FRIDGE

Chemicals Sector Summit Preparation:

Government support mechanisms (Step 2)

1 April 2005
REVISED DRAFT

KAISER ASSOCIATES

ECONOMIC DEVELOPMENT PRACTICE

Leadership House 40 Shortmarket Street
Cape Town 8000 South Africa
tel +27 21 481 6000 fax +27 21 481 6001
www.kaiseredp.com

CAPE TOWN • LONDON
NEW DELHI • SÃO PAULO
DUBAI • WASHINGTON

TABLE OF CONTENTS

EXECUTIVE SUMMARY

In preparation for the Chemicals Sector Summit in 2005, FRIDGE commissioned assistance in evaluating the current government support mechanisms, and in developing recommendations to address any gaps. This study focused on two areas of government support: financial incentives and other support mechanisms for large enterprises[1], and financial and other support mechanisms to facilitate innovation[2] in the sector. This document details the research findings and recommendations to improve government support mechanisms.

The **methodology** used included detailed secondary research to determine the full range of incentives and support mechanisms currently available to the chemicals sector. An innovation chain model was then developed according to agreed principles against which incentives for innovation could be compared. The incentives and support mechanisms offering were then assessed by using:

- Assessment of usage profile
- Mapping innovation incentive provision against the innovation model to determine key gaps
- Stakeholder input

Recommendations were then developed to address shortcomings in the current offering.

Key findings and recommendations on government support for the chemicals sector

Key findings were that the following gaps existed in incentive offering:
Gaps in financial support schemes:

- Fragmentation and gaps, with inadequate accommodation of sector-specific needs e.g. accommodating capital intensity of most chemicals companies[3]
- Lack of incentives that help access market information
- Insufficient incentives to help marketing in export markets

Gaps in incentive administration

- Lack of awareness of government support and criteria for qualification for incentives are not widely known[4]
- Application process is complicated and often cumbersome
- Lack of transparency once application is submitted

Key recommendations to address these gaps included:

- Innovation incentives administration
  - Streamline and coordinate incentives for the sector across the entire innovation chain
- Make existing government incentives more accessible to the chemicals sector
  - Lobby for improvements in government incentive design and administration
  - Develop a single source of information and application resources on innovation related incentives and support programmes – include information on all programmes, links to relevant incentive entities, information on eligibility and application processes, worked examples and case studies, etc.
  - Provide a “one-stop-shop” service where applicants can present the project and its objectives and be connected with the appropriate incentives entity

[1] Please note that Blueprint analysed the support requirements of small and medium-sized enterprises in the chemicals sector.
[2] For both large and small enterprises in the sector.
[3] N.B. it has not been possible to verify this through the incentives usage analysis due to lack of data availability
[4] Note: These challenges are stronger for smaller companies and new entrants

- Enhance role of intermediaries/consultants
  - As it is estimated that over 95% of TEO's applications are received through consultants (this is likely to be similar for other incentive applications), improving the role of these consultants could be an effective way to improve process administration and information sharing
    - Develop criteria for preferred suppliers
    - Establish a Code of Practice
- Publicise available incentives in key industry publications (e.g. Engineering News) and to industry service providers (e.g. professional service providers, CSIR, universities, etc.)
- Communicate changes to government innovation support and implications for the chemicals sector once the plans are finalised (e.g. Foundation for Technological Innovation; Small Enterprise Development Agency) Communicate role of Manufacturing Advisory Centres/replacement SEDA access points - potentially provide single point of contact that assists in determining most suitable incentives to apply for

Key findings and recommendations on government support to facilitate innovation in the chemicals sector

Innovation or research and development (R&D) in the chemicals sector involves both ***product innovation*** and ***process innovation***, and covers both ***basic research*** and ***applied research***. Innovation is critical to industry performance and sustainable growth in the sector. However, there has been a decline in R&D in the private sector in South Africa as many corporations have disinvested in R&D whilst focusing on restructuring to face global economic challenges. Less than 1% of sales revenue in the chemicals industry is directed towards R&D, which is considerably below international standards. At the same time there has been a low level of government investment in R&D – while the National R&D Strategy has pledged a doubling of government investment in Science and Technology to raise national investment to 1% of GDP, this remains significantly lower than international benchmarks.

To encourage an increase in private sector investment in innovation, the government of South Africa provides a range of financial incentives and wider support mechanisms in the form of tax incentives for R&D activities, research grants (e.g. Innovation Fund or Support Programme for Industrial Innovation), development finance for enterprise development (e.g. Feasibility Study Scheme), and also "soft" support measures (e.g. Material and Manufacturing Support through the CSIR). The aim of this study was to assess the existing incentives and support mechanisms for innovation and determine any key gaps currently faced by stakeholders in the chemicals sector.

In order to make this assessment an innovation process chain was developed based on a review of existing national and international innovation chains as shown below.

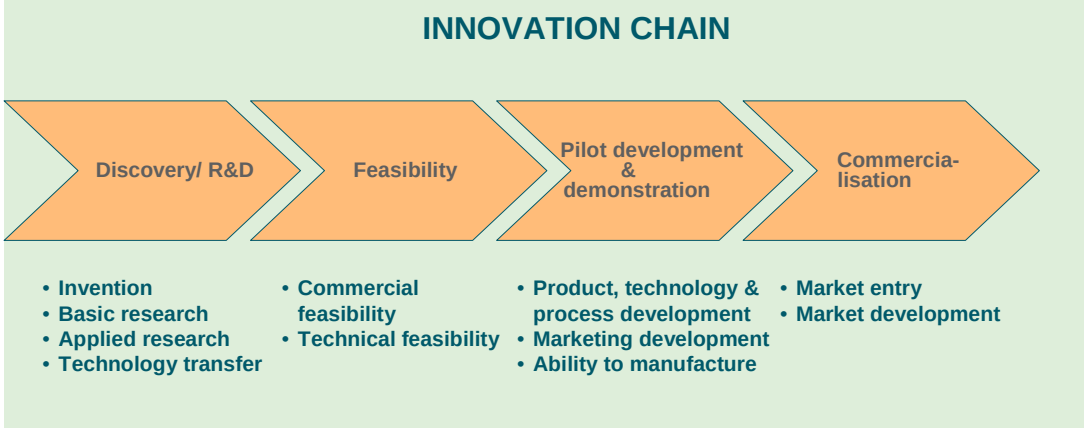

Figure I: Innovation process chain

Existing government incentives and support mechanisms for innovation were mapped against this model to identify any obvious gaps. The following **gaps in innovation support** were identified:

- Overall there is a lack of a seamless support programmes that take an innovation project from idea development through to commercialisation
    - Exceptions are programmes such as the Innovation Fund and the CSIR Material Manufacturing Support Programme
- In terms of financial assistance for innovation provided by government, the major incentives programmes (i.e. THRIP, SPII, Accelerated Depreciation Allowance) are more focused on the later stages of the innovation chain – in particular the pilot development and commercialisation stages.
- Few incentives exist to support firms in enlarging levels of R&D staff.

In addition, interviews with industry stakeholders were conducted, and key policy documents relating to innovation in South Africa in general and the chemicals sector in particular were also reviewed. This review highlighted the following gaps in support and improvement requirements:

- Lack of skills and scientists who can engage in R&D and innovation
- Lack of research infrastructure and funds in public research institutions
- Insufficient collaboration by public research institutions and the private sector
- Inadequate incentives and support to take innovations to pilot plant development and then to commercial scale manufacturing

The study identified the following **recommendations** to improve existing government support mechanisms for innovation:

- Innovation incentive strategy
    - Change eligibility criteria – Lobby for improvements in government incentive prioritisation to make key growth areas in the chemicals sector a priority area for innovation funding (as has already been done with biotechnology), in order to increase the share of innovation incentives that are accessible to the chemicals sector
    - Additional funds
        - Lobby for additional funds to help the discovery and early feasibility testing of new concepts
        - Lobby for additional funds to help accelerate commercial ramp-up after the pilot stage development and initial market entry
        - Accelerate the implementation of government-backed venture capital under the proposed Innovation Fund
    - Focus on human capital

        - Lobby for additional funds or incentive programmes that encourage employment of more research personnel (e.g. grants)
        - Resolve the current policy tension under which development strategies that aim at upskilling staff for production activities are prioritised over strategies that aim at increasing employment in research and development
- Develop Innovation Centres to foster collaboration and skills development across entire innovation chain
- Lobby for more public sector investment in infrastructure and skills development
    - Secure additional funding of specialised chemical sector (and related knowledge and know-how) university departments to carry out basic research; this can then be commercialised in partnership with the private sector once new concepts are proven

These recommendations are framed by the recognition that the limited market size in South Africa may not sustain major programmes of blue sky/basic research. However, future innovation support programmes should encourage research into new product development (rather than product modification and process improvement research only) in sub-sectors with high growth potential. New product development is particularly important to increasing beneficiation and the higher value added chemicals in sector. Ongoing support for process innovation remains important for the manufacture of high volume, low cost chemicals where innovation can provide sustained cost competitiveness.

In addition, a set of potential innovation indicators was recommended that track both the ***innovation intensity*** and ***innovation direction*** in the industry. This set of innovation indicators can be measured in regular "innovation audits" to assess progress in developing greater innovation capacity going forward.

Key findings and recommendation on government support mechanisms for large enterprises

The government of South Africa provides a range of financial incentives applicable to the manufacturing sectors and support mechanisms that are applicable to the chemicals sector. For example, The Enterprise Organisation (TEO) administers amongst others the Strategic Industrial Projects programme and the Critical Infrastructure Fund. The objective of this study was to assess the current profile of usage of these incentives and support mechanisms through the assessment of government incentive entity records, and to identify an appropriate set of measures to address any gaps.

