Business Symposium on Science, Technology and Innovation Investment

02 JUNE 2016, INNOVATION HUB CONFERENCE CENTRE

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1. Opening Remarks (Dr Phil Mjwara)

Dr Phil Mjwara welcomed everyone to the symposium. The aim of the symposium was to stimulate dialogue between the business community and government on the importance of investment in research and development (R&D) and to look at factors affecting business investment in science, technology and innovation (STI), particularly during the period of low business confidence. The 2015 South African STI indicators booklet was also launched at the symposium.

Dr Mjwara commended NACI for being forward looking noting that the symposium comes off the back of a recently published IMD report on competitiveness which indicated that investment in R&D as a percentage of GDP is one of the key areas of concern. The R&D survey indicates that South Africa is at about 0.73 % of GDP in terms of the gross expenditure on R&D and that business expenditure on R&D has been in constant decline, although there is a slight increase. This indicates an opportune time to have a conversation how Government could encourage business to invest more on R&D and for business to share their obstacles to this and ideas to increase the investment rate on R&D.

With this background, he invited Mr. Dhesigen Naidoo to introduce the Minister of Science and Technology.

2. Introduction of the Minister (Mr Dhesigen Naidoo)

Mr. Dhesigen Naidoo pointed out that if one looks at the last 21 years of Science and Technology (S&T) in South Africa, there is a good story that encourages everyone in their little community of practice. He noted that although still not where they should be, production rates and the levels of activity are higher and better, even in a state of R&D expenditure decline around the world. Delegates were encouraged to take heart in that the country is not doing as bad as many parts of the world in this regard.

Increasingly around the world there is a call for public investment in STI to have dividends in the short term. He noted that ambitious targets were set in the National Development

Plan (NDP) and that as a globe; even more ambitious targets are set in the Sector Development Goals (SDGs). He cautioned that if we continue with conventional pathways we are going to archive only percentages of these targets. Organs of state such as NACI, ASSAf and Cohort together with all the S&T partners were encouraged to play a much bigger role in order to realise the set goals. He highlighted that through the symposium, delegates will learn more about the bases for the dialogue and STI indicators that demonstrate numerous attempts to connect the S&T enterprise to the real economy and the world of business; which is viewed as essential in getting many more players to move in this domain.

In introducing the Honourable Minister of Science and Technology, Mr Naidoo shared her background, ministerial portfolios and her level of importance in the global dialogue around STI and in particular around investments and their need for increase. He indicated that the Minister has been a bastion of our new democracy and the struggle movement and that she is cited as continuing to draw in the private sector to raise the profile of social innovation and to promote the kind of enterprises that becomes a pivot around our trajectory as a country.

3. Address by the Honourable Minister of Science and Technology Mrs Naledi Pandor, MP

The Minister thanked the Director General, Dr Phil Mjwara and Mr Naidoo. She welcomed delegates to the symposium, reminding them that South Africa faces an immense task of fundamentally altering the character of the country from that which was inherited in 1994 to one in which the aspiration and potential of every person has the likelihood of being realised. This is a very very large ask as it puts us in spaces that are very discomforting and unfamiliar. It includes the majority in this country feeling a difference from the actions being undertaken. Failure to do this and to alter the conditions, we face a fairly dismal future and a likelihood of disastrous political and economic consequences.

If individuals' work only impacts on a small component of the society there is no impact in the ultimate goals. Those that are reaching out beyond their familiarity to people who

for many decades have been untouched by our science, intellect and technology are going to change South Africa. It was noted that this is the task confronting delegates and that they should always check who they are impacting upon as the preamble of how they need to think in terms of the challenges that confront the democratic South Africa.

