Capital Development and assessing impact

The NFs have been positioned by the NRF to make significant contributions to the development of human capital in those strategic areas that they service. Numerous Human capital development initiatives exist including NASSP, the multi-wave initiative, and an extensive SKA Human Capacity development strategy. In the nuclear sciences the Manus MatSci programme and exchange programmes with CERN and other international facilities contribute to a competitive human resource base.

Flagship projects at the NFs all include focused HCD investments and bursary programmes. In addition to the postgraduate training programmes from the facilities, all of them contribute to science advancement initiatives. These include the SALT collateral benefit programme, the SAEON education programmes, and the NZG life sciences education programmes. Determining the impact of these interventions is still a problematic for the system as whole and requires considered research effort. Figure 4.3 provides a summary of those areas where NFs make a contribution and demonstrates the challenge of translating these inputs into demonstrable economic and social impacts.

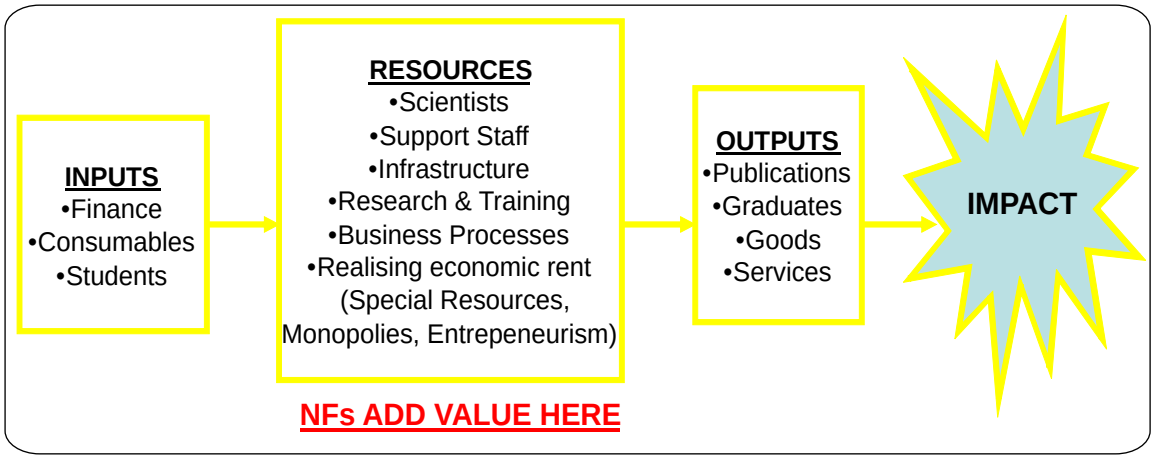

Figure 4.3 Schematic representation of the major value add areas in which the National Facilities operate.

Although the relationships between the inputs, resources and outputs can be quite easily summarized, what remains problematic is to convert these economic concepts to non-commercial environments. The monitoring and evaluation systems of our government have changed to emphasize the measurement and acknowledgement of impact. This is an area where the NRF still needs to conduct some critical work which will benefit the NSI, in general, and help to describe its impact in more acceptable terms.

4.3 Strategic Science Platform Provisioning

The primary reason for the existence of NFs is to make unique infrastructure and expertise available to the broader academic community. These, ideally, state of the art facilities and research platforms are too expensive to duplicate and would otherwise not be available to the South African research community. Efforts are required to ensure that all NFs provide maximum impact to the community and that these facilities are optimised to leverage them in support of critical human capacity development initiatives. The existence of NFs pursuing this goal from different organizations would make strategic decisions on platform provision fairly difficult to implement.

The NFs serve a wide-ranging mixture of scientific disciplines and the operating environment that they exist in can also vary greatly depending on many factors within our NSI and the international landscape. The governance frameworks of the NFs differ and the recommendations of the NRF review of 2005, in particular have largely not been followed with respect to formation of Scientific Advisory Boards. To date, only iThemba LABS and SAEON have these boards in place. Where this has been done it has led to stable and supportive relationships between the NRF / NF and its targeted user community. There is now an opportunity to formally instruct all NFs to comply with this requirement so as to benefit from the strategic inputs from their user communities of South African researchers. Ideally, the relationship between international networks that interact with a given NF should also be accommodated in the composition of the advisory boards.

