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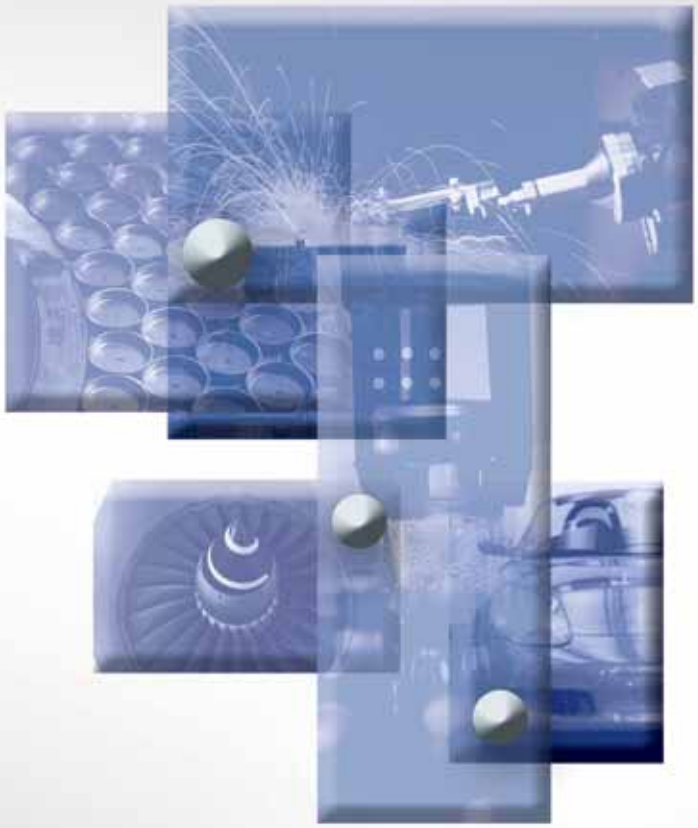

A NATIONAL ADVANCED MANUFACTURING TECHNOLOGY STRATEGY FOR SOUTH AFRICA

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Department of Science and Technology

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Preamble

The National Advisory Council on Innovation (NACI) advises the Minister of Science and Technology on strategies for the promotion of technology innovation; international scientific liaison; science and technology policy and the co-ordination and stimulation of the National System of Innovation.

In May 2002, NACI identified the need for developing a National Advanced Manufacturing Technology Strategy for South Africa.

This document presents the National Advanced Manufacturing Technology Strategy (AMTS) for South Africa. The process for developing the strategy was one of extensive consultation within the private, public and education sectors, and care was taken to ensure strategic fit with other national strategies and the avoidance of unnecessary duplication.

The contributions received from many industrialists, academics and government officials have added significant value to date and the solicitation of further comments is encouraged.

Comments on this strategy should be addressed in writing to:

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1. Introduction

Manufacturing is important to South Africa. It contributes over 18.5% of the national gross domestic product (GDP), over half of all exports and is the second largest employer.

As important as it is, there are signs that the manufacturing sector is in decline, as evidenced by:

- A declining value-add from the sector (3.6% in 2001 compared with 5.1% in 2000)[1]
- A declining rate of change in manufacturing export growth[2]
- A dramatic decline in gross domestic fixed investment in the sector between 1991-1996 and 1996-2001[2]
- A low labour intensity[2]
- A decline in employment across the sector[2]

The South African Government, in recognizing the importance of manufacturing in the economy, recently developed two strategies: the **National Research and Development Strategy (NRDS)** and the **Integrated Manufacturing Strategy (IMS)**. The former, released by the Department of Science and Technology (DST), aims at ensuring that technology resources are better developed, focused and utilized. The latter, by the Department of Trade and Industry (**dti**), recognizes that South Africa's future competitiveness will depend on the capacity of the manufacturing sector to master advanced technology domains, to innovate and to meet the precise needs of customers.

The IMS recognizes the need to move from raw material-intensive manufactured goods towards increasingly knowledge-intensive goods and services. The NRDS regards Technology and Innovation Missions as central elements for accelerating economic growth, the creation of wealth on a sustainable basis, and the improvement of quality of life of South Africans.

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1 *Statistics South Africa, Gross Domestic Product annual estimates 1993-2001*

2 *A review of the changing composition of the South African economy. Trade and Industry Policy Strategies*

1.1. The Importance of the South African Manufacturing Sector

There are three main reasons why South Africa, in attempting to achieve higher growth rates in its economy, needs to focus on its manufacturing sector:

a. Throughout history, countries trying to improve their economic and social standing have sought to move to higher value-added activities. As these require more capital, technology and skills, only a small group of countries has been able to engage in these activities. Consequently, these countries have commanded a market premium, which in turn, has provided them with higher returns for their resources. The primary shift in the Industrial Revolution was from agriculture to manufacturing and many developing countries are still struggling to achieve this. Others, which have made the first transition, have moved on from simpler manufacturing operations to more complex operations and to high technology services. South Africa also needs to make this next transition.

b. Manufactured goods are highly tradeable in most countries, which is an important feature for the economic and social development process. International trade drives higher growth rates than would be the case if domestic demand were the only driver of growth. The East Asian tigers used precisely this mechanism to achieve high growth rates at a time when domestic demand was growing at only modest rates.

c. Manufacturing supplements and complements other sectors of the economy. South Africa's traditional industries have been resource based, particularly in minerals. Today most minerals are exported in primary metal forms, the main exception to this being fabricated steel structures. This prevents South Africa from reaping the full benefit of its very rich resource base. Manufacturing can add value to these exports by converting ores to primary metals and primary metals to higher value-added manufactured products. Manufacturing will also complement the service sector. High-value manufacturing will generate demand for the provision of technology-intensive services. On the other hand, failure to upgrade resource-based industries will make South Africa vulnerable to the global trend of deteriorating terms of trade for commodity producers, which has been evident over the last few decades. Thus manufacturing can be seen as an important catalyst for the upgrading of the entire economy.

1.2. The Technology Perspective of a Competitive South African Manufacturing Sector

Within the manufacturing sector, there are interesting trends that distinguish manufactured goods of different technology intensities. In a recent paper, Professor Sanjaya Lall of Oxford showed that over the period 1985 - 1998, high technology intensity industries of developing countries grew at over 20%, with electronic items dominating this category. Medium and low technology intensity industries in these same countries grew by between 10 and 15%, while resource-based industries grew at just over 5%.

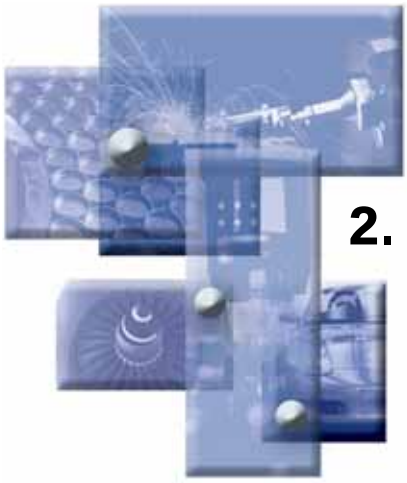
Within South Africa, a similar trend can be seen. Over the period 1994 to 2001, the growth rates of different technology segments of the manufacturing sector were as depicted in Table 1.

	1994-1996	1996-1998	1998-2000	2000-2001
Low technology	1.59%	-0.98%	-3.45%	1.3%
Medium technology	8.85%	-0.84%	0.20%	-3.2%
High technology	14.25%	3.08%	11.84%	8.3%

Table 1. Growth rates versus technology intensity

(Source: TIPS South African Standardized Industry Data Base)

Clearly, high-technology manufacturing industries offer the greatest advantage for growth, which raises the question of what is required for South Africa to become competitive in these areas.



2. A Technological Vision for the Industrial Sector

The technological vision for the industrial sector has as its principal element, the improvement in the competitiveness of the industrial sector, as defined in technological terms.

In the Industrial Development Report for 2002/2003 of the United Nations Industrial Development Organisation (UNIDO), the competitiveness of 87 countries was determined using an index called the Competitive Industrial Performance Index or CIPI. South Africa's rating in 1998, the latest year for which comparable data was available, was 0.108. This placed South Africa amongst a band of countries, which includes Turkey and Greece (CIPI ratings of 0.10 to 0.11) somewhat below our South American counterparts like Brazil and Argentina (CIPI ratings of 0.14 to 0.15) and very much below our East Asian counterpart (Malaysia) and Australia (CIPI ratings of 0.21 to 0.28) (See Table 2).

Country	Business R&D per capita (US$, 1998)	Royalties per capita (US$, 1998)	Technology R&D per capita (US$, 1998)
South Africa	12.8	4.0	16.8
Argentina	8.5	11.7	20.2
Brazil	13.7	6.5	20.2
Australia	148.0	53.8	201.8
Malaysia	6.7	107.8	114.5

Table 2. South Africa's technological standing, as measured by different indicators

As increasing competitiveness is the raison d'être for technological upgrading, the principal element of the Technological Vision must be the achievement of a substantial upgrading of the CIPI index by 2014. The most appropriate indicator for this strategy is technology intensity, defined as technology spending per capita. The latter includes domestic R&D as well as the acquisition of foreign technology.