Please note that to date only very limited quantitative input from the government incentive entities that is required to analyse the incentive usage profile of the chemicals industry in South Africa has been received. All relevant government departments were repeatedly contacted and information is still awaited.

However, based on discussions with stakeholders in the industry there appear to be the following key gaps in support and recommended improvement opportunities:

- Incentives strategy
    - Encourage development of additional start-up finance schemes as there is a potential market failure amongst private sector lenders to provide adequate funding
    - More support for accessing market information and conducting marketing activities in key export markets
    - Review level and terms and conditions of development finance and tax incentives

- Ensure that granting criteria take into account the capital intensive nature of the chemicals industry, and that further investment will most likely result in increased capital intensity.

Many of the administration-related improvements are not exclusively relevant to the Chemicals sector, and might also be applicable to other sectors and overall incentive administration.

A. INTRODUCTION AND METHODOLOGY

1 Introduction to the document

As part of the FRIDGE study in preparation for the Chemicals Sector Summit, research was commissioned to consolidate information on existing incentives and support mechanisms that are applicable to the chemicals sector. The aim was to assess these incentives and support mechanisms as they relate to large enterprises[5] and innovation in the sector[6]and to identify any improvement opportunities and areas where additional support is needed.

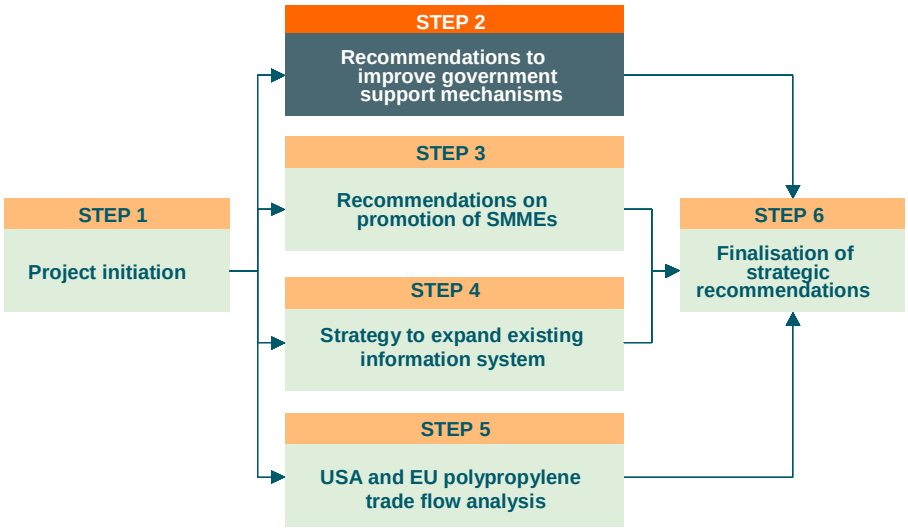

Figure 1: Overall project process context

This document details the research findings and recommendations to improve government support mechanisms. The figure above shows how this step relates to the overall project process.

[6] For both large and small enterprises in the sector

2 Methodology

Detailed secondary research was conducted to determine the full range of incentives and support mechanisms currently available to the chemicals sector. Please see Annexure 2 for a detailed overview.

An innovation model was then developed based on a review of available innovation models and adaptation to reflect the needs of the chemicals sector based on agreed principles. These principles included the following:

- The innovation model should cover the whole innovation chain from R&D through to commercialisation. Other principles set for the selection and adaptation of the model were as follows:
- Use Robert Cooper's stage gate model as the basis for the innovation chain model
  - This is a model that looks at innovation ***as a process*** – i.e. the process of taking an invention through to commercial introduction that typically involves the following steps:
    - Basic or applied research
    - Development
    - Commercialisation
    - Diffusion and marketing
  - This model is widely used and will have high familiarity amongst target audience; it also provides a good schematic model and maps well on to decisions that business managers need to take – i.e. the development and commercialisation process.
  - Please refer to Annexure 3 for an overview of both Robert Cooper's stage gate model and other key innovation models.
- Ensure that the model is "residence based" – i.e. well suited to the conditions in South Africa
- Ensure that the innovation model and innovation indicators are well aligned with innovation approaches and measures set out in the South African R&D Strategy
- Ensure that the model is also comparable to models used by the CSIR
- All innovation indicators need to be appropriate to the chemicals sector, quantifiable and clearly measurable
- Innovation indicators should, if possible, also include measures of the wider enabling environment for innovation (cf. EU Innovation Scoreboard), and consider not only the intensity of innovation, but the direction of innovation as well
    - From a policy perspective, a more integrated viewpoint also considers innovation as a system[7] of interconnected organisations and institutions that influence the development, diffusion and use of innovations. Thinking about innovation from a systems approach highlights important factors that impact on how innovation actually occurs in the economy
    - In terms of the direction of innovation, measures should be chosen that link to the core objectives set out in the sector summit (e.g. cleaner production measures, labour-intensive technology measures, etc.).

Government-supported incentive schemes were then mapped against the innovation chain developed in the previous step to determine the gaps in incentive and support provision.

Incentives usage was also investigated, however very limited quantitative input from the government incentive entities that was required to analyse the incentive usage profile of the chemicals industry in South Africa was received. All relevant government departments were repeatedly contacted and information was still awaited. The exception was information on incentives awards for the Strategic Industrial Projects programme administered by TEO – please see further information below.

[7] Source: Growth and Innovation Policy Team, Ministry of Economic Development, Government of New Zealand: Growth and Innovation Framework (2002)

In addition to the review of incentives usage, a number of stakeholder interviews with leading chemicals industry players was conducted to determine their assessment of the role of innovation in future sector competitiveness and sustainability as well as required government support for innovation.

A comprehensive review of published reports relevant to innovation in South Africa in general, and innovation in the chemicals sector in particular, was also conducted. Key sources consulted include:

- Sector Skills Plan[8] (draft)
- National policy and strategy on innovation - Advanced Manufacturing and Technology Strategy (AMTS)
- National Skills Development Strategy 2005-2010 (final draft)
- South Africa's National Research & Development Strategy (2002)
- Integrated Manufacturing Strategy

Key gaps in incentive administration and offering were then identified using the input from key stakeholders and incentive gaps in the innovation chain were identified using the mapping process. Recommendations were then developed to address these gaps.

[8] Please note that this strategy document is still in draft format and some of the issues drawn from it may therefore be subject to change during the final consultation process.

B. FINDINGS

3 Innovation model

3.1 Innovation model

Based on the principles detailed in section 2 above, the following innovation model was developed that can be applied to both product and process innovation:

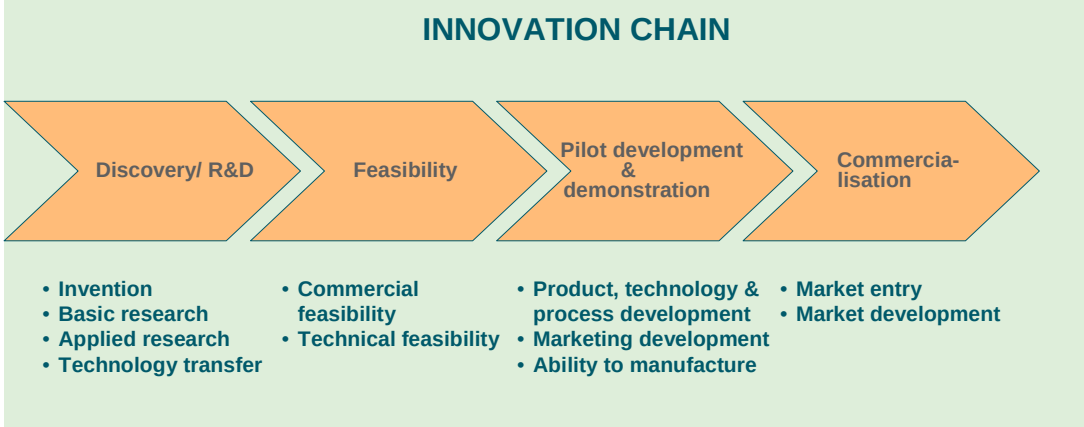

Figure 2: Innovation chain

Based on the Oslo Manual's definitions for innovation, these two different types of innovation can be defined for the chemicals industry as follows[9]:

- ***Product innovation*** is the market introduction of a product (i.e. chemical goods or service) that is new or significantly changed in terms of core characteristics, technical specifications or any other immaterial component or the intended use or ease of use. Product innovation inevitably involves changes of both processes and products. Product innovation typically dominates the innovation of non-basic chemicals. An example of product innovation could be using a new feedstock and a new process to produce a new non-basic chemical.
- ***Process innovation*** comprises the introduction of a new or significantly changed production process, supply method or product delivery method into the firm. The result must have a significant impact on the level of chemical production, the product quality or the production and distribution costs. Based on this definition, process innovation for production of a specific chemical product does not include end-of-pipe technologies. Process innovation typically dominates the innovation of basic chemicals. An example of process innovation could be using a new feedstock and a new process to produce the same basic chemical as before.