The creation of appropriate Advisory Boards for all NFs will result in more attention of strategic issues in the NFs and ultimately inputs from the academic community will find their way into government agencies and DST directly. The proposal to introduce the NRF Facilities Advisory Council (NFAC – comprising the heads of National Facility Advisory Boards) into the NF governance framework should vigorously be pursued (see Figure 4.4).

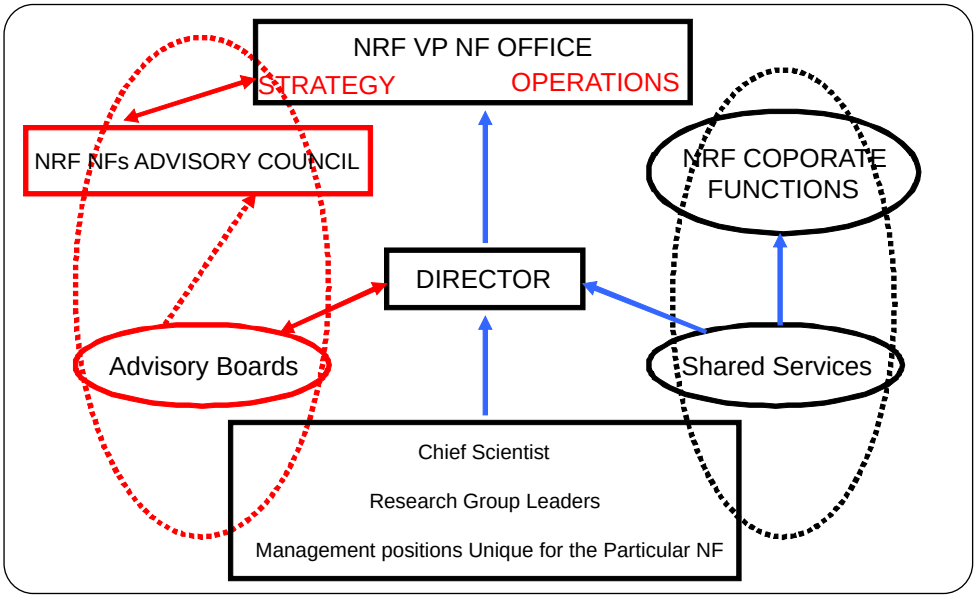

Figure 4.4 A proposed NF operational and strategic advisory framework

4.5 Optimising Relationships with Industry Sector Partners

The relationship between the NFs and industrial partners differs amongst the NFs. This varies from an extreme example such as HMO with 60% of its turnover from industrial contracts, through iThemba LABS with dominance in the global radioactive isotopes production market, restricted consultancy work in materials science, to the astronomy groups where there are no obvious sales to be made. The management of clients and intellectual property that enables HMO and iThemba LABS, including the other facilities, to capture such markets should be encouraged as those activities are within the broad mandate of the NFs.

Plans are underway to increase the capacity of radioactive beams at iThemba LABS, a new public private partnership on particle therapy for cancers is planned and the NZG is planning to spin out some of its commercial activities to private service providers. These are welcome developments as they contribute to economic growth, job creation and improved institutional sustainability.

New opportunities also are abound. A special relationship has developed between the astronomy sector and the engineering industry in that the construction of SALT and now MeerKAT has been a good example of mission driven innovation. South African companies have grown in the wake of the highly specialised assignments they have received from the NFs concerned. In line with the expected new intellectual property management frameworks, the NRF has developed standard contracting rules for situations where co-development of IP happens between a NF and a private company. This is to ensure that we secure the State's pre-emptive rights to such government funded IP. New shared capacity in the management of NFs through the corporate NF infrastructure is fostering improved business decisions and the management of IP in accordance with new legal requirements.