Industrial competitiveness, however, is a multi-faceted goal and several departments and programmes have to come together to achieve this result, as Figure 1 shows.

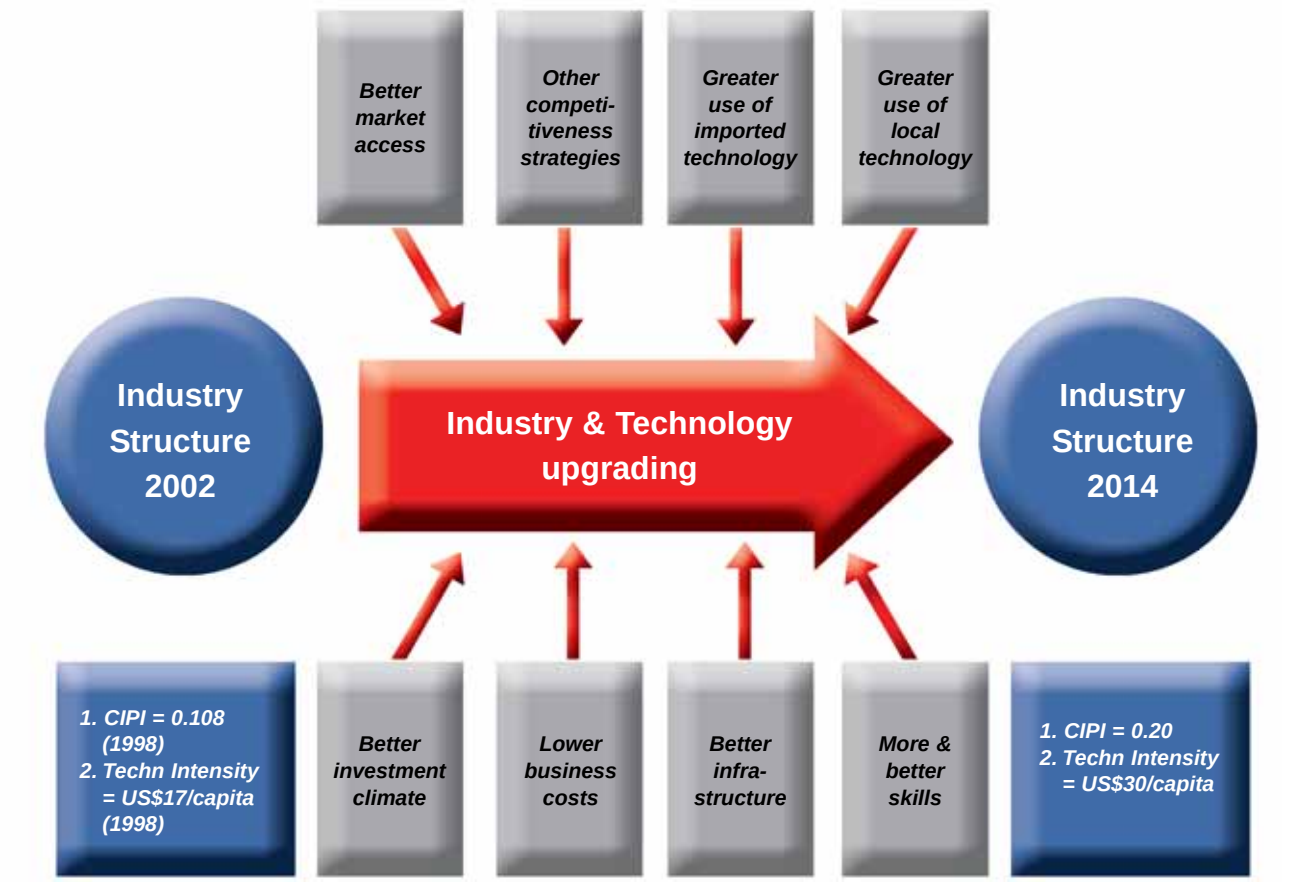
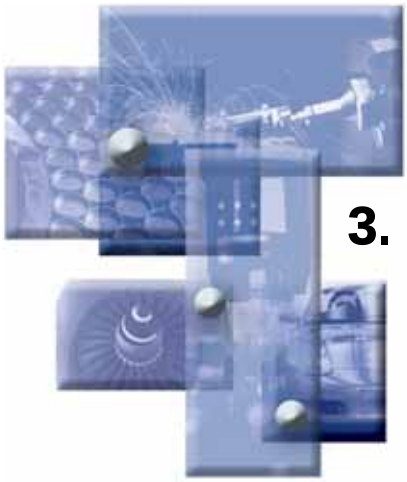


Figure 1. The requirements for industrial competitiveness

The vision must also link competitiveness with national and social goals such as economic growth, job creation, equity and geographic distribution. The link between stronger competitiveness and contribution towards the growth and employment goals lies principally in the choice of priority sectors.

While the methodology for upgrading the technology or competitiveness of different sectors is broadly the same, the results of such effort in terms of growth or jobs created can vary widely. Hence the choice of sector and technology focal area is critical.



3. Goals and Objectives

The goals and objectives of the National Advanced Manufacturing Technology Strategy are to:

- Develop a vision of the technological profile of the industrial sector in the year 2014
- Identify priority sectors which have the greatest potential for supporting relevant goals contained in the IMS and the NRDS. These goals include national and social goals such as job creation and equity
- Stimulate technological upgrading in industry
- Facilitate the flow of technological resources to industry through new knowledge networks to foster innovation
- Facilitate the building of an environment conducive to innovation, particularly through the supply of skilled manpower, technology infrastructure and funds.

4. The Process for Developing a National Advanced Manufacturing Technology Strategy

The strategy initially focuses on a select number of industry sectors and technology focus areas as summarised below in Figure 2. The sectors were mainly selected from those identified in the Integrated Manufacturing Strategy and the technology focus areas were identified as those with the greatest potential impact on the South African manufacturing sector. Standards, quality assurance, accreditation and metrology (SQAM) and small and medium enterprise development are cross-cutting focus areas. It is likely that as the process continues, other sectors and technology focus areas will be added.

Technology Focus Areas / **Industry Sectors**	Advanced Materials	Product Technologies	Production Technologies	Logistics	Cleaner Production Technologies	ICT in Manufacturing	Small & Medium Enterprise Development [1]	SQAM Technology issues[1]
Automotive (& Transport)								
Metals (& Minerals)								
Chemicals								
Clothing & Textiles								
Craft								
Aerospace [1]								
Capital Goods [1]								

Figure 2. The sector/technology focus area matrix

1 *The Aerospace and Capital Goods Sectors and Small and Medium Enterprise Development and Standards, Quality, Accreditation and Metrology (SQAM) technology areas are currently under development.*

The choice of a matrix approach was strategic as the limitations of silo thinking within sectors and within technology focus areas were seen as constraints. The quantum leap sought by this initiative, is more likely to be found between sectors and technology focus areas.

The approach (see Figure 3) ensured:

- Wide consultation with industry, local and international science councils, Tertiary Education Institutions (TEIs), labour and government; and
- Learning from international best practices and processes - successes and failures.