One of the challenges cited was related to a need to address the low economic growth. This implies increasing skills in the country; provision of modern infrastructure, greater access to technology and the establishment of new business enterprises; particularly small, medium and micro enterprises (SMMEs); which are seen as areas where the opportunity for growth lies. In addition, there is a need to change the structure of the economy to enhance competitiveness and to create new products and services. She cited that discussions among certain experts and politicians in attendance regularly see a need to reform the structure of the South African economy which is often left undefined and hence a deeper conversation about this concept is required, especially in the light of enhancing competitiveness and creation of new products and services.

The NDP Vision 2030 addresses some of these challenges in its affirmation of research, development and innovation as key contributors to creating new knowledge, application of knowledge in production processes and disseminating knowledge through teaching and research collaborations. In this context she shared the aim of the symposium as to discuss how the key actors for this task can effectively collaborate across their domains to place South Africa on a new trajectory of growth and development. Her view was that if the stakeholders do not follow this approach, the level of achievement will be thwarted. She commended the fairly robust and able S&T sector with several competent research institutions and an increasing number of emerging researchers.

South Africa has well designed R&D strategies, mechanisms and policies aimed at incentivising R&D as well as a set of well-articulated priority areas that have a major contribution to the intentions to modernise and diversify the economy. Implementation of the ten year innovation strategy and its focus on hydrogen fuel cells, mineral beneficiation, additive manufacturing, nano-technology and nano-processing and bio economy have put the country in a firm position to offer attractive partnerships in innovation to the

business sector and other sectors in the society. This puts the country at a position where it can more decisively focus on inclusive growth.

The Minister shared a parliamentary address by the Minister of Finance, Pravin Gordhan on the three key areas that South Africa is focusing on to achieve inclusive growth, 1) restoring confidence and boosting investment by local and international investors where she also responded in line with activities in the STI domain in response to these goals, 2) unblocking obstacles to foster economic growth in key sectors and 3) identifying fiscal and regulatory reforms and strengthening state owned companies. There is a concerted focus on these priorities as business, labour and government collaboration can serve as a catalyst for the inclusive growth strategy.

She asserted that as part of this inclusive growth ambition, the symposium would discuss the role of business and public sector in R&D investment. There was a decline in business R&D investment since 2009 which were tumultuous years for the business sector and as such impacted on business confidence. There is a great correlation between business confidence and business investment in R&D so the lower the confidence, the lower the investment; hence an increase in levels of confidence is required to increase R&D investment. She noted that her hope is the ability of DST supported by NACI to create new opportunities for business R&D investment in South Africa.

She informed delegates that government identified nine strategic areas for growth and will share supporting R&D and innovation in several of these nine objectives. She implored private sector partners to consider likely partnerships. According to the investment figures, the real investment by government in R&D was 14.74 billion in the financial year 2013/14 and this was similar to the quantum invested on R&D in 2004 with only a slight increase in the years in between. Similarly, real investment in business R&D was 6.5 billion in 2013/14, having fallen back to the sum invested in 2004. It was only in higher education R&D that the real investment in R&D has continued to grow. It was 2.6 billion in 2004 and it had reached 4.5 billion in 2013/14 in the university sector.

Innovation expenditure and activities undertaken by the business sector have, in government's view, a more direct and immediate impact on GDP growth, on exports and employment than do innovation expenditure and activities in other sectors. This implies that even if government invests and increases it's spent or indeed NGOs or the tertiary sector, they do not have the same economic impact as the private sector does. Accordingly from a developmental and growth perspective, declines in the share of business expenditure on R&D should be a major concern for the country. The latest survey of 2014 on R&D shows some improvement and uptake in business expenditure.

Policy implications when there are low levels of investment are that Government is compelled to revise its target for gross expenditure on R&D and to look at new support instruments for technology start-ups in order to grow expenditure and business activity in that arena. Government needs to perhaps look at new ways of leveraging and encouraging business sector support for R&D. There is a host of policy implications that government has to give attention to in order to have a stimulatory effect on increased business investment. It would have to introduce specialisations for example, into policies, including a focus on new growth sectors such as the services sector. It is also looking at enhancing a number of policies that are already in place in order to achieve some momentum in moving toward these improved goals.