4.6.0 Facility Placement Options and Approaches

The NRF has taken a hard look at the history and strategic positioning of NFs. In particular, the NRF Executive feels strongly that infrastructure investments such as NFs that have no life cycle assessment, are not re-aligned with emergent strategic priorities or are simply maintained for historic reasons are destined to become dinosaurs in the NSI. This static approach is not in the interest of South African science investments and addressing national science priorities. In this regard we could adopt a number of alternative approaches

4.6.1 Retaining the current static management framework of the current suite of NFs

The option for the NFs to remain under unchanged management conditions appears to be problematic and not progressive. In any science system the most pressing infrastructure investments would evolve over time as national strategic priorities shift and science develops globally. This does not mean that historic investments are always inappropriate. On the contrary, many such investments can turn into considerable national assets that contribute fundamentally to strategic, economic and social priorities. However, new priorities will always emerge and historic investments need to be continually assessed and possibly even re-contextualised. An assumption of a static investment pattern in NFs appears unrealistic. Similarly, developments in the strategic and operational environments of NFs over time require that management and governance frameworks should evolve concurrently in order to remain appropriate and not encumber the main purpose of a NF. Recent developments in internationalization of activities of some NFs, mega-investments by government, and other factors requires a more urgent review of the current static model of the life cycle of NFs.

4.6.2 Create a New National Facilities Agency

The creation of a new agency to deal exclusively with the NFs has been proposed in the past. In 1999, the National Research Facilities Act was proposed. The orderly management of the NFs on a sustainable basis needs to be enabled by legislative conditions as proposed at that time. The choice of whether this is done through the promulgation of a new Act of Parliament, the National Research Facilities Act, thereby creating a new Science Agency or via amendments to the NRF Act is a matter of choice. The advantage of having an agency created by an Act of Parliament to exclusively manage the NFs would result in better clarity of mandate but may increase operating overheads unnecessarily. Particularly if a NFs developmental approach is feasible and can be adopted as proposed in this paper. Similarly, proliferation of state-owned entities as a result of sector specific interests or as a result of NFs seeking to exit on reaching mature life-cycle stages should be avoided for the same reasons. This should also to counter the creation of an unsustainable precedent that can proliferate across the NSI as other state-owned establishments may seek to travel the same path out of their current controlling entities *en masse* for vague reasons.

What is important, however, is that there should be a regulated environment that ensures stable administrative processes and funding mechanisms for the NFs. This can be implemented within the NRF or a new agency as long as flexibility of management frameworks and appropriate governance, taking into account stakeholder interests are ensured. It is however a most urgent matter to ensure that the NFs do not enter into an unsustainable state in terms of their investment in infrastructure and expertise – the principal reasons for their existence.

4.6.3 A Government Agency is a Nurturing Environment for Development and Sustainability of National Facilities

The government, through its agency the NRF, has proactively managed the NFs for the last 10 years and ensured their existence through various strategic interventions as shown in *section 3*, above. Further, several NFs have been declared from existing organisations, bearing testament to that a government agency with a broad strategic overview of NF strategy is an environment suitable for the establishment and growth of NFs in support of the NSI. It is also a suitable environment to potentially balance these actions with the changing priorities of government.

However, there have been no new NFs created since 1994 and this is curious - especially seeing the many strategic challenges of a scientific nature that the country faces. The NFs that were declared since the 1999 review are organisations that were either already in existence and/or placed in unsustainable situations before they were declared as NFs. The DST has received them into its agency and this has enabled nurturing them into relatively stable entities, even against the backdrop of financial challenges. SAEON was established but has not been formally declared as a NF.

In our view, the mix of some inertia in planning for the declaration and funding of NFs that are relevant to current and topical strategic challenges has contributed to some resentment for the currently funded NFs, and has led to questions about their current placement and strategic relevance. Many of these views are intensified by a static management and governance model.

The concept of managing the entry and evolution of organisations into the family of NFs is hereby proposed - where the level of surety and maturity of the strategic and operational environment determines how much direct control should be exercised over a particular facility. This concept can also be expanded to clusters of NFs and can be developed to determine the appropriate conditions for the devolution of strategic control from the developmental role of a government agency to an appropriate alternative management and governance framework which recognizes some of the factors identified above in this document. This model does not imply any automatic creation of new agencies by facilities reaching a certain level of maturity. It suggests that the NRF should find appropriate governance systems for such NFs still within its suite.