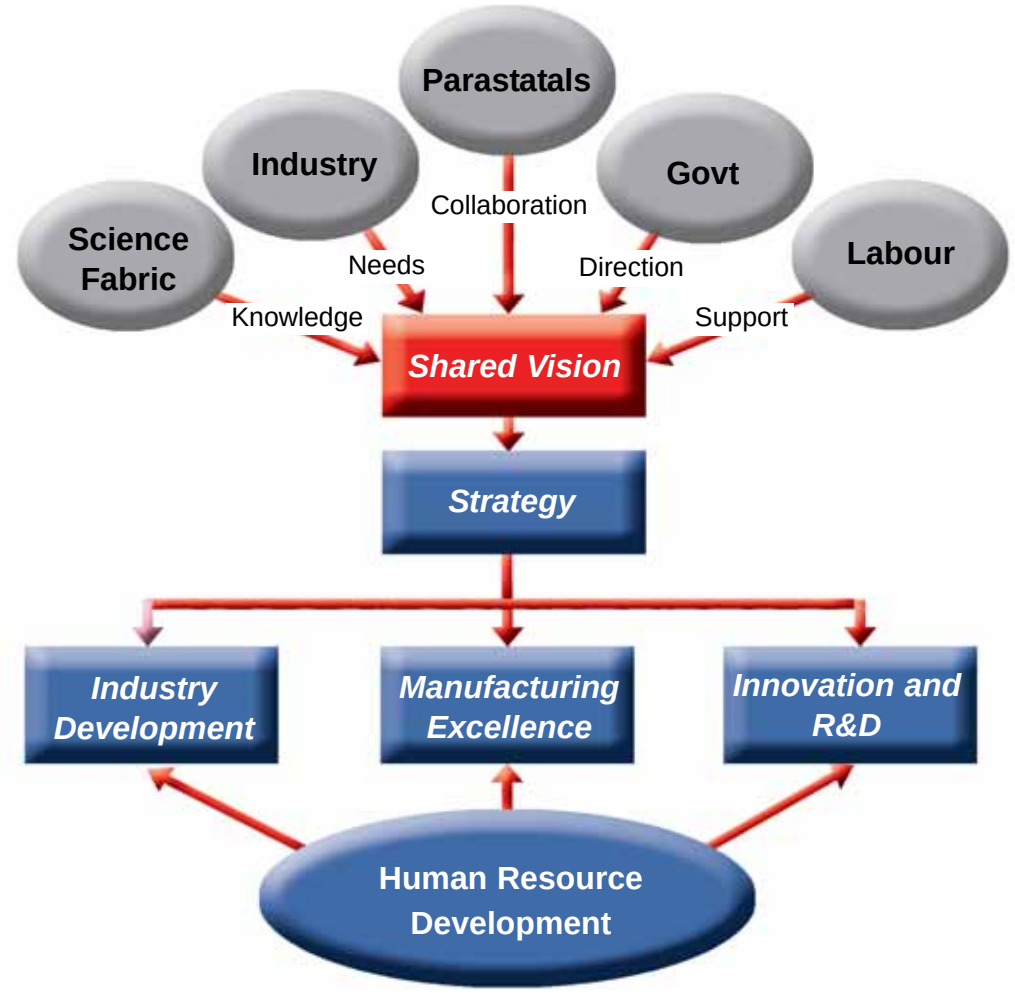
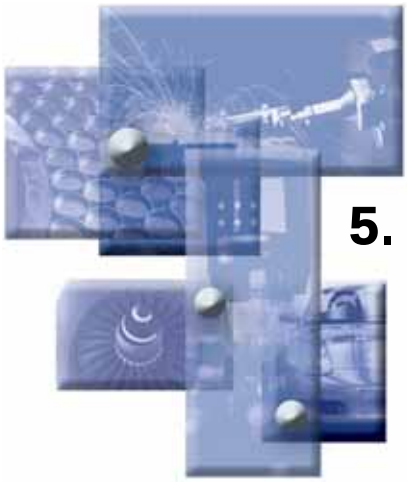


Figure 3. The approach to the strategy development and its outputs

An Advisory Group guided the overall process and a Reviewer Panel ensured quality findings from the process, specifically concentrating on the outputs from sector or technology focus areas (Appendix 1).

Members of sector and technology focus area teams were drawn from government, industry and academia to ensure comprehensive debate and outputs. Through internal debate and external stakeholder interaction, these teams identified key issues facing the sectors and technology focus areas which, if resolved, would provide the advances necessary for above-average growth in the economy.



5. Key Recommendations

The South African innovation system has been, and still is, generally characterized by fragmentation, silo-mode approaches and a lack of resources. The ability of this system to offer innovative solutions would be enhanced if there were greater collaboration, facilitation and leadership:

- Within disciplines/sectors
- Between disciplines
- Between sectors and technology focus areas.

The strategy has produced a number of recommendations. These may be categorized as a) the generic facilitating mechanisms and b) the sector and technology-specific initiatives underlying the strategy.

The strategy implementation will be achieved through a combination of Centres of Innovation, Innovation Networks and specific initiatives or projects. Specific programmes such as focused human resource development will be driven through TEIs. The need to ensure provincial and metropolitan council alignment and support for initiatives, is an essential part of implementation which is outlined in Section 5.6.

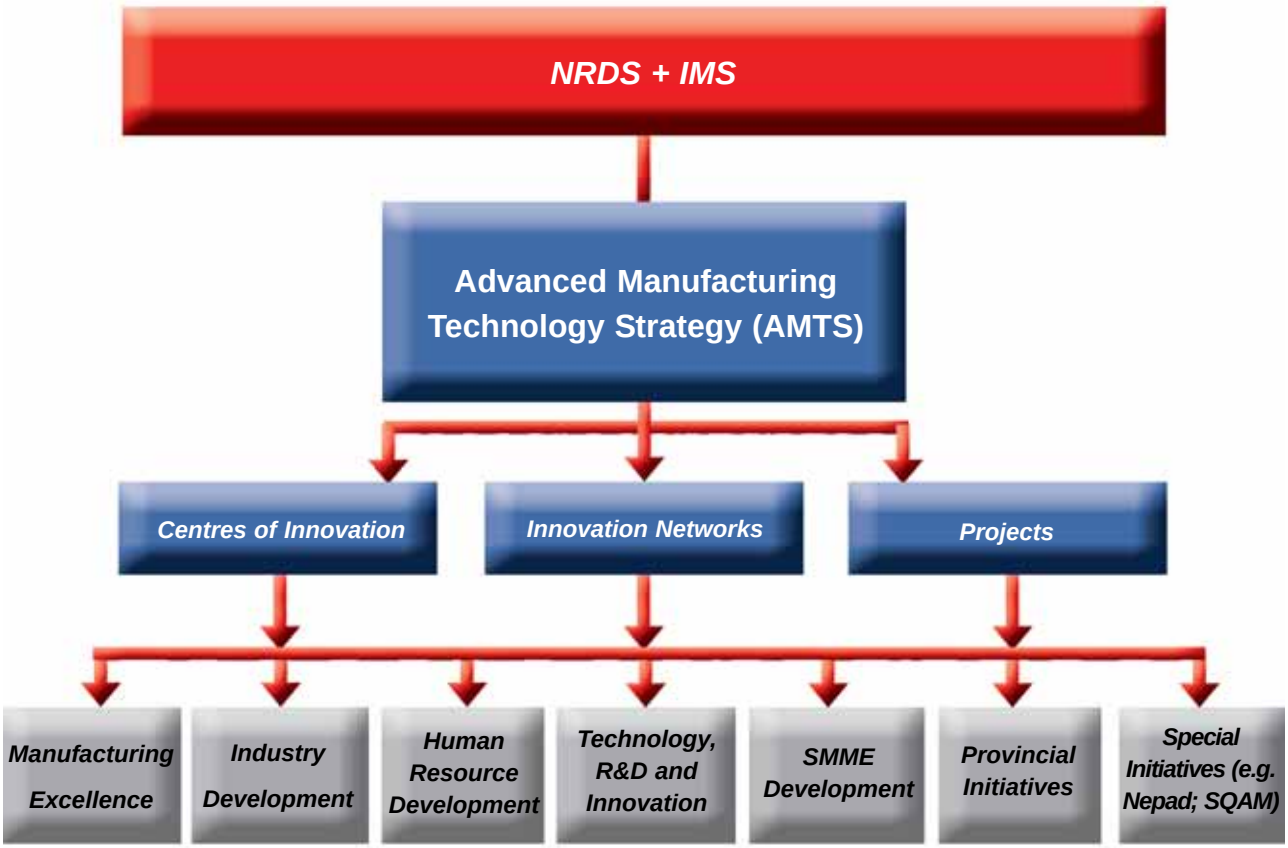


Figure 4. The strategy implementation process

5.1 Innovation Centres

Innovation Centres are proposed where:

- There is no existing structure capable of meeting the needs identified;
- A central hub of expertise and critical mass has been identified as a necessary pre-condition to meeting strategy objectives, including human resource development; and/or
- A sector or technology focus area requires a significant resource commitment to derive suitable economies of scale or scope. This is likely to apply to capital equipment-intensive innovation and critical interactions between technology providers. The scope of operations is also likely to be wide with multiple technology area interactions to solve sectoral problems.

Figures 5a and 5b show the management models for sector and technology innovation centres respectively. Although the nature of the programmes will differ, these centres will be managed by a centre manager reporting to the equivalent of a Board consisting of three to five members from relevant Government Departments and Science Councils. The centre strategies will be influenced by Industry Advisory Boards or Technology Focus Steering Committees.