For illustrative purposes, an example is provided (below) of particular processes within product innovation that might fall within the model. Many of these processes would also relate to process innovation (with the partial exception of the market-related aspects):

[9] Source: Tao Ren, An Overview of Innovation in the Chemical Industry: Process Innovation and Product Innovation (2004)

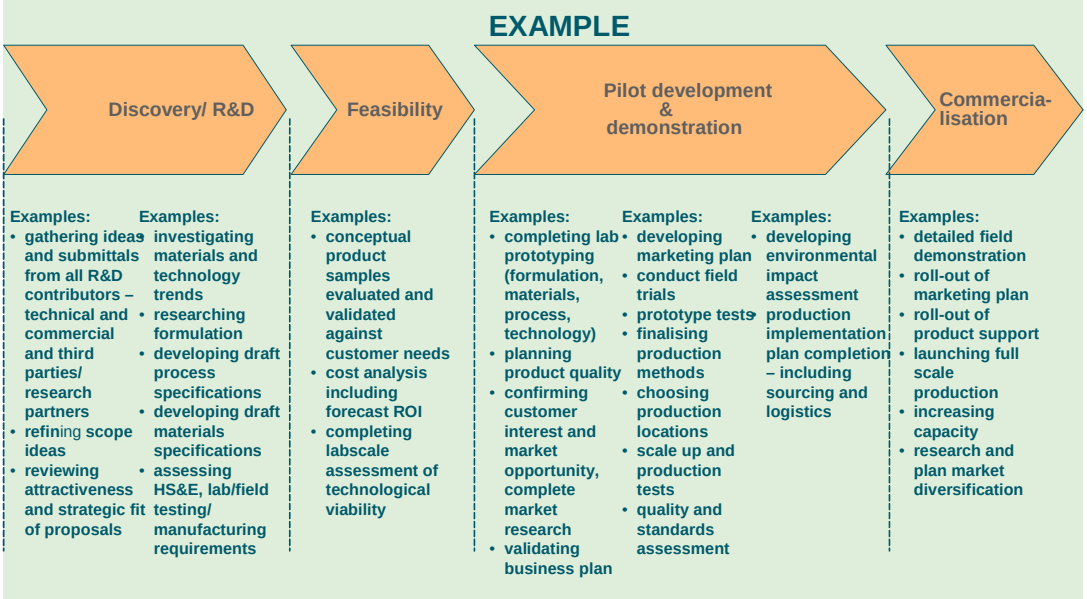

Figure 3: Examples of processes in the innovation chain

3.2 Innovation indicators

There are many standardised measures for the rate or **intensity of innovation**[10] that should be used to measure innovation at various stages of the innovation chain. In order to review sector innovation performance they were grouped into ***input, throughput and output measures***[11]***:***

- Input measures could include the following:
  - R&D intensity e.g. mean of R&D expenditure/ sales in %
  - R&D personnel intensity e.g. mean of employees involved in R&D/ total employees
  - Innovation-intensity e.g. mean of innovation related expenditure/ sales in %
  - Sector involvement in R&D e.g. share of all companies that carry out R&D
- Throughput measures could include the following:
  - % change (year-on-year) in number of chemicals-related patents for which applied[12]
  - % change (year-on-year) in number of chemicals-related patents obtained
- Output indicators could include the following:
  - % of all registered companies in the chemicals sector that introduced product innovations into the market (over historical period)
  - % of all registered companies in the chemicals sector that adopted process innovation (over historical period)

However, due to the importance of the "enabling environment" in stimulating sector innovation some additional indicators of **innovation direction** should be tracked. It is important to note that the National R&D Strategy already sets out to measure on an ongoing basis a basket of indicators that track the development of the enabling environment for innovation and R&D (see Annexure 1). In particular, it is recommended that the following

[10] For example, key definitions and measures are set out in the OECD Oslo Manual (1997) and Frascati Manual (2002). These manuals have been developed by the OECD to define R&D and innovation activities for the collection of national statistics. However, the definitions are also widely used to define limits to the scope of public sector R&D and by the WTO to help define the reasonable limits of industry support programmes.
[11] Source: Diez & Berger, 2003 - ibid
[12] Please note that current patent registration systems do not track sector information. It would be valuable to include this category in future

indicators of research and technology tracked in the National R&D strategy should be included. Please note that these could be defined to fit the chemicals sector explicitly.

- Tertiary science enrolment
  - E.g. proportion of SET tertiary students as % all tertiary students
  - E.g. proportion of chemistry tertiary students as % all tertiary students (incl. Chemistry, Chemical Technology, Chemical Engineering, etc.)
- Human capital
  - E.g. no. of SET practitioners per 10,000 of workforce
  - E.g. no. of chemistry practitioners per 10,000 of workforce
- Public R&D expenditures (GERD - BERD)
  - E.g. Public R&D expenditures as % of GDP
  - E.g. Public R&D expenditures for chemicals as % of GDP or % total public R&D expenditures

Further, there is the potential to link innovation to wider development goals for the sector that are agreed upon by sector constituencies. These development goals can be included by looking at some measures of ***innovation direction***. Please note, however, that unlike for the rate of innovation there are no standard indicators for the direction of innovation, and there may be difficulties in gathering accurate data. Potential measures to consider are as follows[13]:

- Energy efficiency and cleaner production methods, such as:
  - % of chemical companies who consider reducing environmental damage as an important objective of innovation
  - % of chemical companies who consider material consumption as an important objective of innovation
  - % of chemical companies who consider energy consumption as an important objective of innovation
  - % companies that had implemented processes that qualify in terms of agreed cleaner production principles
  - % companies that had consciously adopted a labour-intensive technology
- OHS&E
  - E.g. Share of chemical companies who consider improving OHS&E as an important objective of innovation
  - % improvement in occupational health and safety compliance

The nature of these factors might require a survey-driven approach, although there might be potential to integrate directional criteria into official statistics gathering in some cases.

The following figure shows how these two types of innovation measures – i.e. measures of innovation intensity and measures of innovation environment and direction – map onto the innovation model:

[13] Source: EU Community Innovation Survey II

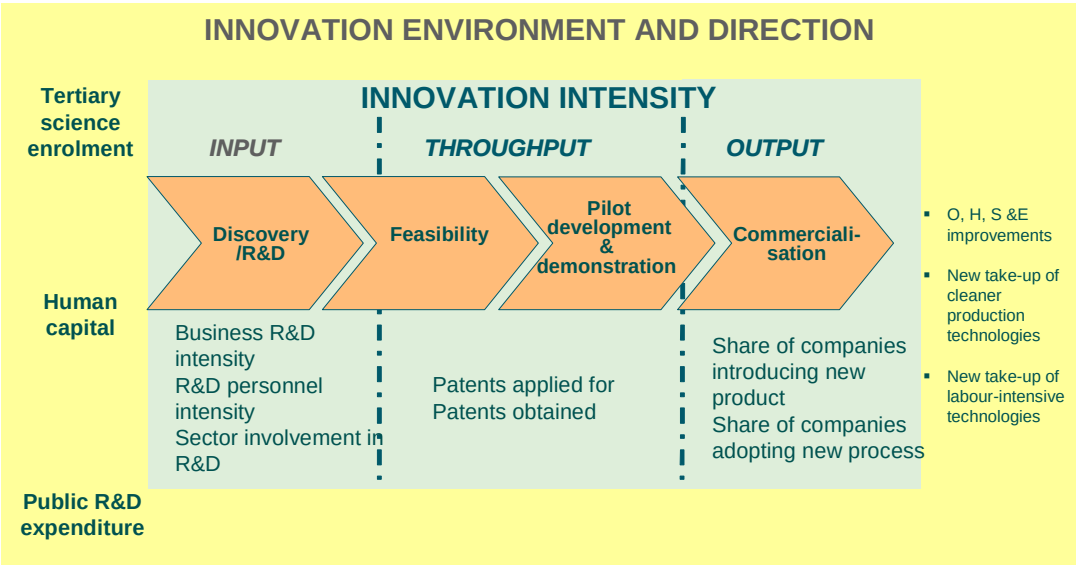

Figure 4: Innovation environment and direction context of the innovation chain

4 Assessment of government support mechanisms for innovation

4.1 Gap analysis of incentives for innovation

There is a wide range of support measures that broadly fall into the following categories[14]:

- Research grants: e.g. Innovation Fund; Technology and Human Resources for Industry Programme (THRIP); Support Programme for Industrial Innovation (SPII); etc.
- Development finance especially for enterprise development: Development Finance; Seed Capital; Risk Capital; Feasibility Study Scheme; etc.
- Tax incentives for R&D
- "Soft" support measures: e.g. Material and Manufacturing Support through the CSIR

The following potential gaps in incentives provision for government-supported incentive schemes relevant to innovation were revealed when these were mapped against the innovation chain:

- With the possible exceptions of the Innovation Fund and the CSIR Material and Manufacturing support programme, no single support scheme covers the entire innovation chain.
- In terms of government financial assistance for innovation the major incentives programmes (i.e. THRIP, SPII, Accelerated Depreciation Allowance) are more focused on the later stages innovation chain – in particular the pilot development and commercialisation stages.
- Few incentives exist to support firms in enlarging levels of R&D staff.

The following table provides an indication of how key government-funded incentives and support programmes relate to the key innovation chain stages of discovery / R&D, feasibility, pilot development and demonstration, and commercialisation. Where programmes do not provide incentives but rather commercial support for entities, they are indicated by grey shading.