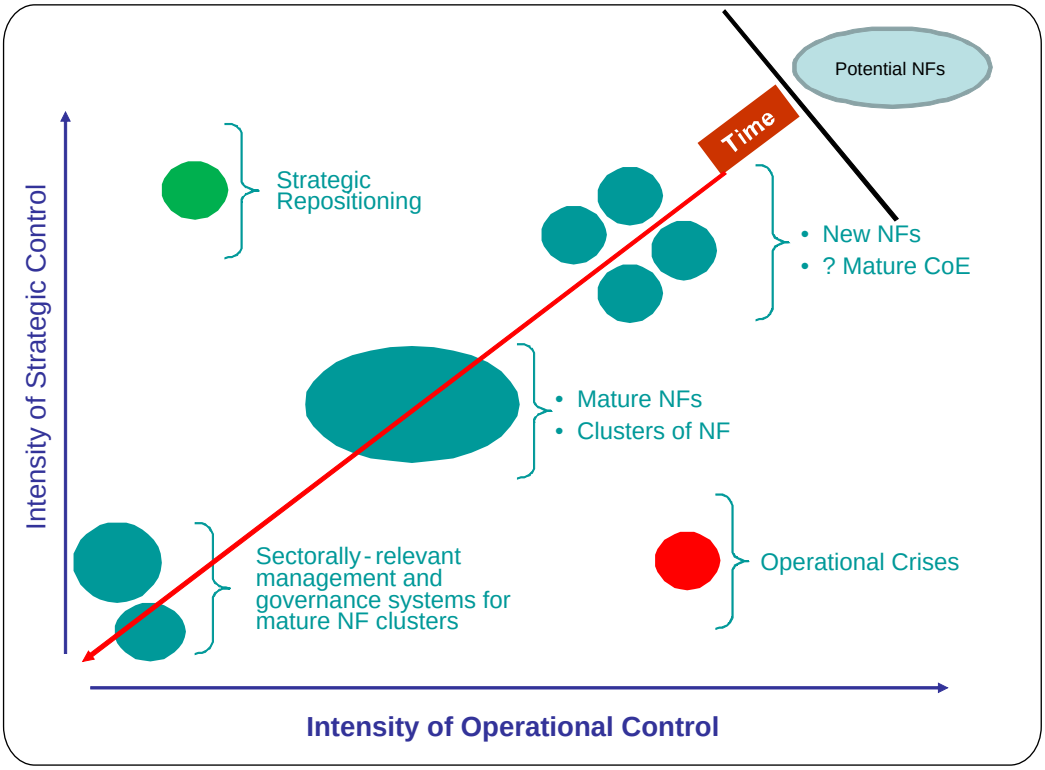

Figure 4.5 A model that depicts the shift in operational and strategic control for a developing NF or cluster of facilities in the NSI.

This model, figure 4.5 would be most appropriate in a landscape where the government establishes new and emergent NFs and develops them using appropriate management and governance models related to the stability of the strategic environment, operational issues and stakeholder dynamics. The aim is that the long-term strategy would be informed by sector experts in an appropriate advisory role without compromising the need for good financial management, corporate governance and the influence of government.

The model presented above introduces, for the first time, strategic motion into the concept of NFs and gives context to a government agency's developmental role in funding and building to maturity NFs that support a particular mandate of strategic importance. This also means that as NFs mature, the need for intensive management reduces to a point where additional capacity at the government agency could be released to focus on new entrants and long-term strategic planning.

Simultaneously, the model gives effect to mechanisms to pay attention to the needs of newer NFs where the initial conditions are characterized by higher levels of strategic and operational control. This would be the result of firm directives that government would give about the strategic purpose of such new NFs to pursue very specific scientific agendas. Progression through the developmental phases would lead to decreasing levels of direct control of an NF strategy and operations through appropriate advisory structures up to a point where there is a *de facto* devolution of everyday operational control to a more appropriate management and governance framework for the sector. At this point, necessary reviews about continued strategic roles, optimal placement and possibly even decommissioning would apply.