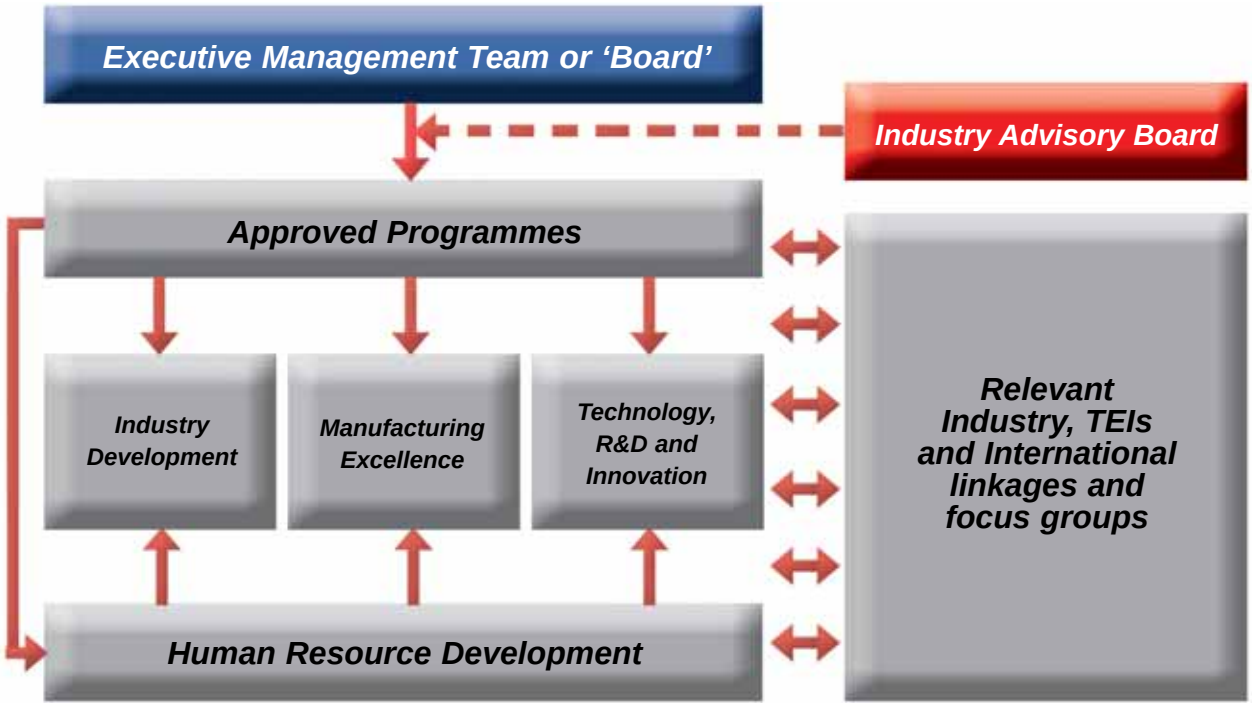


Figure 5a. Indicative management model for sector innovation centres

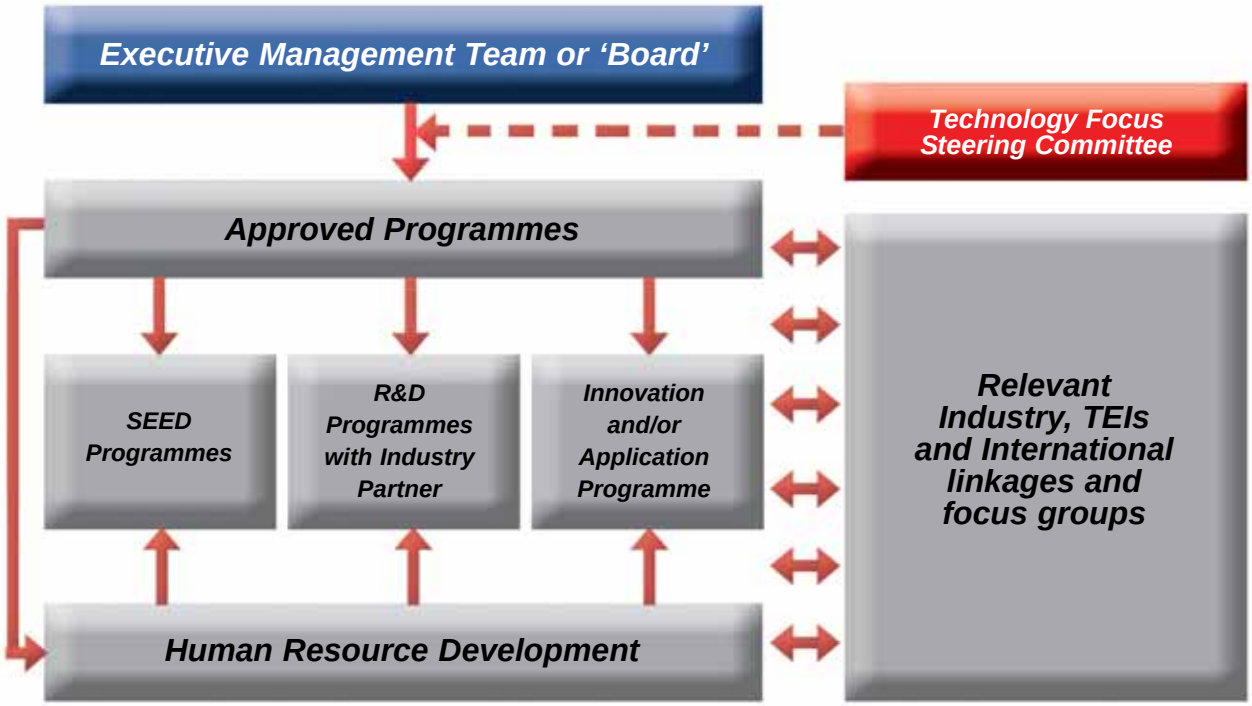


Figure 5b. Indicative management model for technology innovation centres

The Innovation Centres can be divided into

- Those that already exist as physical centres and which would be further developed to meet the objectives of the strategy; and
- Those that do not yet exist and need to be created to meet the objectives of the strategy.

5.1.1. Existing Centres

Within each sector and technology focus area, there are pockets of expertise and leadership which can contribute to the strategy and which will require additional support in order to fulfil expanded mandates.

Examples of Existing Centres to be Strengthened

Automotive Sector

The Automotive Industry Development Centre (AIDC) exists as a Centre jointly supported by industry, government, and the CSIR. This centre should be expanded to ensure a national impact compared to the current main focus on Gauteng. The resulting research and development proposed will facilitate the introduction of new vehicle models by the MNCs and OEMs which will significantly differ from current models and advanced technology capacity is critical. In an increasingly competitive market, improved manufacturing systems and ensuring a move towards agile and lean manufacturing will support the growth of the South African automotive sector. It is envisaged that several of the proposed initiatives will be financially self-sustaining in the medium to long term.

Product Development Technology

The National Product Development Centre (NPDC) is a DST-funded and industry-supported Centre managed by the CSIR. Technologies, methodologies and systems used to develop new products from concept through manufacture to usage, as well as the re-design and re-engineering of existing products will impact on a number of sectors. The NPDC needs to be strengthened to provide R&D on emerging technology areas, such as Virtual Prototyping and improve (through a national programme) South African design competence and capacity - impacting on sectors as diverse as high-tech aerospace and automotive to the comparably low-tech cultural and crafts sector.

Cleaner Production Technology

Since 2002, the UNIDO-established Cleaner Production Centre has focused on industry sectors and associations requiring assistance regarding compliance with existing and proposed local and international regulations. Through the development of this strategy, it was emphasized that this centre should be expanded to further develop national capacity in cleaner production technologies as well as specific environmentally sound production technologies in a number of sectors. Successful R&D in cleaner production technologies remains a crucial component of sustainable development, environmental protection and opening doors to global trade.

5.1.2 New Centres

Logistics Innovation Centre

The Centre will act as a catalyst in continuously improving the competitiveness of the South African industry via logistics excellence. It will strive to drive and support a nationally co-ordinated effort, provide a 'one-stop-shop' for industry and co-ordinate R&D in the logistics domain to the benefit of South African industry as well as the region.

National Textile and Clothing Innovation Centre

The South African textile and clothing industry requires a national centre that can co-ordinate and project manage all research activities, link pockets of excellence and carry out the required R&D for the South African textile and clothing industry in collaboration with industry and TEIs. Of importance is R&D in electronic technical knowledge databases; multifunctional and intelligent textiles; and value addition to natural fibres.

5.2. Innovation Networks

Innovation Networks are proposed where:

- Resources, mainly personnel and equipment, already exist to some extent, but are fragmented geographically - the fragmentation, itself, is not limiting the meeting of the objectives of this strategy; and
- A central hub of expertise is not necessary to meet the objectives of the strategy.

The Innovation Networks concept will not duplicate existing network structures but will endeavour to provide stronger leadership, co-ordination and management to existing and future role-players. While not mutually exclusive, these can be categorized as Innovation Networks that support sectors and Innovation Networks that support technology focus areas.

Figures 6a and 6b show the management models for Sector and Technology-focused Innovation Networks. Networks can function in many ways but to ensure implementation of the strategy, the following is deemed necessary:

- An Initiative Steering Committee/Industry Advisory Board
- A Network Initiative Management Team
- Approved programmes with clear outputs.