Entities	Programmes	Stage of innovation chain			
		Discovery / R&D	Feasibility	Pilot Development & Demon-stration	Commercial-isation
National Treasury	Tax concessions	✓Tax concessions on R&D expenditure			✓Tax concessions for capital expenditure on manufacturing equipment (in conjunction with the SIP)
Dept Science & Technology (with the dti)	Innovation Fund	✓Available to a broad range of entities for funding research and feasibility. The Innovation Fund	✓	✓	Commercialis ation Office provides support for patenting and commercialisa tion costs

[14] Partially based on analysis by Sunil Mani; United Nations University/Institute for New Technologies – "Government, Innovation and Technology Policy: An Analysis of the South African Experience since 1994" (2001)

Entities	Programmes	Stage of innovation chain			
		Discovery / R&D	Feasibility	Pilot Development & Demon-stration	Commercial-isation
Khula	Technology Transfer Guarantee Fund			✓Encourages purchase of technology for manufacturing	✓
The Enterprise Organisa-tion	Accelerated depreciation allowance				✓Encourages purchase of manufacturing equipment
	Foreign Investment Grant				✓/✗Encourages import of manufacturing equipment
	Small and Medium Enterprise Development Programme				✓Encourages new investment in plant and equipment
	Skills Support Programme	✓/✗Encourages training and training infrastructure development, and therefore available skills			✓/✗Encourages training and training infrastructure development, and therefore available skills
IDC	Support Programme for Industrial Innovation (SPII)	✓/✗Partnership scheme	✓/✗Feasibility scheme	✓Matching	
	Risk Capital facility			✓/✗	✓/✗
TISA	Support for international registration of patents, trademarks and quality marks				✓/✗Support for commercialisation activities
CIPRO	Domestic registration of patents and trademarks		✓Patent registration will increase feasibility of project		
SABS	Product test subsidy for SMMEs			✓/✗Encourages testing of new products	

Entities	Programmes	Stage of innovation chain			
		Discovery / R&D	Feasibility	Pilot Development & Demon-stration	Commercial-isation
	Product certification (Mark scheme) and Capability Assessments			✓/✗ Product certification services	
	System Certification (ISO 9000, 14000, OHSAS 18000, HACCP)			✓/✗ System certification services	✓/✗
Technology for Women in Business	Technology access	✓ Support for women in gaining access to technology			
	Science, technology, engineering and entrepreneurship career guidance for young women	✓/✗ Gives guidance and encourage-ment for women should they want to enter the chemicals industry			
CSIR	Material and manufacturing support	✓ Support services	✓	✓	
	Technology for Development Programme	✓ Aids in technology transfer		✓ Aids in technology transfer	
	Technology and Human Resources for Industry Programme (THRIP)	✓/✗ Contrib utes to research projects that develop human resources		✓ Contributes to research projects that develop human resources	
Business Partners	Innovation Investment Product			✓/✗ Provide s financing options	✓/✗ Provide s financing options
Chemin	Technology Incubator			✓ Provides laboratory infrastructure support and administrative support	✓ Provides business, marketing, and limited financial support

Potential changes in innovation support

- The National R&D Strategy sets out proposals for the development of the 'Foundation for Technological Innovation' (FTI) that will sit within the Department of Science and Technology. The aim of this function will be to act as a knowledge-based financing agency concentrating on innovation within each of the technology missions. It will fund innovation across the public and private sectors, and across the value chain from concept to market–though, with a key focus on high-cost development and market acceptance stages through commercialisation, incubation and diffusion. The FTI will potentially provide a single point of strategic direction for the above financing instruments (e.g. SPII) and technology diffusion and transfer programmes (e.g. GODISA)
- There may also be changes to the nature of innovation support relating to small businesses as the Small Enterprise Development Agency takes over the role of Khula, Ntsika and the Manufacturing Advisory Centres, including the administration of the Technology Transfer Guarantee scheme.

4.2 Wider issues relating to incentives for innovation

The following chart maps out some of the key gaps in innovation support based on stakeholder input. In particular it highlights some of the challenges faced in the industry in progressing from one stage to the next in the innovation chain.

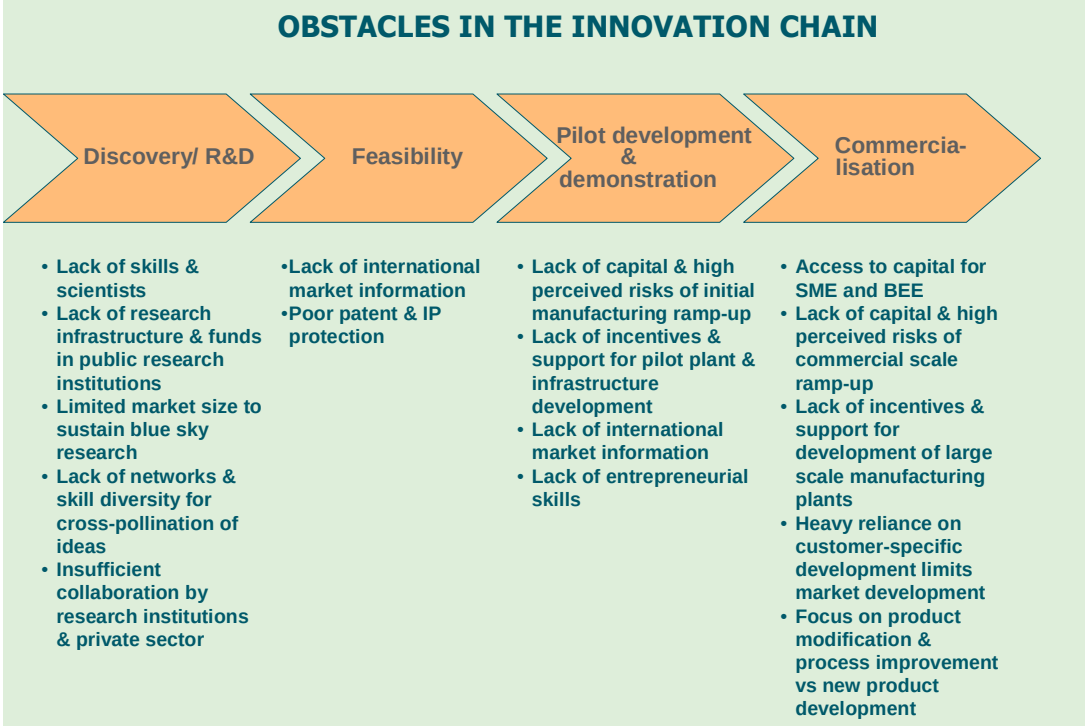

Figure 5: Obstacles at each stage in the value chain

Further detail on these issues is provided in the bullets below:

- Lack of awareness as to what stage of the innovation chain it is appropriate to apply for support - and what support to apply for at that stage
    - Few stakeholders appeared to have applied for incentives specifically for the purpose of innovation.
    - Poor alignment between different innovation support programmes means that each has different criteria and a different application process – potential applicants need to invest significant effort just to understand the different programmes.

- Prioritisation for available funding is not well suited to the chemicals sector
  - While there are sufficient funds available overall, these are not accessible for much of the chemicals sector due to focus on biotechnology as a priority area for innovation funding.
- Incentives potentially have a role to play across the entire innovation chain in trying to accelerate the innovation process
  - Currently the pace of research and innovation is too slow and market opportunities may be missed if good ideas are not commercialised in a competitive timeframe
  - Overall, there is seen to be a lack in incentive provision after the discovery/R&D stage for issues such as developing the ability to manufacture in the development and demonstration phase (e.g. to optimise processes and to scale-up production). There is also a lack of incentive support to take a new product to large scale production and the associated capital-intensive development of new plants and infrastructure.
  - Unlike in the biotech sector where Biotech Regional Innovation Centres (BRICS) are stimulating growth, collaboration and skills development through the early and late stage of development, there is no such comprehensive support spanning the entire innovation chain available in the chemicals sector. Current chemical incubators do not cover the whole innovation chain.
- Additional help to accelerate commercial ramp-up after the pilot development and then the market entry stage of commercialisation are complete
  - In particular, smaller companies risk losing a lot of money if the initial commercialisation cannot be speeded up.
- Infrastructure for developing and implementing technology has not been developed in the chemicals sector (as underscored by very low R&D expenditures in the sector)[15]
  - Less than 1% of the sales revenue in the industry is directed towards R&D, which is considerably below international standards.
- Imbalance between product application and research oriented towards process development[16]
  - In particular, more research into new product development should be encouraged through incentives as currently the focus is mainly on adapting existing products and their manufacturing processes.
- Incentives to encourage research and innovation in beneficiation and higher value added chemicals
- Given the importance of human capital in innovation, support to encourage employment of more research personnel could also be useful e.g. grants

Other constraints identified include:

- Inadequate appropriate skills are a key obstacle to innovation
  - Continued government support in HR development is seen by the industry as equally important as financial incentives for private sector innovation:
    - Government support for universities and technikons so that more research can be carried out there and commercialised in partnership with the private sector once concept is proven
    - In some cases, competing nations have higher government funding for research institutes who can 'sell' new product concepts and technologies to businesses at reasonable rates for commercialisation.
    - Overall, further investment in specialised university departments is critical. These will require leading edge research infrastructure to be successful.
- The South African market is not large enough to sustain large investments in blue sky research

[15] Source: Sector Skills Plan
[16] Source: Sector Skills Plan

- The lack of market size and lack of capital to produce a new product also leads to heavy reliance on customer-specific innovation and manufacturing which, in turn, further limits the market for a product

The relative lack of innovation and R&D activity has been recognised outside the chemicals sector as a national issue. **General problems in South Africa with regards to innovation** include the following:

- Lack of networks that encourage cross-pollination of ideas
  - Also, secrecy and lack of information on who is working on what[17]
- Access to capital – particularly for black investors looking to commercialise a new idea
  - Finance houses have limited interest in start-ups
  - Now partly addressed by the Innovation Fund
  - Own contributions are set too high therefore further limiting access to venture capital
- Lack of venture capital stimulation and fiscal incentives to encourage private sector participation in innovation and R&D[18]
- Low level of government investment in R&D
  - Partly due to termination of key government-funded technology missions in early 1990s
  - However, current national investment of 0.7% of GDP remains significantly less than international benchmarks (e.g. OECD average across public and private sectors is 2.15% of GDP); National R&D Strategy pledges doubling of government investment in S&T 2002-2005 to raise national investment to 1% of GDP[19]
- Declining research and development in the private sector
  - Many corporations in South Africa have disinvested in R&D while focusing on restructuring to face global economic changes
  - Industrial R&D for foreign-owned businesses is typically carried out abroad
- Low levels of patenting and intellectual property protection
  - At present South Africa lacks a formal policy for intellectual property protection of publicly financed research leading to uncertainty amongst individuals and institutions over intellectual property rights and their management
- Difficulties sustaining long-term innovation programmes despite increase in R&D expenditure and making innovation a corporate value[20]
  - Due to lack of diversity in skills base and time needed to achieve culture changes
- National infrastructure not large enough to support purchasing of new technology, research or compounds[21]
- Severe shortage of scientists and engineers who can engage in innovation and R&D
  - Lack of capacity for local innovation and high dependency on imported know-how in many areas where South Africa is currently competitive
  - Partly due to low enrolment in science and engineering subjects in higher education, and also possibly migration abroad of technically skilled personnel leading to a "brain drain"
  - Also low levels of participation amongst women and people from previously disadvantaged communities
- Policy tension with regards to innovation and human resource development[22]
  - Prioritisation of strategies aimed at upskilling staff for production activities rather than for research

[17] Source: T. Gqubule; Business Day – "SA must create a culture of innovation" (Dec 2003
[18] Source: South Africa's National Research & Development Strategy (2002)
[19] Source: South Africa's National Research & Development Strategy (2002)
[20] Source: T. Gqubule – ***ibid***
[21] Source: T. Gqubule – ***ibid***
[22] Source: Sunil Mani; United Nations University/Institute for New Technologies – "Government, Innovation and Technology Policy: An Analysis of the South African Experience since 1994" (2001)

- Government S&T system and governance not fully aligned to effectively support the National Innovation System[23]

The **expected benefits of increased innovation** include the following:

- New entrants into the industry and increased entrepreneurship
- Increased sustainability
  - E.g. Reviewing resource and energy use
  - E.g. Utilisation of waste stockpiles to reduce impact on the environment
  - Improving the sustainability index for South Africa in international markets can provide competitive advantage over non-compliant supplier countries
- Increased competitiveness
  - Through better responsiveness to key global drivers of change affecting the increasingly mature global chemicals industry. The Sector Skills Plan identifies these as follows:
    - New external technologies such as the Internet
    - Increased value of intellectual property, branding and know-how
    - Development of knowledge networks to effectively utilise employees' knowledge
    - The impact of the "triple bottom line" on companies' strategies (a framework for measuring and reporting corporate performance in terms of economic, social and environmental parameters)
  - Through more efficient processes and introducing lean production technology
    - E.g. New technology allowing greater extraction and separation leading to better recoveries
  - Through optimising capacity to market demands
    - E.g. the development of small-scale plants at a significant capacity reduction compared with world-scale plants. Recent successes include the reduction of alcohol plant (oxo-alcohol, methanol and distillation) and vessel reactors down to 1/6th of original design
  - Through identifying Import replacement opportunities
  - Through reducing time to market
- Increased beneficiation of domestic primary materials
  - E.g. Potential beneficiation of exports

4.3 International comparisons of innovation support

Incentives offered internationally to encourage innovation were investigated to gauge the relative success of South African incentive policy to that of other developing countries. Innovation policies across 5 countries researched by Sunil Mani (2004) are set out in the table below[24]. Please note that this analysis covered a wide range of sectors, including the chemicals sector.

[23] Source: South Africa's National Research & Development Strategy (2002)
[24] Mani, S, Government, innovation and technology policy: an international comparative analysis, International Journal of Technology and Globalisation, Vol 1, No. 1, 2004

Country	Tax Incentives for R&D	Research Grants	Government-backed Venture Capital	Non-Fiscal Instruments
Singapore	Double deduction on R&D expenses for both manufacturing and services	Research incentive schemes for companies Innovation development scheme Funds for industrial clusters Promising local enterprises scheme	Techno-entrepreneurship fund: the government launched a US$ 1 billion investment fund to attract more venture capital activities to Singapore	Strengthening tertiary education in S&T fields at the university and polytechnic levels Engineering positive spillovers to local small and medium enterprises from FDI Strengthening the technological infrastructure by setting up 13 Government research institutes (GRIs) in areas of high technology
Malaysia	Nine different types of tax incentives for R&D	Industry R&D grant scheme Technology acquisition fund Intensification of research in priority areas; Commercialisation of R&D fund Multimedia grant scheme Demonstrator applications grant scheme	No specific policy on venture capital industry	Not clearly articulated
South Africa	Poorly defined tax incentive scheme	Innovation fund Technology and Human Resources for Industry Programme (THRIP) Support Programme for Industrial Innovation (SPII) Partnership in Industrial Innovation	No specific policy on venture capital industry	Strengthening the technological infrastructure: some reforms of GRIs

Country	Tax Incentives for R&D	Research Grants	Government-backed Venture Capital	Non-Fiscal Instruments
India	A variety of direct and indirect tax incentives for R&D, but poorly administered	Program aimed at technological self-reliance Fund for technology development and application Home grown technology program Technology projects on mission mode	Government backed venture capital funds Reasonably well articulated public policies for the development of venture capital	Strengthening the technological infrastructure by reforming the GRIs
Brazil	Five different types of tax incentives for R&D	Three different types of research grants and loans administered by two different agencies of the government	The INOVAR project – in its initial stages	Strengthening the technological infrastructure by reforming the GRIs

Mani finds that only Singapore has an effective innovation policy due to its emphasis on human resource development and its emphasis on raising research consciousness of small and medium size firms, especially at a local level. This was achieved by first developing a "critical mass" of trained personnel, followed by fiscal incentives to encourage R&D. This effective policy was evidenced by increasing research intensity, number of patents, and a relatively high high-tech export intensity.

Mani's research finds that while the South African and Malaysian governments have both implemented research grants, and while South Africa's system of innovation compares favourably to other countries, these countries lag behind in innovation due to a shortage of skilled human resources. In the case of Malaysia, innovation is hampered by low enrolment ratios in S&T subjects.

These findings therefore emphasise the importance of developing skilled human resources in South Africa as critical to the stimulation of innovation, as detailed above.

5 Assessment of government support mechanisms for large enterprises

5.1 Overview of existing incentives available to large enterprises in the chemicals sector

The key incentives and support mechanisms for large enterprises (in addition to those available for innovation) are as follows:

- **TEO**
  - Critical Infrastructure Fund
  - Accelerated Depreciation Scheme
  - Industrial Development Zone
  - Foreign Investment Grant
  - Strategic Industrial Projects
  - Sectoral Partnership Fund
  - Export Marketing and Investment Assistance (EMIA) suite of incentives (formerly administered by TISA) – although oriented towards small business, these incentives can also be accessed to some degree by larger enterprises
- **IDC**
  - Finance for the expansion of the Manufacturing Sector
  - Risk Capital Facility
- **National Treasury**
  - Tax concessions
- **SALMAR**
  - Assists in the establishment of consumer or industrial chemical companies or plants. They focus on the complete greenfield startup of businesses operating in the chemical industries

However, please note the following anticipated changes affecting some of the above list of government incentives and support entities:

- According to the 23 February 2005 Budget speech, "the special tax allowances for strategic industrial projects will lapse in July 2005", on the basis that "a more favourable depreciation regime for manufacturing assets has been introduced and a more direct programme of government investment in critical infrastructure is under way". Given that the SIP incentive is one of the most used incentives by large corporates in the chemicals sector, this may create a gap in government support.
- Within the Customised Sector Programmes that are being developed by the dti (which are due for completion in September 2005), sector-specific incentives may be developed. While no incentives relevant to the chemicals sector are being developed during the current financial year, there may be scope for customised government support in the medium to long term.

5.2 Overview of incentives usage profile

Stakeholder interviews suggested that the Strategic Industrial Projects (SIP) programme is the incentive most widely applied by large corporates in the chemicals industry and with highest awareness amongst stakeholders. This incentive is typically applied to assist expansion and the development on new plants. Also, the chemicals industry is also making good use of the National Industrial Participation (civil industrial offset) projects. These projects bring investments, exports, skills and technology transfers and jobs into the South African economy through the offset obligations of international defence contractors.

Incentive usage on SIP programme

While the chemicals industry's share of successful applications for the SIP programme has fallen (from ~70% to 50%), the chemical industry is a major recipient of this incentives

programme. Its key aim is to attract industrial investment into South Africa and create employment opportunities. Successful past SIP applications include:

- Umkoomas Lignin (Pty) Ltd – development of a lignosulphonates plant mainly for export
- African Oxygen Ltd – development of a new bulk gas plant
- Sasol Octene – development of a purer Octene manufacturing plant
- Sasol DIA – investment in an acrylic acid plant

The following table shows the awards of Strategic Industrial Projects by dti/TEO for 2002 and 2003:

INCENTIVE NAME: **Strategic Industrial Projects**		**2002**		**2003**	
		Total	**Chemicals**	**Total**	**Chemicals**
Number of successful applications		7	5	8	4
Tax Forfeited		R491 mil	R167 mil	R381 mil	R166 mil
Provincial breakdown of successful applications	WC	1	1	1	1
	Gauteng	2	2	4	1
	KZN	2	1	1	0
	EC	1	0	1	1
	Mp	1	1	2	1
% BEE ownership of all successful applications		0	0	0	0
Number of unsuccessful applicants:		2	0	1	1

5.3 Overview of perceived gaps in incentives and government support by industry participants

Key issues raised in terms of the strategic importance of incentives include the following:

- Government incentives are seen as critical for supporting individual businesses and the chemicals sector overall
  - As incentives help to counteract some of the competitive challenges vis-à-vis global competitors it is critical that the incentives offered by the South African government are comparable to key competitors (e.g. India or China).
  - However, government support in other areas such as regulation and similar "enabling environment" support measures are equally important.
- Successful applications are seen as highly effective; e.g. the amount of incentives is appropriate to the development need.
- The dti is generally seen as providing relatively good support for larger companies
- While large corporate players generally have the capacity to develop the incentives application, the process could be simplified

The following gaps in support and improvement opportunities for the provision of government incentives have been identified. Please note that the pale cells represent issues relating to gaps in financial support schemes, while the darker cells represent issues relating to incentive administration.