Government has determined that it will focus more strongly on areas in which it has direct control which means maintaining and increasing the level of R&D investment by government, higher education and science councils in South Africa. Science councils have become increasingly dependent on additional revenue from contract R&D and so when you have a reduction in business investment it impacts them. Government is also looking at ways to improve the funding of science councils in order to supplement their income in this lower business confidence environment.

Government aims to focus on maintaining policy stability on its assistance for the business sector and will continue with continuity and certainty in the R&D tax incentive scheme and other direct R&D incentives in order to encourage both local and foreign investment in R&D performed by business. In addition to the DST and Treasury

incentives, there is the Department of Trade and Industry`s (***the dti***) Technology for Human Resources in Industry Program (THRIP) which continues to support hundreds of research projects at universities and science councils throughout the country. It is based on the principals of a public/private partnership with funding for each project provided by both the industry partner and THRIP (180 million annually). In 2014/15 they supported 296 projects, 1,548 researches and produced 45 patents, 294 products and prototypes and 1,311 publications; which are a good outcome for the budget allocated.

Government seeks to improve funding for SMMEs, particularly through the bio-manufacturing facility, nano-technology processing facilities as well as the Council for Scientific and Industrial Research (CSIR); and have also become keenly aware of the need for a venture capital (VC) fund for high technology SMMEs and technology start-ups. There is a need to actively engage the South African VC to encourage and facilitate joint investments in commercial science, technology and public benefit projects. There is also a need to assist with developing new generation VC companies through mechanisms such as the Treasury's VC Company Tax Incentive Scheme.

There is a need for special efforts to offer technology innovation fund opportunities to international VC companies that command fairly significant financial resources. This move and alignment is believed to have a capacity to improve South Africa's access to second stage financing and local innovation would benefit from these companies' experience and expertise. The ultimate goal is closing the gap between public sector and private VC and to ascertain how funding instruments can be aligned in order to have a greater impact on sectors that are innovative, productive and viable for growth.

She expressed her joy on Minister Gordhan's announcement of establishing a small and medium enterprise fund with just over one billion rand already committed and complemented by mentoring through seasoned business leaders providing support for start-ups; noting that this is an option for encouraging global business R&D to venture into South Africa. Delegates were implored to give strong attention to this.

One of the options that government views as viable for South Africa is the Chilean option, a model based on a Centers of Excellence (CoEs) approach. The World Bank uses he

model to support S&T on the African continent. The Bill and Melinda Gates Foundation used this Chilean model to fund health research facilities on the African continent and the African Union is increasingly looking at this model to further fund S&T in various African countries. The difference that the model brings is that it encourages international laboratories and research units of universities to locate to Chile.

Critics of the Chilean model say that the right approach should be to rather pour money into Chilean universities and not money into bringing institutes into the country and that international CoEs have encouraged techno-colonialism and that foreign CoEs focus on commercialising in Chile technologies that have already been developed in their home countries. She noted that although there may be truth in these criticisms it is a model worth exploring if South Africa is to see a steep change in global R&D.

Delegates were reminded of the 200 foreign run R&D centers hosted by China 15 years ago and that today China hosts more than 1,500 international innovation facilities throughout the country. South Africa celebrated the establishment of three international centers of innovation last year. Delegates were encouraged to consider what the country could do with just 60 of these facilities compared to what China's 1,500 achieved. Through the deliberations and delegates' advice and input, she hoped that there will be a rich source of ideas on how to build on the foundation that have already been established on the excellence that exists in many of the businesses and how government can ensure that policy instruments and programmers assist the country in achieving greater growth, confidence and improved lives for the people of South Africa.

The Minister concluded by saying that she looked forward to the deliberations of the symposium and expressed her hope that an agreement on collaborations which will take the country to a new level of innovation development in South Africa will be gained. The Minister wished everybody well and expressed her hope that positive results would come from the discussions.