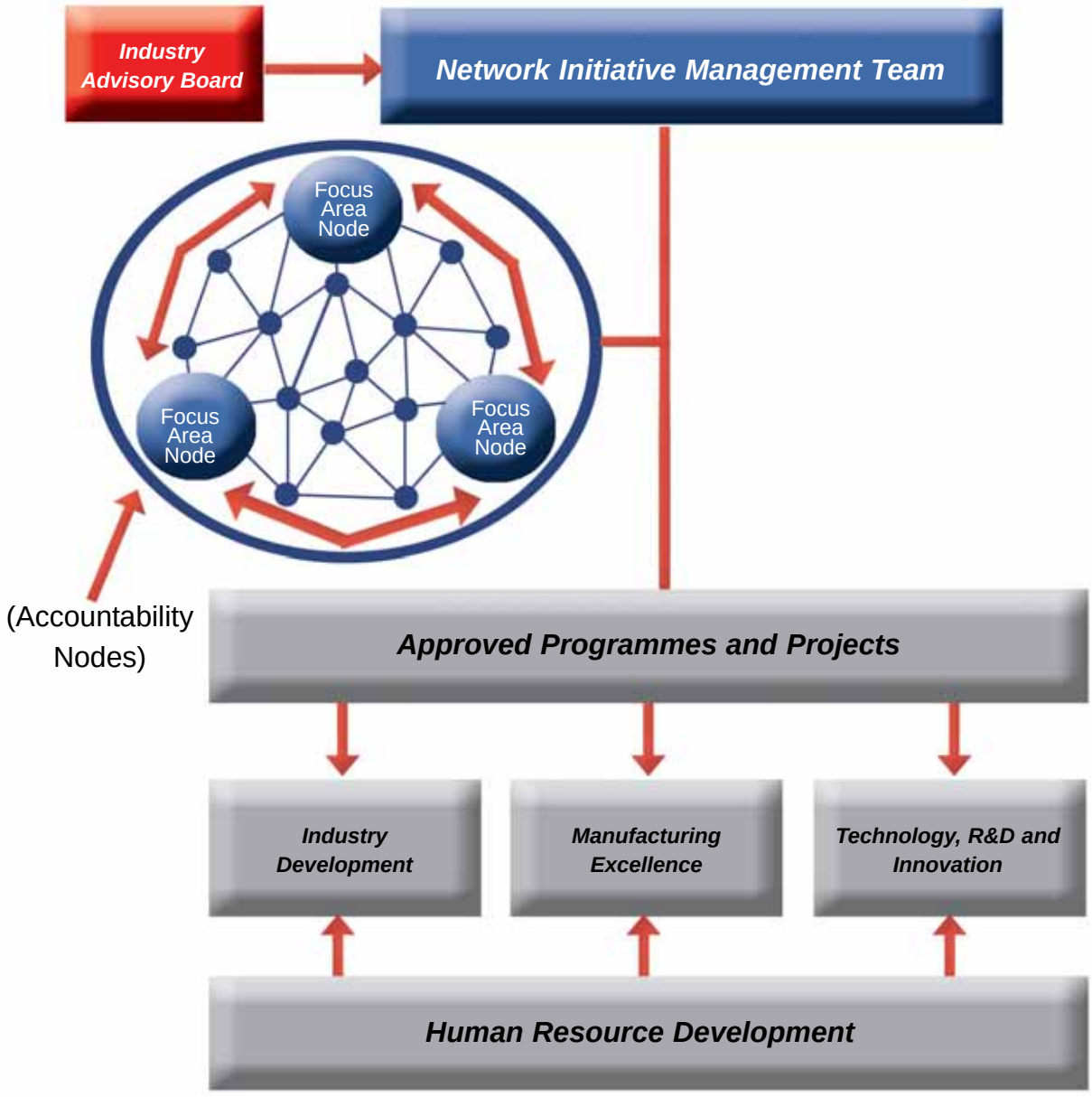


Figure 6a. Indicative management model for sector network of innovation

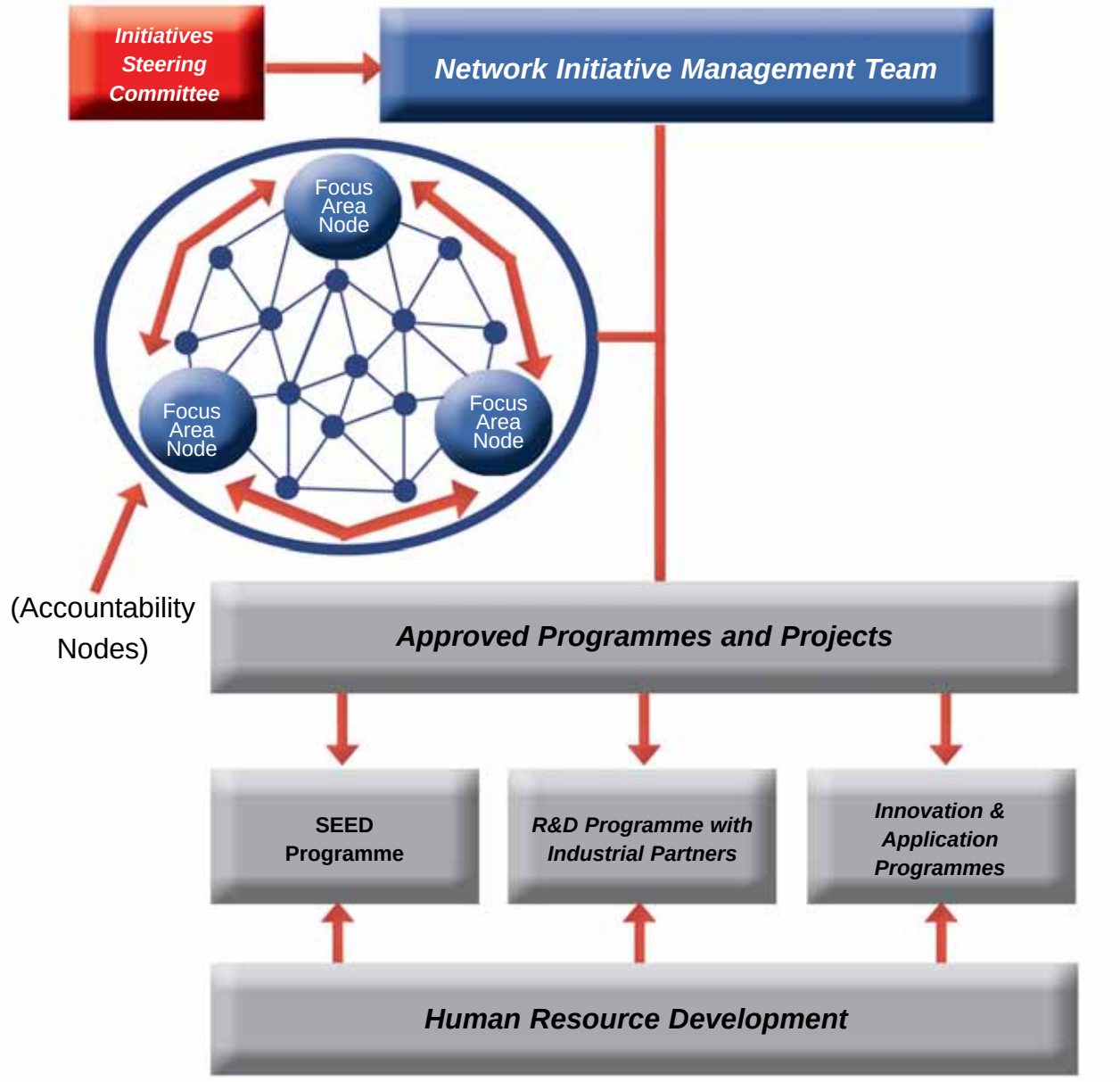


Figure 6b. Indicative management model for technology network of innovation

5.2.1. Identified Innovation Networks

Advanced Metals Network (Sector focus)

An Innovation Network would facilitate the execution of initiatives to improve competitiveness in carbon steel; stainless steel; light metals and alloys and precious metals. The major industries of application are amongst others, automotive, aerospace, household products (White Goods), building and construction, jewellery, mining and packaging.

National Craft Development Network (Sector focus)
The focus of this Innovation Network will be on maintaining and building capacity in R&D to support the sector; implementing national cultural industry strategy and programmes; development and commercialisation initiatives in the craft sector; and accredited training programmes in line with Sector Education and Training Authority (SETA).

ICT in Manufacturing Innovation Network (ICTMIN) (Technology Focus)
The manufacturing sector consists of a large number of companies in different industries and sub sectors with different levels of ICT usage. It is evident that leadership is required to assist the manufacturing sector to ultimately ensure South Africa has an ICT-empowered manufacturing base. A network of excellence will ensure that existing initiatives and partnerships are utilised efficiently to empower the manufacturing industry with e-commerce, provide access to advanced computing and modelling capabilities and research, and implement next-generation manufacturing ICT systems and grid manufacturing concepts.

Advanced Materials Network (Technology Focus)
The Advanced Materials Network (AMN) will result in new product development, material beneficiation and improved performance of production and manufacturing systems. The aim will be to transform scientific discovery into social benefits and to realize private sector commercialisation, thereby opening up new opportunities for South Africa. The initial focus will be on nanomaterials; advanced polymers and ceramics; and high-performance materials based on natural resources (including minerals). The latter will be linked to the Advanced Metals Network. Aspects of smart materials, biomaterials and composites are included in the above three focus areas.

5.2.2. Innovation Networks under review

The Aerospace Network (Sector focus)
This network is in the early stages of formation, but is considered vital to the further development of this sector. In particular, the sector stands to benefit from the Non-Defence and Defence Industrial Participation programmes (NIP/DIP) if it can provide the advanced manufacturing capabilities required by the obligators. The foundation of the network is developing with commitments to proceed sourced from DENEL, Kentron, Eloptro, and SAA Technical.