Gaps in financial support schemes:

- (Perceived) fragmentation and gaps, with inadequate accommodation of sector-specific needs e.g. accommodating capital intensity of most chemicals companies[25]
- Lack of incentives that help access market information
- Insufficient incentives to help marketing in export markets
- Support for start-ups
    - Incentive structure – i.e. tax breaks – more applicable for established industry players vs. start-ups

Gaps in incentive administration

- Lack of awareness of government support and criteria for qualification for incentives are not widely known[26]
    - Wide range of incentives can be confusing to assess
    - Hard to determine eligibility prior to filling in application
    - No single point of contact that assists in determining most suitable incentives for which to apply
- Application process is complicated and often cumbersome
    - Hard to determine eligibility prior to filling in application
    - No single point of entry where general details are filled in once
- Lack of transparency once application submitted
    - Including lack of timely feedback if application not successful

[25] N.B. it has not been possible to verify this through the incentives usage analysis due to lack of data availability
[26] Note: These challenges are stronger for smaller companies and new entrants

C. RECOMMENDATIONS

6 Recommendations to improve overall government support

The following recommendations were made that apply to both innovation and large scale companies, as they pertain mostly to administration, communication and access issues

- Incentives administration
  - Streamline and coordinate incentives for the sector across the entire innovation chain
  - Develop tools that enable potential applications to easily assess which incentives fit a given strategic business need and to make a quick first assessment of eligibility
  - Simplify application procedures and tailor to chemicals industry
    - Potentially create “accounts” or “applicants database” so that company information of repeat applicants can be stored
  - Develop a single source of information and application resources on innovation related incentives and support programmes – include information on all programmes, links to relevant incentive entities, information on eligibility and application processes, worked examples and case studies, etc.
  - Provide a “one-stop-shop” service where applicants can present the project and its objectives and be connected with the appropriate incentives entity
  - Improve transparency of application approval process
    - Introduce tracking system where applicants can view progress and timeline for resolution of their application (the dti is currently in the process of developing a similar system)
- Make existing government incentives more accessible to the chemicals sector
  - Publicise available incentives in key industry publications (e.g. Engineering News) and to industry service providers (e.g. professional service providers, CSIR, universities, etc.)
  - Communicate changes to government innovation support and implications for the chemicals sector once the plans are finalised (e.g. Foundation for Technological Innovation; Small Enterprise Development Agency)
  - Communicate role of Manufacturing Advisory Centres/replacement SEDA access points - potentially provide single point of contact that assists in determining most suitable incentives to apply for
  - Enhance role of intermediaries/consultants
    - As it is estimated that over 95% of TEO’s applications are received through consultants (this is likely to be similar for other incentive applications), improving the role of these consultants could be an effective way to improve process administration and information sharing
      - Develop criteria for preferred suppliers
      - Establish a Code of Practice
      - Provide information for professional advisors to the sector (e.g. business consultants, accountants, research institutions, universities, etc.)

7 Recommendations to improve government support for innovation

Based on the analysis there appear to be the following gaps in support and key improvement opportunities:

- Innovation incentive strategy
  - Change eligibility criteria – Lobby for improvements in government incentive prioritisation to make key growth areas in the chemicals sector a priority area for innovation funding (cf. biotechnology), in order to increase the share of innovation incentives that are accessible to the chemicals sector
  - Additional funds
    - Lobby for additional funds to help the discovery and early feasibility testing of new concepts
    - Lobby for additional funds to help accelerate commercial ramp-up after the pilot stage development and initial market entry
    - Accelerate the implementation of government-backed venture capital under the proposed Innovation Fund
  - Focus on human capital
    - Lobby for additional funds or incentive programmes that encourage employment of more research personnel (e.g. grants)
    - Resolve the current policy tension under which development strategies that aim at upskilling staff for production activities are prioritised over strategies that aim at increasing employment in research and development
    - Lobby for programmes that develop entrepreneurial skills for S&T graduates
- Develop Innovation Centres to foster collaboration and skills development across entire innovation chain
- Lobby for more public sector investment in infrastructure and skills development
  - Secure additional funding of specialised chemical sector (and related knowledge and know-how) university departments to carry out basic research; this can then be commercialised in partnership with the private sector once new concepts are proven

Given the relatively small size of the South African market is it important to prioritise research areas that are able to sustain investments in innovation. While the market may not sustain major programmes of blue sky/basic research, future innovation support programmes should encourage research into new product development (rather than product modification and process improvement research) in sub-sectors with high growth potential. New product development is particularly important to increasing beneficiation and the higher value added chemicals in sector.

In addition the study highlighted a range of wider measures to improve innovation in the chemicals sector:

- Establish an innovation policy for the sector
- Conduct regular "innovation audits" using key measures of ***innovation intensity*** and possibly also ***innovation direction***

8 Recommendations to improve incentive offering to large enterprises

Based on the analysis there appear to be the following gaps in support and key improvement opportunities:

- Incentives strategy
  - Encourage development of additional start-up finance schemes as there is a potential market failure amongst private sector lenders to provide adequate funding
  - More support for accessing market information and conducting marketing activities in key export markets
    - Identify qualification criteria and funding requirements for expansion of existing programmes such as EMIA and National Pavilions
  - Review level and terms and conditions of development finance and tax incentives
  - Investigate further the support provision for start-ups incl. e.g. soft loans (as opposed to tax breaks), funding of technology, subsidies for major capital equipment, etc.
  - Ensure that granting criteria take into account the capital intensive nature of the chemicals industry

Many of the administration-related improvements are not exclusively relevant to the chemicals sector, and might also be applicable to other sectors or incentive offerings in general.

Annexure 1: R&D indicators used in South Africa's National R&D Strategy

Quality of life

- Technology Achievement Index (developed by the UNDP)
  - Technology creation index
    - Patent index
    - Royalty and license fee index
  - Diffusion of recent innovations index
    - Internet host index
    - High- and medium-technology export index
  - Diffusion of old innovations index
    - Telephony index
    - Electricity index (based on consumption)
  - Human skills index
    - Mean years of schooling index
    - Gross tertiary science enrolment index

Growth and wealth creation

- Technology based economic growth

Science, engineering and technology human capital

- Researchers per thousand of work force
- SET demography
- Technical progress

Technical progress (improvement and innovation)

- Patents
- Number of SA originated US patents
- High-tech start-ups
- Business innovation investment
- Key technology missions

Business performance and key industrial sectors

- Technology/trade mix
- Proportion of high-tech firms
- Sectoral performance

Future R&D capacity

- University enrolments (S&T)
- Proportion of S&T tertiary students
  - Of all tertiary students
  - Of age group
- S&T post-graduate degrees
- Matriculants with Maths and Science

Current R&D capacity

- Publications
  - Citations per article
- Global share of publications
- R&D intensity (investment)
  - Business R&D intensity
  - Government R&D intensity
    - Government R&D expenditure/ GDP

Imported know-how

- Technology balance of payments
- Imported high-tech equipment

Annexure 2: Overview of incentives available to chemicals industry

The following table provides an overview of existing incentives applicable to manufacturing sectors in general and other support mechanism that are applicable to the chemicals sector[27]. Darker cells denote financial support/incentives, while lighter cells represent wider support mechanisms.

Entity	Support mechanism	Type of support and key aims	Target organisations		Granting criteria
			Type	Sector	
The Enterprise Organisation	Critical infrastructure Fund	A cash grant of up to 30% of the costs of any project to improve critical infrastructure. Aims to improve competitiveness, create economic development and jobs, support activities that have strategic economic advantages for South Africa, and achieve a more even geographical spread of economic activities	Broad range of entities to which this is available, including: ▸ local government, ▸ provincial government, ▸ private sector ▸ private public partnerships ▸ industrial development project operators ▸ Strategic Investment Programme applications ▸ investors in strategic economic projects	All sectors which operate in sectors that develop infrastructure	Qualifying infrastructure includes: ▸ Transport systems ▸ Electricity transmission and Distribution ▸ Telecommunication networks ▸ Sewage systems ▸ Waste storage and disposal ▸ Fuel supply systems Qualifying costs include: ▸ Direct installation, construction and erection of infrastructure costs ▸ Remuneration costs paid to employees ▸ Direct material costs ▸ Cost of new capital items

[27] Please note that this overview focuses on support mechanisms available to large corporate ventures; Blueprint conducted an analysis of support mechanisms available to SMME businesses in parallel to the work of Kaiser Associates.