4. Presentation of the 2015 STI indicators booklet (Dr Azar Jammine)

Dr Azar Jammine gave a presentation on the findings of the 2015 STI Indicators booklet. He expressed his gratitude to the dignitaries and other members of the NACI council for attending the symposium indicating that it is an annual attempt to improve the ability to track progress in the STI space. He noted that the Minister's speech was very inspirational with a multitude of nuggets of inspiration and information about where South Africa is, what the challenges are and what some of the successes have been. He expressed his hope that some of these will manifest themselves in the summary of the very thick booklet of information.

He thanked all institutions involved in compiling the statistics and the NACI Secretariat, in particular Petrus Letaba, for assisting in compiling the booklet. He also thanked Professor Anastasious Pouris for his contribution in developing the report and keeping pace with international trends thereby encouraging the production of comparable statistics with those of the rest of the world. He noted that the idea of STI indicators is a reasonably new phenomenon worldwide and that South Africa has tried to keep pace with trends that have been going on around the rest of the world. This is due to the growth of information technology and the advances that have been made.

Referring to a question often asked on why South Africa is now third in rankings of GDP in Africa and how the country is falling further and further behind, he noted that the country rose from 56th to 49th place in the world's competitiveness index last year and that Nigeria is 125th out of 140 countries, and Egypt is about 92nd out of 140 countries. Delegates were reminded that GDP does not actually describe everything that is going on in a country and that on the S&T front South Africa is still by far the leader in Africa.

STI is a key source of competitiveness and is also articulated by the NDP. He cited the Minister's referral to the plan and her questioning of the end goal and possible shortcomings in policy direction noting that there are those who stick to the indicators to measure things and who embark upon three of the pillars in terms of trying to assess growth in the country as encapsulated in the NDP. He emphasised the importance of innovation and that the idea is to try and encourage collaboration with the business sector

by opening the space for business to become more involved with government in moving the country forward. Another ideology seeks to redress the imbalances of the past and forget about the NDP, which is a neo-liberal construct unlikely to propel the country until such time as the two ideologies start meeting on common ground. He noted that without doing this there will be a struggle to really take full advantage of the opportunities that lie especially in the field of innovation and development. Initiatives like the symposium are held to try and bring the two competing ideologies together. The STI impact pathway is mostly incremental, indirect or too complex to observe. Through indicators the attempt is to map the progress made as systematic STI measurement and evaluation methods are required for evidence based policy decisions.

South Africa adopted a concept of the NSI through the 1996 White Paper on S&T and NACI was implored to work on this, develop ideas and use those as a benchmark for advancing R&D in the country. He defined the NSI as simply - all individuals and organisations that are involved in creating and using a knowledge base in order to build a better South Africa. The NSI is the means through which the country seeks to create, acquire, diffuse and put into practice new knowledge and according to the White Paper on S&T, the NSI can only be judged as healthy if the knowledge, technology products and processes produced have been converted into increased wealth by industry and business and into an improved quality of life for all members of society. He noted that in this lies one of the themes consistently encountered in NACI discussions related to making R&D and Innovation more relevant in uplifting the economy as a whole and providing business opportunities; emphasising that it requires all players to play a role.

The 2015 indicators publication contributes to building the monitoring, evaluation and learning capability for assessing the state of the NSI. The report focused more on international comparisons against which South Africa can benchmark its progress using indicators structured around the 2002 National R&D strategy indicators logic model framework. This can be seen as a flow chart that demonstrates the link between technological progress requiring improvements in human capital both historically and in terms of creation of new R&D capacity. Through this business performance and knowledge throughout the country can be improved with the ultimate goal to create an

improvement in the quality of life through wealth creation. Delegates were encouraged to not only look at the 2015 booklet and but to also use previous versions as they remain very useful in many instances since the exact data is not reproduced annually. He emphasised that the report is meant as a building block for information that people should be using and encouraged science councils, government departments and private sector to use the indicators extensively.