The Capital Goods Network (Sector Focus)
The diversity of capital goods manufactured in South Africa, and the importance of the sector to economic development is noted. The formation of a network of key players in this sector is vital if the technological capabilities being developed by this strategy can be utilized, if not directed by, these players.

The Chemical Industry Network (Sector focus)
The network will facilitate the development of the sector through:

- the interpretation of the sector's needs
- creating and maintaining a relevant database of the sector including skills, technologies, products and materials
- developing programmes to provide technology flow and key development needs in process technology and platform skills, including catalysis, synthesis, extraction, computational technology, beneficiation and value addition opportunities, in order to take advantage of South Africa's competitive advantages.

The Advanced Production Innovation Network (Technology Focus)
The complexity and fragmented nature of production environments, and their requirements for technological solutions have retarded the development of a specific and targeted set of interventions. A network approach, with contributions by both suppliers and consumers of technology is envisaged, but further analysis, lobbying and discussion are required.

It is recommended that the initial steps required for network establishment revolve around a more detailed analysis of the production technology demands across industry. This should be driven by an expanded advanced production technology focus area team, the original team having reduced the focus to a more manageable list of intervention possibilities. The inclusion of international experts (e.g. from the Warwick Manufacturing Group in the UK) and experts from TEIs is highly recommended.

5.3. Projects

The figure below illustrates the execution and impact of potential lead projects and the cross linkages between technology focus areas and the addressing of sectoral needs.

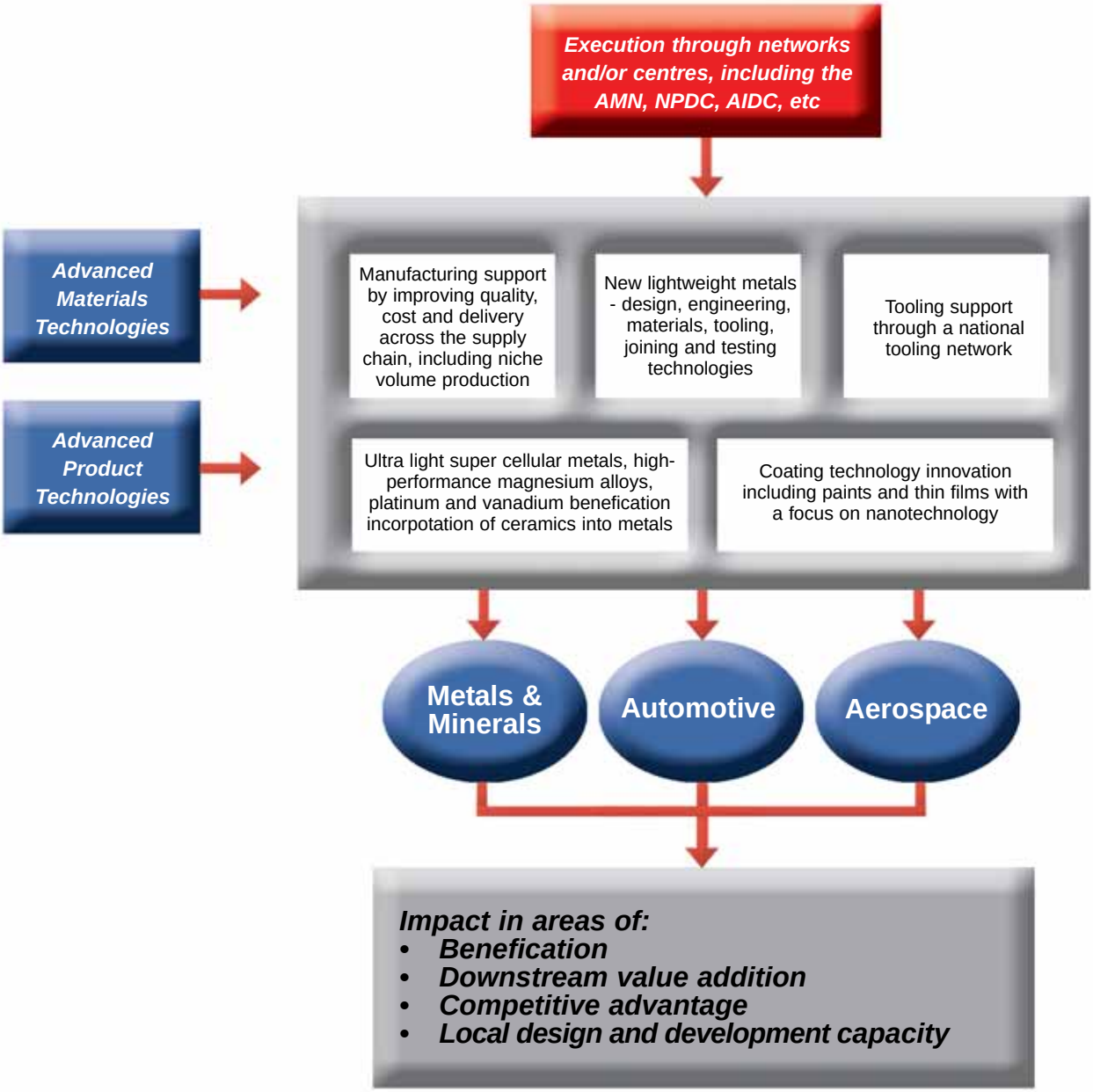


Figure 7. Example of projects implementation

Examples of Potential Lead Projects or Programmes

- An internationally accredited automotive testing facility
- Aluminium, magnesium and titanium light metals development
- Impact of aluminium in the short to medium term, impact of magnesium in the medium to long term
- Coating technology innovation, incl. paints and thin films with a focus on nanotechnology
- Development of SME and BEE in stainless steel consumerware industry aesthetic designs
- New light weight metals
- Platinum beneficiation
- High-performance magnesium alloys
- High-performance textiles through use of nanotechnology
- Optimisation of three processes to extract Al and other by-products from coal ash
- Production of TiO_2 sponge recovered from slag with new technology
- Industry information portal to facilitate communication between industry, government and R&D organisations.

5.4. Human Resource Development

The need for human resource development is critical in each of the three key requirements for developing the manufacturing sector. This is demonstrated in Figure 8.

Figure 8. The importance of human resource development in the growth of the manufacturing sector

The available evidence indicates that there is indeed a significant demand for people with skills, which is not matched by their availability. Factors such as economic growth, sectoral levels of labour intensity, projections of net migration, sectoral age profiles, the business cycle, government expenditure decisions, projections of HIV/AIDS morbidity rates, industrial policy and foreign direct investment, all affect this supply and demand dynamic.

Without an understanding of the dynamics of the skills environment, it is not possible to plan appropriately. The consequences of skills imbalances are undoubtedly negative.

This needs to be corrected through a focus on industry-driven and academic institution-supported human resource development.

Tertiary education institutions, industry bodies, labour unions, the Department of Labour, DST, the **dti**, Department of Education and the relevant SETAs must play important roles in creating the human capital which is a cornerstone of an advanced manufacturing sector. The development of linkages with and between these bodies, and the co-ordination thereof, must form a key underlying component of the strategy.

5.5. Supporting Initiatives

5.5.1. Small and Medium Enterprises (SMEs)

SMEs contribute approximately 35% to South Africa's GDP. During the past decade, the small business sector has maintained positive employment growth. This is in stark contrast to the job losses experienced in the public and large enterprise sectors. Small business, therefore, has a critical role to play in the growth and competitiveness of our economy.

It has been estimated by Statistics South Africa (2000) that there were over 1,6 million SMEs in South Africa, 10% of which were in the manufacturing sector. The manufacturing sector is very dynamic and, according to the Global Entrepreneurship Monitor, has a high share of the new firms being created.

By integrating SME initiatives within national research and development and industrial policies, the contribution by SMEs to employment creation and economic growth can be greatly enhanced. The creation of new enterprises also provides an ideal opportunity to advance black economic empowerment and reduce the income inequality in our economy.

It is recommended that the implementation phase focus more strongly on identifying interventions that will enhance the competitiveness of the SME manufacturing sector. A number of initiatives aimed at advancing SMEs and BEE companies have already been identified in Volume 2. These will be linked to existing programmes such as NAMAC and GODISA.

5.5.2. Standards, Quality Assurance, Accreditation and Metrology (SQAM)

It is an internationally recognised fact that competitiveness is facilitated by a sound and efficient standards and conformity assessment infrastructure. A nation's ability to develop technical norms and to confidently and competently evaluate products against such norms is therefore of the utmost importance
White Paper on Science and Technology

Following the recent completion of the National Economic Development and Labour Council (NEDLAC) facilitated national SQAM review, the importance of national infrastructure and related programmes in support of growth and development, trade agreements and the technical regulatory framework was emphasized. The **dti** recognizes and highlights the importance of SQAM as part of the Integrated Manufacturing Strategy.