The introduction of strategic motion, described earlier, would become an important component of the management of NFs by a government agency. This will allow for the entry and maturity of NFs into different management and governance arrangements. This motion will also enable strategic planning, renewal and repositioning - a critical function of an agency according to the OECD review of the NSI (2007). This means that the agency will empower government to meet its strategic challenges, develop new stable organisations in the academic sector and ensure their maturity under appropriate conditions. At the same time any notion of stagnation, strategic drift or strategic misalignment would be prevented in the system over time due to the role of a government agency with a broad overview covering these matters and working very closely with government.

This evolutionary perspective of the NFs concept will open up space for an agency to tackle long-standing requests for new NFs to be developed, in an attempt to address the strategic challenges of crime through high technologies, criminology and other social sciences, Antarctic (Polar) research for the exploitation of our geographic advantage in the Southern Oceans, immunology of infectious and orphan diseases for the fight against the burden of disease including HIV and TB infection, for example. The DST has already commissioned and received finished strategic plans for the Polar Research Institute and the National Pre-clinical Biomedical Research facilities and the strategic space for these, or others, to be implemented may be assisted by introducing this developmental NFs concept.

4.6.4 Placement in appropriate sector-specific environments

There is some debate over where to place the current NFs in the timeline proposed above and possible exit routes have been suggested but this is a premature discussion for now. If the strategic developmental model for NFs is adopted, it will be important to move NFs to new institutional arrangements carefully in order to avoid their collapse through inappropriate support structures.

In this regard, the movement of NFs to new institutions or sectors, without mechanisms to ensure that they; have access to appropriate funds for operations, recapitalisation resources and do not fall into new management problems – such as those that are occasioned by new institutional arrangements, could undermine their continued strategic role. It should not be an exercise of shifting problems and burdens around the landscape but one that is geared towards optimising strategic influence and strategic renewal. It is therefore a specific preference that the life-cycle management model emphasizes flexible management and governance systems that are related to maturity of a NF. This is against the alternative placement of NFs or creation of new state owned entities when an NF, or a cluster, declares the desire to migrate

5.0 RECOMMENDATIONS TO THE MINISTER OF SCIENCE AND TECHNOLOGY

The focus of the NFs in platform provisioning, human capacity development, university partnerships, developing science impact and developing industrial partnerships has been well served – albeit with the symptomatic evidence pointing towards government policy renewal. There are now opportunities to strengthen this historic institutional development approach by implementing the following recommendations below.

5.1 Sustainability of NFs needs a suitable legislative environment

Nfs are an essential component of a healthy and competitive science system in areas of science that require unique large infrastructure investments or unique and concentrated assemblages of core competencies. There is an opportunity to enact legislation that puts into effect the recommendations that the management of the NFs should be strengthened by legislative provisions. These provisions can be included in amendments to the NRF Act and should generally provide for the elimination of *ad-hoc* decision making. The most urgent areas that require legislative provisions are those which pertain to:

- Periodic review of funding levels and maintenance of sustainable funding for normal operations and expansion of NFs where authorised and required;
- Periodic review of the state of major capital equipment, submission and approval mechanisms for recapitalisation plans;
- Periodic review of the life stage of NFs and determination of time lines for the status of any NF to be retained, subject to the changing priorities of government;
- Mechanisms for establishment, maintenance and loss of status as a NF that is pursuing a named strategy of government;
- Mechanisms for the movement of mature NFs to more appropriate management and governance frameworks that are sectorally-acceptable but linked to retention of a broad strategic overview and the influence of government where necessary.
- Mechanisms for assessing the merits of, and leading to funding of long-term strategic, flagship research projects in pursuance of national objectives.

Many of the current problems at the NFs are symptoms of a depressed funding environment and correcting this situation may lead to the disappearance of a large portion of grievances in the academic communities affected.