In summarising the findings, he noted that some of the successes made in S&T include an increase in the country's academic publications' global share from 0.51% of the world's publications in 2005 to 0.81% in 2014; bearing in mind that the country's share of world GDP is about 0.3%. South Africa's world share of population in 2014 was 0.75%, 53 million people out of 7.2 billion. The country's research output comprises about 85% of Southern Africa's total output according to UNESCO. Growth in the number of citations relative to the world rose very impressively from an index value of 1.03 in 2013 to 1.74 in 2014 and this is based on a model where one indicates being in line with the world average, so we are pushing beyond our weight in terms of academics being cited for academic research which is quite commendable.

The country's share of patents in chemical engineering is around 6%, with a very high patent throughput in special machines. South Africa produces 0.13% of the world's patents on chemical engineering. According to the World Bank in 2011, the country's advantage rested in low value added and high volume products in the chemical sector. However, new sources of growth and competitiveness need to be found in areas such as advanced manufacturing, pharmaceuticals and nano-technologies.

The number of researchers per thousand in South Africa is very low. The level of Science, Engineering and Technology graduations (SET) is relatively low. In 2014, about 30% of all graduates were in SET, compared with much higher ratios in many of the comparator countries (e.g. 47% of all graduates in South Korea are in SET). There is a low percentage of Grade 12s passing the National Senior Certificate (NSC). In 2015, the number of students who got 50% for Mathematics in Matric was 51,500 and those who got 60% or

more was only 31,000. That it is a better measure for looking at who can really exploit mathematical and numerical concepts in real business activity.

When one relates this to the fact that 12 years earlier, approximately one and a quarter million students entered the educational system, you recognise yet again that no more than one in 40 of those who start school in South Africa end up getting at least 60% for Mathematics in matric and around one in 60 get 60% or more for Physical Science in Matric - that is absolutely crucial in terms of employment and also developing research in S&T in the country. On the positive side, the growth in the number of doctoral degrees awarded in S&T has been increasing quite impressively over the years but so too have doctoral degrees in other areas with the ratio of S&T doctoral degrees declining somewhat relative to the total number of doctoral degrees awarded.

Amongst black Africans in South Africa, the increase in doctoral degrees has been very impressive and in 2013 overtook the number of doctoral degrees achieved by whites. However in terms of the transformation in South Africa, even though blacks have been advancing very impressively in terms of getting doctorates, relatively few of them have actually been incorporated into the private sector. The vast majority of black academics reside within the academic or the science councils. It is critical to concentrate on how to move some of the achievements of the black educated section of our society more into the private sector. There are obvious potential stumbling blocks in this regard, e.g. networking - one of the bugbears in terms of transformation.

Much of the economic and business power in the country still resides within a relatively small white minority who possibly have friends who might be able to help his/her children get a job, which is not the case with the black African population. Another contributing factor may be the fact that about 75% of research articles in South Africa are produced by just five universities out of 25 and there may be a distinct reluctance on the part of the private sector to employ anyone who achieves a degree outside of the big five universities. There is a need to diffuse achievements made on the academic front more broadly than concentrating them on just those top five universities.

South Africa's economic decline in the last few years has had an important role to play in the decline in the amount of R&D expenditure. This is a complex issue and does not necessarily follow that lower economic growth automatically means less R&D spending. The lower economic growth means less business opportunities for businesses to make money from which they can then finance R&D expenditure.

When comparing the trend of R&D spending as a percent of GDP in South Africa against other comparator countries included in the analysis, i.e. Brazil, Russia, India and China, etc., South Africa is the only one with a decline in that ratio of R&D spending relative to GDP. It was noted that this should not be viewed as just a case of South Africa underperforming as the country actually outperformed Brazil and Russia in recent years. However, these countries are in dire straits in recession and yet their R&D spending has not declined as a percentage of GDP like South Africa's. The general expenditure on R&D, for South Africa was 0.73% in 2013/14, way down compared with China (2.01%), Brazil (1.15%) and Russia at 1.13%; and the national target is to achieve one and a half percent of R&D spending as a percent of GDP by 2019. This is a tall order and there have been some calls in the media for the Minister to reduce that target to a so-called more realistic level.