Entity	Support mechanism	Type of support and key aims	Target organisations		Granting criteria
			Type	Sector	
	Accelerated depreciation allowance	Allowance to write off manufacturing assets over 4 years. +40% of cost in first year and +20% for the next three years Aims to promote acquisition of new assets in manufacturing sector.	All entities in South Africa that meet qualifying criteria	All	▶ Must have acquired assets after 1 March 2002. ▶ Must be establishing new manufacturing plant or expanding existing plant. ▶ Available to local and foreign firms

Entity	Support mechanism	Type of support and key aims	Target organisations		Granting criteria
			Type	Sector	
	Industrial Development Zone	Purpose-built, industrial estate designed to encourage international competitiveness in South Africa's manufacturing sector Advantages include import tariff exemptions, VAT incentives and transport linkages: ▶ Direct links to an international port or airport. ▶ Dedicated customs support services to expedite excise inspection and clearing ▶ Duty-free importation of production-related raw materials and inputs ▶ A zero rate of VAT on supplies procured from South African sources ▶ Import status for finished goods which are sold into South Africa ▶ Government incentive schemes ▶ Reduced taxation and exemption for some activities/products ▶ Access to the latest information technology for global communications	Targeted at companies focused on manufacturing for export	All manufacturing	Note: There is current suspension on any new IDZ designations.

Entity	Support mechanism	Type of support and key aims	Target organisations		Granting criteria
			Type	Sector	
	Foreign Investment Grant	A cash incentive that compensates foreign investors up to 15% of moving new machinery and equipment (excluding vehicles) from abroad, up to a maximum of R3m	Large enterprises	Manufacturing	The grant applies to qualifying transfer, freight, travel, statutory, local and foreign costs for new machinery. The scheme is available to foreign investors with a shareholding of at least 50%, where applicants also qualify for the SMEDP.
	Strategic Industrial Projects	Provides industrial investment allowances in the form of tax relief for costs relating to industrial assets. The allowance is either 50% with a maximum value of R300m or 100% with a maximum of R6m, depending on evaluation according to qualification criteria	Focuses on large businesses as minimum investment considered is R50 m	Manufacturing (excluding tobacco), computer and computer-related activities, research and development activities	Investment in qualifying activities should not be less than R50m, and the project should: ▸ increase annual production of the relevant sector ▸ not substantially displace jobs ▸ promote employment in the sector ▸ not be benefiting from certain other schemes Projects are evaluated for qualification according to: ▸ introduction of new processes or product ▸ filling a critical gap in an industrial cluster ▸ involvement of a process that represents at least 35% value added ▸ sourcing of inputs from SMMEs ▸ provision of infrastructure freely accessible to general public ▸ job creation
	Sector Partnership Fund	Grant (max R 1 million) covering up to 65% of preparation costs for technical and marketing programmes	Large enterprises	Manufacturing and Agro-processing	▸ Initiative must focus on new investments/ skills/ research and development

Entity	Support mechanism	Type of support and key aims	Target organisations		Granting criteria
			Type	Sector	
	Small and Medium Enterprise Development Programme	Two year cash incentive on qualifying assets and 3rd year if labour requirement is met. Aim is to create wealth, generate employment and develop entrepeneurship	Small and medium enterprises	▶ Manufacturing ▶ Tourism	▶ Must invest a maximum of R100 million in land, buildings, plant, and equipment as part of new projects or of the expansion of existing ones ▶ Open to foreign and local firms
	Skills Support Programme	50% grant of the actual training costs, the development of a training curriculum, and land and buildings related to training Up to 30% of firm's annual wage bill granted if training programme is approved	General	All	▶ Must qualify for SMEDP or SIP first in order to apply ▶ Training programme must be certifiable
	EMIA	Contributes to exhibition costs, travel and transport costs, subsistence allowance for exhibitors at selected trade fairs and exhibitions	PDIs and SMMEs	All	Granted on the basis of the expected demand for the product in foreign markets, as well as: ▶ product range on RSA pavilion ▶ quality of product ▶ number of possible participants ▶ size of exhibition products/material ▶ timely application
TISA	Registration of patents, trademarks and quality marks				
	Sector specific assistance (export councils, industry associations, Joint Action				

Entity	Support mechanism	Type of support and key aims	Target organisations		Granting criteria
			Type	Sector	
	Groups etc)				
CIPRO	Registration of CC's and companies				
SABS	Product testing	Subsidy for SMMEs testing products.			
	Product certification (Mark scheme) and Capability Assessments				
	System Certification (ISO 9000, 14000, OHSAS 18000, HACCP)				
IDC	Finance for the expansion of the manufacturing sector	Finance provided in the form of equity, quasi equity, suspensive sales or loans at competitive rates		Manufacturing	Awarded according to: ▸ economic merit ▸ contribution of at least 33 – 40% ▸ emphasis on projects that will have a significant developmental impact

Entity	Support mechanism	Type of support and key aims	Target organisations		Granting criteria
			Type	Sector	
	Support Programme for Industrial Innovation	The Matching Scheme ▸ grant of 50% of the actual direct cost incurred in development activity, up to a maximum grant amount of R1.5 million per project. The Feasibility Scheme ▸ supports the preparation of a feasibility study for potentially innovative projects by means of a grant of 50% of the costs of a consultant. The grant is limited to R30 000 and only small, medium or micro enterprises qualify for support. The Partnership Scheme ▸ gives a grant of 50% of the actual direct cost incurred in development activity with no upper limit. This scheme aims to recover the grant to make the scheme self-sustaining, through a levy on the sales resulting from funded projects.	Available to all private sector companies	Manufacturing	Applicants for the Matching Scheme and the Feasibility scheme are assessed according to their potential to successfully launch a new product/process, including: ▸ managerial ability ▸ financial ability to successfully complete the proposed development and commercialisation ▸ ability to manufacture and market products Further assessment involves the degree to which innovation has been used and the potential for success of the product/process: ▸ the innovation of the proposed product/process must represent a significant technological advance ▸ the innovation should provide a commercial advantage over existing products ▸ the marketability of the product (or the product manufactured as a result of the process), ▸ compliance with international standards Applications to the Feasibilty Scheme are limited further by the following: ▸ a significant portion of development and subsequent production must take place within South Africa. ▸ product developments for a single client do not generally qualify for support. ▸ basic and applied research do not qualify for support

Entity	Support mechanism	Type of support and key aims	Target organisations		Granting criteria
			Type	Sector	
					▶ projects already receiving support from government institutions do not qualify for support in terms of this scheme projects exempted from this latter requirement that at the time of application are more than 50% complete do not generally qualify for funding, although small firms (assets less than r1 million) may
	Risk Capital facility				
Technology for Women in Business	Identification, recognition and celebration of women owned enterprises	This is done through the Twib awards, an annual event where women are invited to fill in nomination forms or nominate other women who have shown application of innovative technology in their businesses	Women in the private sector		
	Technology access	Assists in technology access through partnership with technology experts in the various sectors	Women in the private sector		
	Science, technology, engineering and entrepreneurship career guidance for young women	Provincial workshops for young women, targeting mainly rural areas, motivating and guiding them in science careers through psychologists and mentors	Women in the private sector		
Khula	Technology Transfer	Provides loan guarantees to facilitate access to	Small, medium and micro enterprises	No specific sector,	Technology must be approved by the CSIR

Entity	Support mechanism	Type of support and key aims	Target organisations		Granting criteria
			Type	Sector	
	Guarantee Fund	manufacturing technologies			
CSIR	Material and manufacturing support	Centres that support technology and commercialisation initiatives		Materials and manufacturing	
	Technology for Development Programme	Aims to transfer developed technologies to existing communities with a focus on community facilitation and SMME development		Food, biological, chemical sectors	
	Technology and Human Resources for Industry Programme (THRIP)	Funds projects that have a technological focus and include human resource development			
Dept Science & Technology (with the dti)	Godisa incubator programme	Aims to enhance competitiveness, productivity and sustainability through technological innovation, facilitated by Technology Incubator Centres – see Chemin below	Small, medium and micro businesses		

Entity	Support mechanism	Type of support and key aims	Target organisations		Granting criteria
			Type	Sector	
	Innovation Fund		Available to a broad range of entities including: ▸ NGOs ▸ science councils ▸ private companies ▸ SMMEs ▸ tertiary institutions involved in research, science, engineering and technology	Focus areas are new materials ad advanced manufacturing, ICT, biotechnology, fauna and flora and crime prevention	Preference is given to proposals that have potential to ▸ expand existing commodity sectors ▸ facilitate the migration of existing industries to new added value areas, or create new leveraged industries from existing industries ▸ enable the establishment of new or emerging high R & D intensive industries ▸ create new opportunities for historically disadvantaged groups ▸ involve within a consortium arrangement the appropriate combination of research, business, NGO & BEE partners
National Treasury	Tax concessions	Capital investments on buildings and equipment may be written off on a straight line basis at 25% per year.			▸ Must be approved by the CSIR (Council for Scientific and Industrial Research) ▸ Buildings and equipment must be used exclusively for scientific research
Business Partners	Innovation Investment Product	A customised debt and equity investment of up to R1m	▸ Small and medium enterprises ▸ Excludes non-profit organisations	All sectors, except: ▸ on-lending ▸ farming	▸ Economic merit of business idea ▸ Levels of contribution by entrepreneur
Chemin	Incubator	Technology incubator that supports process and product technologies, provides technical and business services, training, sourcing of funding, limited financial support	▸ Small and medium enterprises, start-ups, chemical allied industries, science councils, higher education institutions	Downstream chemicals industry, specifically fine and performance chemicals	▸ Project must involve chemistry, and the product or process must impact on the downstream chemical sector ▸ The technology must be post-research phase, i.e. proven at laboratory scale ▸ Market potential must be demonstrated ▸ At least one entrepreneur involved
Salmar	Commercial support	Assists in the establishment of consumer or industrial chemical companies or plants – plant design, marketing etc	Greenfield/ start-up	Consumer and industrial chemicals	

Annexure 3: Overview of innovation chain models

Robert Cooper's stage gate process

Robert Cooper's stage gate process is one the most widely used innovation chain models. For example, according to a best-practices study by the Product Development & Management Association (PDMA), 68% of leading U.S. product developers now use some type of Stage-Gate process[28]. Fundamentally it aims to provide a more effective, efficient, faster innovation process that produces more successful new product developments.