Development and investment in appropriate metrology facilities to support technological developments as well as the development of standards to ensure compliance of the emerging technologies, products and processes are key success factors for the successful implementation of this strategy. International acceptance and competitiveness require compliance, notably in the context of the regulatory frameworks of trade agreements. Linkages between the Advanced Manufacturing Technology Strategy and SQAM issues should be continually reviewed.

5.5.3. NePAD

The need to integrate this strategy with other government strategies to enhance the development of both national and regional economies has been recognised throughout this process. With respect to the latter, this strategy fully supports the New Partnership for Africa's Development (NePAD), as the development of local manufacturing industry and the lessons learnt would both support the goals of NePAD.

This strategy will impact on:

- Market access
- Diversification of production and exports
- Developing higher value-added products
- Capacity building in public and private sectors
- Building up technical expertise and science and technological skills.

The linkages between the Advanced Manufacturing Technology Strategy and the NePAD strategy should be continually reviewed.

5.6. Provincial and Metro Initiatives

The notion of a national strategy requires that the strategy has the support and involvement of provincial stakeholders. The key manufacturing provinces of Gauteng, KwaZulu-Natal, the Western Cape and the Eastern Cape have been targeted by the strategy. This is not at the exclusion of any other province, and the strategy has identified specific initiatives in some of the other provinces.

Provincial and metro stakeholders such as government, business, labour and educational institutions must participate to ensure that sufficient co-ordination and support is in place to derive success.

It is recommended that special interactions (workshops) take place in order for the strategy to align itself with provincial and metro strategies and priorities to drive competitive local manufacturing industries.

5.7. The Management Model

The proposed management model for the strategy, as shown in Figure 9, attempts to give effect to the requirements stated thus far. The key points are:

- A National Strategy Team, consisting of senior staff of **dti**, DST, the Department of Labour, NACI, industry and labour leaders selected through an acceptable process to ensure adequate and relevant endorsement of initiatives. It is essential that every effort be made to include senior captains of industry as opposed to industry representatives.
- An Appointed Management Group, responsible for strategy implementation, project management and reporting to the National Strategy Team.

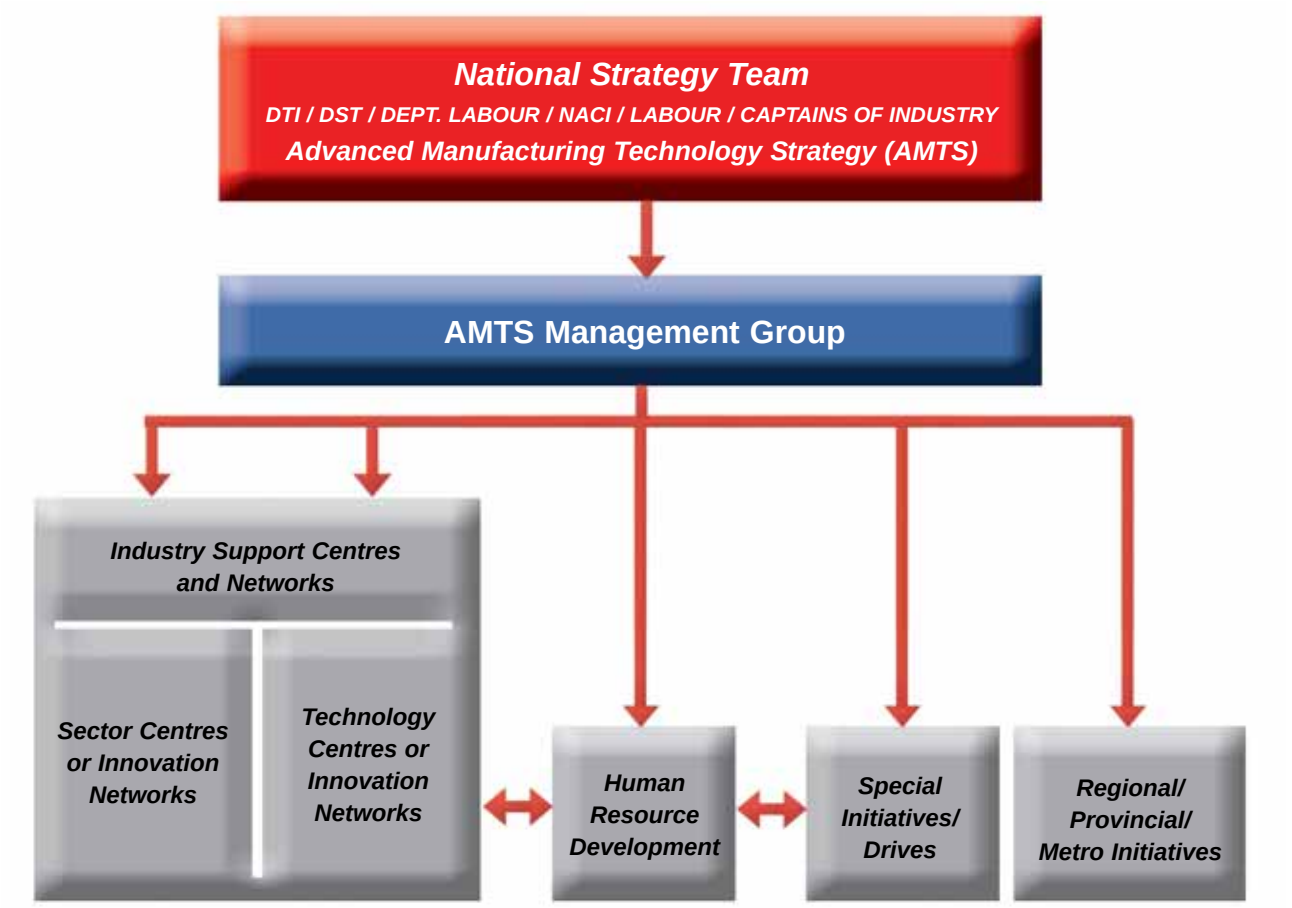


Figure 9. The management model

5.8. Investment

Dedicated funding is essential for ensuring the success and impact of this strategy. The total financial requirement for the implementation of this strategy over three years could be up to R 650 million. Without commitment of significant resources, this strategy will not succeed.

5.9. Potential Funding Models

The South African Government currently promotes a number of incentive schemes / supply - side measures to satisfy objectives such as:

- Wealth creation
- Job creation
- Competitiveness enhancement
- Innovation
- Research and Development
- Empowerment
- Exports
- Skills development

Although most of these funding mechanisms address some of the components in the manufacturing value chain, there are some gaps.

It is recommended that Government review the various supply-side measures in the context of this strategy and establish mechanisms to address gaps. For example, there is minimal funding to support entities such as centres or networks of excellence, infrastructure and operating costs. Most of the funding is directed towards projects.

The following diagram (Figure 10) illustrates scenarios of funding sources through which the Government could channel funding into this strategy. It is important to note that most of these funding sources have stringent criteria for disbursement of funds.

It is recommended that initiatives that satisfy the criteria/ objectives in terms of philosophy should receive dedicated funding (special allocation) from these funds. Where applicable on a project level, funds would be accessed directly in accordance with the criteria and the stipulated processes.