The comparative business spent on R&D has declined as follows: 45.9% in 2013/14 compared with 53.2% in 2009 and 58.3% in 2005/06. The fact is that economic growth has declined and businesses are finding it tougher especially in the concentrated kind of environment where so much of the economic power in South Africa resides with a relatively small number of huge and powerful companies and one would have hoped for more investment in R&D. This highlights the need to start diversifying the spread of the initiative for R&D small and medium sized businesses to do the job if the big businesses are not doing their bit in that regard.

The country produces relatively few patents in both low and high technology sectors. The focus seems to be on the middle technology side and the result is low export performance for both low and high technology manufacturers. This means that there is slow progress

in transforming the country towards being a knowledge-based economy, remaining too heavily dependent on resources.

Patents are highly viewed as reliable indicators of technical progress and innovation. This is supported by the fact that they are well defined, unambiguous, make International comparison possible and facilitate detailed categorisation of inventions. The United States Patent and Trade Mark Office (USPTO) patents are often used internationally to standardise the different patent awarding systems generally and there has been a rising trend of patents granted to South African inventors by the USPTO, except in 2014 when there was a drop although by large there was a rising trend.

The bad news is that that the rising trend did not keep pace with the world trends and the share of South African patents in foreign origin patents granted has actually fallen. This implies that the country is increasing the university citations numbers and is doing very well academically but this is not being translated into actual patents that can assist in promoting South African exports. He noted the top South African signatories in terms of patents, where a Sasol is among the top, with UCT, CSIR, WITS, Discovery, Norst University and AZTEC. Although this is encouraging, he raised a concern that in 2014 many of these declined compared with 2013 cautioning that although one year does not make a trend this needs to be closely monitored. Citing the expertise in chemical engineering through the Sasol initiative, he commended Sasol as one big driver of innovation amongst the big business sector.

He noted the unfortunate trend where many South African businesses rely on just importing their technology and that expenditure for the right to use intellectual property from other countries and high technology payments are not necessarily all that bad. He cited an example of the Koreans who spent a lot on importing technology noting that a lot depends on how such technology is transferred, learned and diffused. South Africa might be importing less technology than the Koreans but more relative to BRIC countries and is paying a lot more in importing technology rather than producing it which leads to the current challenge of insufficient exports.

South Africa is doing well in terms of comparative advantage in exports of primary products and resource based manufacturers. The country scored very poor in low technology manufacturing and in terms of high technology manufacturers, probably because of skills shortages. In terms of medium technologies, however, the country is on par with the rest of the world.

Bringing this back to the analysis of economic growth rates of the different sectors of the economy, he shared concerns because in a country where there is an abundance of relatively unskilled labour and unemployed people, the very sectors that could possibly employ those people most effectively are the ones that are growing least and tends to be the most export oriented. In these sectors there has virtually been no growth over the past seven to eight years, i.e agriculture, mining, manufacturing and electricity. In contrast, what is driving the South African economy upwards are the services sectors which tend to require a certain level of skill. He noted this as a challenge to the transformation of the South African economy structure that needs to be clearly focused and that unless R&D and innovation are improved, the structural imbalance will not be addressed. There was a declining trend in primary and secondary industries relative to tertiary industries. In other words, if the country is not careful, and fails to make progress in R&D and innovation to push the primary and secondary industries upwards, the risk is for even the services sectors gradually declining over time.

The country is not doing that badly if one looks at the rankings on the social progress performance. South Africa is doing particularly well in terms of basic human needs: nutrition, medical care, water sanitation, shelter and safety where it is ranked 92nd, second worst only to India in these comparative countries. In the foundations of wellbeing in terms of knowledge, information and communications, health and eco systems, the country is average, 64th and in terms of opportunities for improving society, South Africa ranks quite highly at 37th in terms of personal freedom, choice, tolerance, inclusion and advanced education.