Its great appeal to management stems its systems of checks and controls that is specifies – essentially, further investment in the next stage of development is restricted until management is comfortable with the outcome of the current stage. The gate can therefore be effective in controlling product quality and development expense.

The stage-gate process aims to also increase time-to-market through:

- Encourages more up-front research resulting in better and sharper product definition which in turn speeds up the development phase and ensures less reiteration and wasted time
- Clearly defined gates with pre-specified deliverables mean faster decision-making
- Stimulates cross-functional, parallel processing

The model has been continuously updated. However, despite modifications to address situations where speed-to-market is paramount, there is still some concern that the stage and gate process encourages sequential and slow. Stages-and-gates processes break work up into sequential phases, and thereby discourage parallel, overlapping activities, especially when they cross the decision points. Such processes do not encourage completing tasks in earlier phases to keep them off of the critical path. In fact, they foster a mindset in which the work proceeds sequentially step by step, so it becomes difficult to even conceive of highly overlapped, iterative processes. Although one of the features of the Robert Cooper's third-generation process is "fuzzy gates", this does not clarify to management or the developers just which activities are supposed to proceed or stop at these decision points[29].

The following figure shows Cooper's stage gate process and a short description of the gates is also provided[30]:

Figure 6: Cooper's stage gate process

Preceding each stage is a decision point or gate which serves as a Go/Kill and prioritisation decision point. Gates provide the funnels where mediocre projects are culled out and resources are allocated to the best projects. Gates deal with three quality issues: quality of execution; business rationale; and the quality of the action plan.

The structure of each gate is similar and considers three key issues:

[28] Source: R. Cooper; "Winning at New Products" (2001)
[29] Source: New Product Dynamics
[30] Source: R. Cooper (2001) - ibid

- **Deliverables:** inputs into the gate review - what the project leader and team deliver to the meeting. These are defined in advance and are the results of actions from the preceding stage. A standard menu of deliverables is specified for each gate.
- **Criteria:** what the project is judged against in order to make the go/kill and prioritisation decisions. These criteria are usually organized into a standard list containing both financial and qualitative criteria but change somewhat from gate to gate.
- **Outputs:** results of the gate review. Gates must have clearly articulated outputs including: a decision (go/kill/hold/recycle) and a path forward (approved project plan, date and deliverables for the next gate agreed upon).

Overall, the benefits of the Stage-Gate process include the following[31]:

- Puts discipline into a somewhat ad-hoc, chaotic process
- Provides improved focus via gates, where poor projects are killed and efforts can be redirected to more promising projects and products
- Ensures a complete process - no critical errors of omission and no missing steps
- Builds the voice of the customer into new product projects
- The process is visible, relatively simple, and easy to understand and communicate
- The requirements are clear: expectations of a project team and leader at each stage and gate are spelled out
- Stage-Gate manages business risk by breaking resource commitments into increments or stages and more money spent up-front greatly improves the odds of success.

Many similar “roadmaps” for New Product Development, R&D and innovation have been developed. While the individual steps may differ slightly, such roadmaps are tools that can help companies and organisations to successfully develop new products or upgrade existing ones through a series of logical steps, starting from the process of idea generation and ending at the launch of the product into a market.

Some of these roadmaps are now designed to be more flexible – for example, the development stages are overlapped; no design is locked-down earlier than absolutely necessary in order not to miss out on any emerging technology. These types of flexible innovation process models are particularly suited to rapidly changing business environments where the time for changes in the business environment to take hold may be shorter than the typical time required to innovate.

The Oklahoma model

In the US many states are sponsoring funds for economic development and innovation in particular in the life sciences. These state-sponsored seed and venture capital (VC) programmes fall into the following basic categories[32]:

- Direct investment by state agencies
- Investment in privately managed, geographically restricted funds
- Investment in a portfolio of private seed and venture capital partnerships

The Oklahoma Model is an example of the latter. Investments are made in several private partnerships, along with other investors. The strategy is to select partnerships that are expected to make excellent market returns, while contributing to the growth of a healthy, local venture capital industry. This model provides a good way to manage risk and helps to focus a rich variety of experienced investors on the legitimate capital needs of local businesses. Oklahoma is not the only state to have adopted this approach; successful investment programmes have also been developed in Maryland, New Mexico, California and many other states in the US.

[31] Product Development Institute Inc.; Cooper & Edgett
[32] National Association of Seed and Venture Capitalists (www.nasfv.org); “Growing new businesses with seed and venture capital: state experiences and options: State-sponsored funds” (2000)

Following is a brief overview of the Oklahoma Model that was implemented in the state from 1993 onwards[33]:

- **VC:** Oklahoma Capital Investment Board (OCIB) Venture Capital Programme
- **Category:** An institutional VC investor (non-pension fund), fulfilling fiduciary obligations while catalysing local economic development
- **Programme:** OCIB created by the state to mobilise equity and near-equity capital for investment in such a manner that will result in a significant potential to create jobs and diversify and stabilise the economy of Oklahoma. To achieve this OCIB encourages and supports the growth of a local risk capital industry capable of financing companies from early-stage start-ups to later stage expansions. The objective is to raise over $240m of new capital for Oklahoma businesses.

The Goldsmith technology commercialisation model

The Goldsmith technology commercialisation model[34] provides a roadmap to developing strategic plans and actions for the commercialisation of advanced technologies. The model breaks the process down into a sequence of three major phases, six stages, 18 significant steps and large number of critical activities that maximize the chances for success. Each phase has technical, marketing and business activities that must be considered as you move through the process. The model provides a comprehensive framework to develop progress measures, to identify information and technical assistance needs, to project development costs, and to forecast financing requirements.

The diagram below shows Goldsmith's model. For each step and activity the model sets out the key objective of the step, technical activities to be completed, technical information to be developed and also a set of criteria by which the output of this step can be evaluated.

	Technical	Market	Business
Discovery Phase			
Investigation	Technology concept analysis	Market needs assessment	Venture assessment
Development Phase			
Feasibility	Technology feasibility	Market study	Economic feasibility
Planning	Engineering prototype	Strategic marketing	Strategic business plan
Introduction	Pre-production prototype	Market Validation	Business start-up
Commercial Phase			
Full scale production	Production	Sales and distribution	Business growth
Maturity	Production support	Market diversification	Business maturity

Bounding Box

A newer alternative to stage and gate processes is the bounding box approach, which is essentially a "management by exceptions" technique in which certain critical parameters of the project, such as profit margin, project budget, product performance level, and launch date, are negotiated as the bounding box. The bounding box therefore defines the zone or boundaries within which a development team can operate in terms of relevant, objective and measurable parameters. These parameters are established jointly by the development team and other decision-makers at outset (e.g. deliver prototype to one lead customer by date X; financial/resource assumptions/forecast).

Then the team is free to move ahead unimpeded as long as it stays within the box. Management regularly checks that the team remains within bounds, and it is also the team's

[33] City of Portland Economic Development Strategy "Strategy for economic vitality – Bioscience report" (2002)
[34] Source: H. Randall Goldsmith, Goldsmith Commercialization Model

responsibility to notify management quickly if it finds that it is leaving the box. If the team leaves the box, then a management review considers whether the project should continue, and if so, the box's limits are reset[35].

It is a useful innovation model if:
- Time to market critical (particularly in the early phases)
- Programme is complex
- Dynamic and unpredictable environments

EU Innovation Scoreboard

Beyond innovation process chains there are also innovation indices used by governments around the world to drive and evaluate their innovation policies. These contain some interesting ideas on measures that can be used to track innovation performance and progress. We have included the EU Innovation Scoreboard as an example:

1. Human resources

- Science & Engineering graduates (% of 20 - 29 years age class)
- Population with tertiary education (% of 25 - 64 years age class)
- Participation in life-long learning (% of 25 - 64 years age class)
- Employment in medium-high and high-tech manufacturing (% of total workforce)
- Employment in high-tech services (% of total workforce)

2. Knowledge creation

- Public R&D expenditures (GERD - BERD) (% of GDP)
- Business expenditures on R&D (BERD) (% of GDP)
- EPO high-tech patent applications (per million population)
- USPTO high-tech patent applications (per million population)
- EPO patent applications (per million population)
- USPTO patents granted (per million population)

3. Transmission and application of knowledge

- SMEs innovating in-house (% of manufacturing SMEs and % of services SMEs)
- SMEs involved in innovation co-operation (% of manufacturing SMEs and % of services SMEs)
- Innovation expenditures (% of all turnover in manufacturing and % of all turnover in services)

4. Innovation finance, output and markets

- Share of high-tech venture capital investment
- Share of early stage venture capital in GDP
- SMEs sales of 'new to market' products (% of all turnover in manufacturing SMEs and % of all turnover in services SMEs)
- SME sales of 'new to the firm but not new to the market' products (% of all turnover in manufacturing SMEs and % of all turnover in services SMEs)
- Internet access/use
- ICT expenditures (% of GDP)
- Share of manufacturing value-added in high-tech sectors
- Volatility-rates of SMEs (% of manufacturing SMEs and % of services SMEs)

[35] Laura Doyle, “Inside the bounding box” (2002)