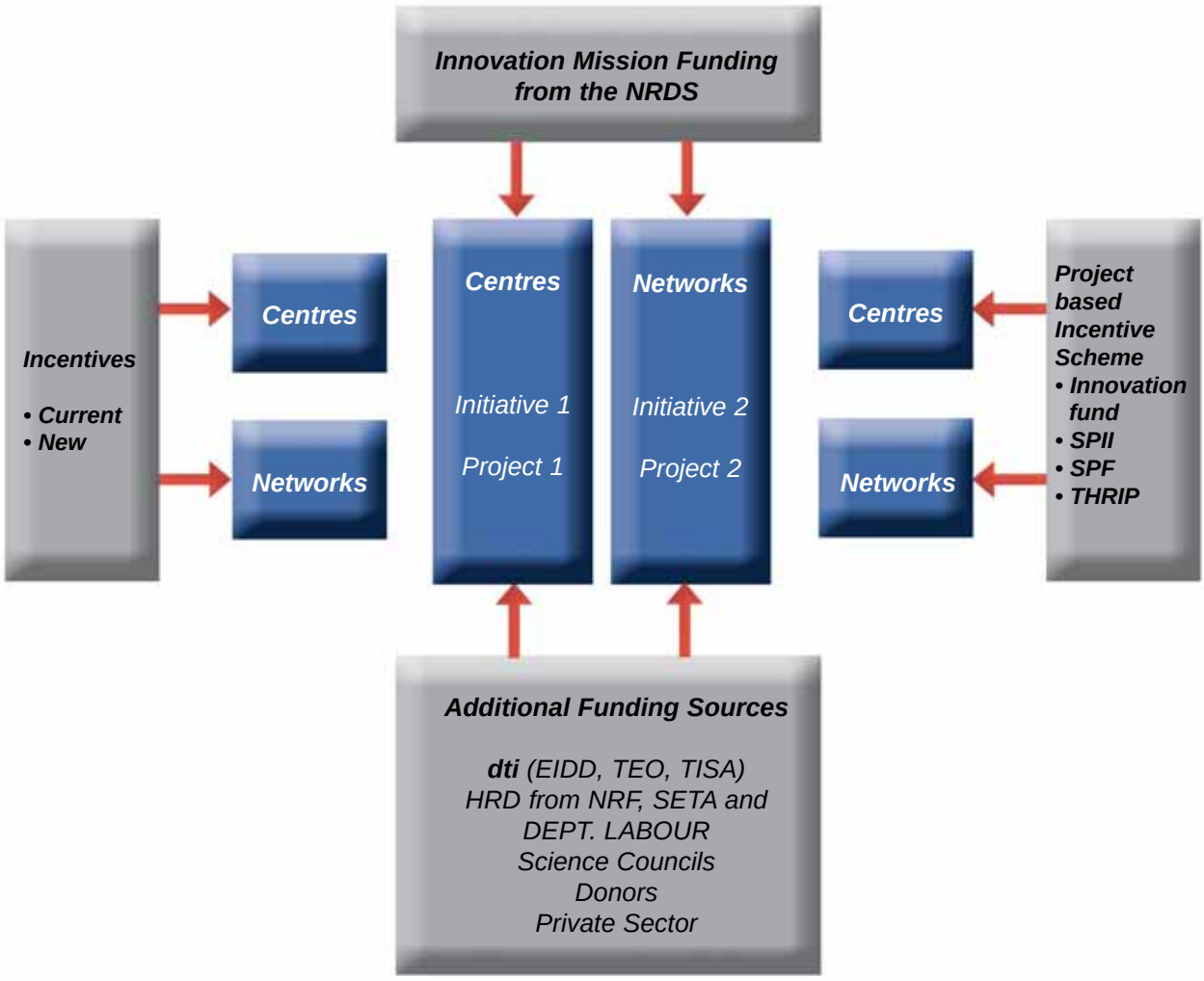


Figure 10. Potential funding sources

Sourcing of funds will remain a core function of the Management Groups, as illustrated in the previously described governance/ implementation models.

5.10. Metrics for Evaluation

The impact of technology, and a plan such as the AMTS, is most directly felt on the competitiveness of specific industries. A country competes on either the basis of superior technical knowledge, low cost, natural resources or on the basis of higher efficiency of some kind. South Africa is increasingly competing on the basis of good technical knowledge.

Other modes of competitiveness in South Africa's context are today either not feasible or not attractive. Failure to support this approach will lead to an erosion of South African industrial competitiveness in the medium term and consequent loss of manufacturing facilities and jobs.

Evaluation criteria will be developed by the National Strategy Team according to the mission and objectives of the individual centres, networks and projects. Reference to the metrics attached to those strategies supported by the AMTS (e.g. the IMS and the National R&D Strategy) will also be considered on an ongoing basis. The evaluation of progress against these defined metrics will be done by the various Advisory Boards and will ultimately revert to the National Strategy Team

The CIPI, (developed by UNIDO) is viewed as a useful tool for the evaluation of this strategy, as it will form a key part of measuring the outcome of other competitiveness improvement strategies.

The CIPI index variables of relevance to the AMTS are:

- The country CIPI (derived from manufacturing value add per capita; manufacturing exports per capita; medium and high-technology manufacturing value add per capita; and medium and high-technology exports per capita)

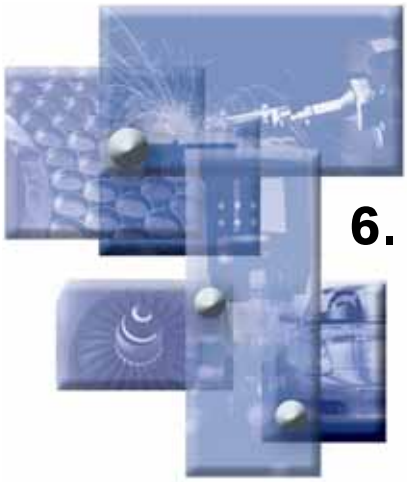
  2002 Current : 0.10
  2014 Target : 0.20

- Technology intensity per capita

  2002 Current : US$17
  2014 Target : US$30

- R&D spend as % of GDP

  2002 Current (estimated) : 0.7%
  2014 Target : doubling



6. Concluding Remarks

The manufacturing sector remains the engine for growth in the South African economy. The application of advanced manufacturing technologies is seen as a critical component to gain competitive advantage in global markets. This strategy has directed decision making through concrete recommendations which are sector and/or technology driven.

The strategy has identified an implementation model which extends from structure through to function and finally, funding and impact evaluation criteria.

The strategy presents an opportunity for government, industry, academia and labour to champion technological advancement in the manufacturing sector for the benefit of South Africa.

Summary of key recommendations

- Management model to be implemented
- New Centres and Networks of Innovation to be established
- Existing Centres of Innovation to be strengthened
- Projects to be executed through the Centres and Networks of Innovation
- Centres, networks and projects under consideration to be developed for approval
- Linkages to special initiatives such as HRD, NePAD, SME,and provincial and metro initiatives to be established
- Total funding of R650m over 3 years to be secured

APPENDIX 1: Members of the Advisory Group and the Reviewer Panel (in alphabetical order)

Advisory Group

Person	Designation	Organisation
Mr Alan Hirsch	Chief Director	President's Office
Dr Dave Kaplan	Chief Economist	**dti**
Mr Zeth Malele	CEO	Arivia.kom
Dr Roy Marcus	Chairperson	National Advisory Council on Innovation (NACI)
Mr Ehud Matya	Executive Director: Generation	Eskom
Ms Hlengiwe Mkhize	Director	Aerosud
Dr Adi Paterson	Branch Manager, Science and Technology	DST
Ms Connie (Constance) September	Member of Parliament	Portfolio Committee: Trade & Industry
Mr Max Sisulu	Deputy Chief Executive Officer	Denel (Pty) Ltd
Mr Harald Vogt	Director: Technical & Logistics	BMW SA (Pty) Ltd

Reviewer Panel

Person	Designation	Organisation
Ms Luci Abrahams	Member	National Advisory Council on Innovation (NACI)
Mr Charles Anderson	Managing Director	Automated Reasoning
Prof Schalk Claasen	Head: Department of Industrial and Systems Engineering	University of Pretoria
Mr Bill Cooper	Chief Executive Officer	Dorbyl
Prof Peter van Eldik	Chief Director: Strategic Information & Planning	Technikon Pretoria
Prof Norman Faull	Professor: Graduate School of Business	University of Cape Town
Mr Kymus Ginwala	Founder and Former President	Northern Research & Engineering Corp
Mr Nigel Gwynne-Evans	Director	Western Cape Government
Dr John Job	Chairman	SAPPI
Mr Garth Jones	Technical Director	Bell Equipment
Dr Paul Jourdan	President	Mintek
Mr Eugene Julies	President	SABS
Dr Eugene Lottering	Manager: Innovation Fund	National Research Foundation
Mr Pradeep Maharajh	Deputy Director General - Treasury	Gauteng Government
Dr Bok Marais	Head of NACI Secretariat	National Advisory Council on Innovation

Person	Designation	Organisation
Dr John Marriott	Head: Research and Development	SASOL
Prof Phuti Ngoepe	Director: Materials Modelling Centre	University of the North
Mr Steven Sack	Chief Director: Culture Industries & Creative Arts	Department of Arts and Culture
Mr Herman Singh	Director for IQ Online Services	Standard Bank E-commerce
Prof Hennie Snyman	Vice-Chancellor & Principal	Technikon Port Elizabeth
Prof Verijenko	Professor: School of Mechanical Engineering	University of Natal

APPENDIX 2: List of Abbreviations

AIDC	Automotive Industry Development Centre
AMN	Advanced Metals Network
AMTS	Advanced Manufacturing Technology Strategy
BEE	Black Economic Empowerment
CIPI	Competitive Industrial Performance Index
CSIR	Council for Scientific and Industrial Research
DST	Department of Science and Technology
dti	Department of Trade and Industry
GDP	Gross Domestic Product
ICT	Information and Communications Technology
ICTMIN	ICT in Manufacturing Innovation Network
IMS	Integrated Manufacturing Strategy
MNC	Multinational Corporation
NACI	National Advisory Council on Innovation
NAMAC	National Manufacturing Advisory Centre
NEDLAC	National Economic Development and Labour Council
NePAD	New Partnership for Africa's Development
NIP / DIP	Non-Defence / Defence Industrial Participation
NPDC	National Product Development Centre
NRDS	National Research and Development Strategy
OEM	Original Equipment Manufacturer
R&D	Research and Development
SETA	Sector Education and Training Authority
SME	Small and Medium Enterprises
SQAM	Standards, Quality Assurance, Accreditation and Metrology
TEI	Tertiary Education Institution
UNIDO	United Nations Industrial Development Organisation

Reader's Notes

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