According to him, at certain levels the country actually has little niches where it is doing particularly well. He emphasised to the importance of some of the indicators in the rankings and reminded delegates of South Africa's ranking in the world competitiveness

ranking. Although terribly low with regard to the labour market and performance in Mathematics, Science and Basic Education, what pushed the ranking enormously is on R&D. In certain areas of R&D and sophistication of SA technology, the country improved enormously relative to the rest of the world, especially with regard to communications and the diffusion of internet and IT information. However, there could be so much more progress if there was more success with R&D.

5. Questions and Discussion

Government has aspirations and policies and is ready to adjust these policies on the basis of the challenges faced. However, although the country has a vibrant public funded research sector, the connection between the public and private sector, both in terms of research being done and absorption of graduates do not seem to be linking.

The Minister indicated that government is ready to begin a thought process on a different funding system e.g VC can be introduced, which will partly come from the state. The question that remains is how to start that conversation, i.e. how does the country get commitment from the private sector for that venture capital - broadly the funding moral that begins to ensure that the rich citation in indices shared and the output from research find a way into the market place. Is it acceptable to continue importing technology at the rate which is illustrated? What can be done to minimise that, because it comes with the money that leaves the country?

A delegate noted a concern in terms of the level of distortion. A question was raised in relation to data collection in terms of where it was collected and whether it was collected from a group of small companies or also included the three to four person businesses that export 80% of their products globally?

Another question raised was in relation to the hang ups about patents. It was noted that in Technology Top 100, a large number of those companies do not support these, particularly in high tech electronics; they view them as not worth their while. They need to be at the cutting edge and continuously develop every six to eight months.

A delegate commented that business confidence is improved when business receive return on the money spent within the internal economy and export sector. It was noted that business is getting more competitive and that SA business has to compare and compete with international competitors but some programmes where hundreds of millions of R&D money has been spent in to-date have had no returns. The local economy does not stimulate confidence in people to invest in R&D.

A comment was raised based on a discussion held after the R&D strategy meeting of 2002 with National Treasury around the VC fund, noting that at the time there was no appetite for risk taking in South African VC sector, hence an idea of a Finnish model of VC Fund; where funding was received from the windfall sales of their shares from Nokia. It was highlighted that at the time, the response from National Treasury was based on the tax incentive for R&D. It was also noted that this is an opportune time for comparing a kind of direct funding versus indirect funding via tax incentives and possibly look at something else.

There was a comment on some of the emerging data that may or may not be part of the report and in terms of how that would impact on the current indicators. It was clarified that a process is underway to look at the many documents and disclosures from SA institutions of which 72% of them are satisfied with being classified as inventions and are in the process of seeking some form of patent protection. There are high numbers of rights and trade secrets and copyright information in the form of computer software that is highly classified. Although technology sectors cannot be identified currently because the performance does not allow it, there is evidence that it does tend to be technology dependent as to what kind of strategy is adopted. It was suggested that this could be a project in terms of appropriateness to receive patent protection. In terms of US PTO indicators or standards it is very useful but if the market is not at the same level, filing with the US PTO will be a challenge. The public sector being assisted is becoming more aware and as such is managing their IP a lot smarter which sometimes impacts on finance strategies. This also has an impact on a decision to either pursue or abandon an application, and so that level of growth and awareness is having an impact on the findings. This however is a challenge to determine and as part of a preparation for a survey to be

conducted on intellectual property and technology transfer in South Africa with the DST, CESTII, NIPNO and the South African Research and Innovation Management Association (SARIMA). The survey will look at the last seven years and will be very useful to share with NACI as it has an influence on the work that NACI is doing. It was agreed that there should be continuous conversations on these going forward and an agreement was reached to have more conversations on this.