5.2 An Agency of Government is well placed to develop and nurture new NFs into maturity for the benefit of the NSI

The DACST (1997) review recommendation, states that the home of a NF is relatively unimportant as long as the host organisation does not encumber its strategy and operations. In this respect, it is important to highlight the NFs suitability for control in a government agency environment whilst acknowledging that the NRF does recommend that some current NFs may move to new and more appropriate homes in the future where it makes better strategic sense. However, this requires decisive action without falling into the trap of creating unsustainable precedents. For such good reasons, the NRF recently recommended that HMO should move to SANSA. When contemplating new NFs it is important to remember the types of facilities that are deemed suitable to become NFs (DACST review 2007):

5.2.1 They are the only facilities of their kind in South Africa; therefore an organisation that is entrusted to manage shared investments on behalf of the NSI, however, with a broad view on the collective national strategy regarding NFs is suitable;

5.2.2 Owing to high capital cost, they cannot be duplicated, so it is imperative that there is no wastage of national resources in different members of the NSI trying to manage and control them individually;

5.2.3 The NFs are largely reliant on state funding so they cannot exist while hosted by organisations outside the PFMA 3(a) scheduling. This includes Higher Education Institutes which, by law, cannot currently be scheduled under the PFMA;

5.2.4 The NFs are primarily involved in basic research and serve a user community in universities and Science Councils, amongst others. They therefore need to be housed in an organisation that has the systems and experience for interaction with the whole university community of South Africa in an impartial manner;

5.2.5 Users from all over the NSI make hands-on use of the facility, so it has to be managed on behalf of all users and not by any particular user, especially a user with significant freedom to drive their own research and organisational agenda outside the aims of government – such as a university;

5.2.6 The aim of promoting significant international collaboration can be assisted by an agency which respects sector specific expertise but with a global view such as that of other similar organisations managing those countries' NFs at a strategic level.

The life-cycle approach, presented above, is recommended as a tactic for the proactive establishment, nurturing and growth of critical human resource capacity in the country. This would be in response to the changing priorities of our society over time and in line with the DST's goals relating to building the country's human capital.

5.3 NFs should be closely aligned with current national strategic priorities

The idea of introducing strategic motion to the management of the NFs will ensure that current and emergent government priorities are served by the creation and nurturing of new NFs whilst mature and relevant NFs can best serve the national interest in a setting with appropriately devolved management and governance frameworks. This should take into account the formal input of sector specific expertise without compromising sustainability, legal and regulatory compliance and the influence of government. This logic is in direct support of the key principles of the DST 10 year Innovation Plan.

1. *Strategic decision*: Although the government should invest throughout the entire innovation chain, strategic choices must be made. This means that the choice of establishment and development of the NFs cannot be driven by scientific interests of institutions or academic communities alone but this must be informed by strategic needs of the country.

2. *Competitive advantage*: the government should invest in areas of the highest socioeconomic return, i.e. the Grand Challenges.

3. *Critical mass*: Investment in key research must be made at a critical mass and this dictates that the funding of established NFs should be at a level to achieve this goal and retain their competitive advantage.

4. *Sustainable capacity*: The R&D scale-up must be consistent for the system to have the appropriate absorptive capacity, with each element (e.g. skills, capital investment) relying on others for the system to work.

5. *Life-cycle planning*: R&D infrastructure must be considered over the long term, including depreciation, skills needs and running costs. This pillar has been addressed directly in the NRF proposal above in introducing strategic motion in the establishment, development of the NFs and their recapitalization and funding linked to supportive legislative provisions. It is therefore recommended that:

    5.3.1 A government agency should house those new NFs that speak to current strategic priorities and develop them to a state of maturity using the life-cycle management and governance approach described above; and

    5.3.2 The NRF is in favour of adopting an evolving NFs programme to serve the NSI needs on a continuous basis.

    5.3.3 A legislative intervention should be considered immediately in order to provide for the successful implementation of any recommendations.

6. 0 References

DACST (1997). The National Research Facilities Review, DACST, Pretoria

OECD (2007). OECD review of South Africa's Innovation Policy, OECD

The Department of Science and Technology's Ten-Year Innovation Plan (2008)