There was a comment that the data collection may not be providing a complete picture and it was emphasised that the data gives an indication of sectors to target. In terms of the tax incentives for SMMEs, it was argues that it would make little sense to change the R&D tax incentives to accommodate such and that a ten year review on R&D tax incentives is being done to identify exactly what it is to be corrected and why there are additional instruments and how do these instruments work together to retain development.

The need to improve the kind of business coverage that responds to the business register was acknowledged and it was noted that working with Statistics South Africa for the last few years, there has been an increase on statistical quality although further improvement is still needed. It was clarified that the data is currently based on companies complying with the R&D tax incentives and the Technology 100 companies.

It was noted that policy misalignment and policy failure is one of the key subjects being addressed in the deliberations with the business community to ensure that government departments are more coordinated in the policies and regulatory frameworks they devour. It was noted that NACI has been working on getting a closer partnership between government, science councils, universities and business. The idea is not just how to get great innovations but also how to commercialise those innovations. Inventors don't get products into the market so there is a need to put strategies in place where business works very closely with the inventors. If there is collaboration with small business one will take so much out that is actually benefitting job creation as well as the key players. Internationally what people have found is that one of the best ways to do that is to get the technology start-ups off the ground.

There was a concern that SA undersells itself because it is among the world's leaders in registration of (patent / intellectual) rights, at a certain point it was third in the world. Although people are unaware of this, it comes from the local system in agriculture - so the range of indicators needs to be involved.

There is a very complex relationship between the private sector and government and that when one looks at government as a source of funds for business research (over time); it started around 13% ten years ago and then rose very steeply with tax incentive introduction. This unfortunately happened right in the middle of the recession and great political uncertainty grew. The challenge is to get back and to run it so when you look at government expenditure on the R&D, government only, in relation to GDP, it has been relatively flat over ten years. It was indicated that a big onus is on government to ramp up alongside NACI, other things that are crucial to the lulling enterprise like higher education, where the figure is point seven. This really creates a headache for government because government has to make choices. What do you put your money into? What are you going to spend on, because all from government means spending less on something else?

In wrapping up the first session, Dr Mjwara indicated that there will be a panel that will address some of the cited issues and concluded by thanking the Minister and Dr Jammine for providing food for thought and for getting the delegates going in the discussions.

6. Panel Discussion: Government support instruments for STI

Dr Mjwara introduced the panel members, Mr Imran Patel (DST) - Mr Stavros Nicolau (Aspen) and Dr Chamunorwa Togo (Innovation Hub). The format of the panel discussions included opening remarks by each panellist, questions and open discussions with delegates and closing remarks.

6.1 Mr Imraan Patel

In his opening remarks, Mr Patel gave a brief overview of government incentives and support instruments for STI. He noted that the discussion is broader than STI and that understanding of diversity of the sector is required. It was emphasised that in order to

address this there is a need to fundamentally think about the structure of the economy. The current structure of the economy is one that was inherited through apartheid as dominated by large firms.

The discussion focused on established firms, noting that there is a need to look at small knowledge intensive enterprises and whether current instruments and support systems address this. The SMMEs should in particular be looked at and most of them are small knowledge intensive industries. There is also a need to look at new entrants and combined in this there is interaction with the private sector, either with individual firms or with sectors and with industries. Referring to the private sector should be understood as referring to a diverse grouping.

There was caution on not only focusing on financial support instruments and that part of the challenges in transforming the economy to meet the new imperatives and competing globally is to look at a number on interventions. He differentiated among support instruments that encourage investment by the private sector noting that there are obvious ones that attract the most attention, which are financial support instruments, technical and infrastructure support instruments and those that deal with market access, opening up markets for countries.

In his assessment of the investment support instruments he noted the recent establishment of one-stop shops in government and indicated that the national one has started and it is functioning. There was no way for the different government departments to talk to industry in a kind of holistic way to clear the barriers. It was emphasised that the one-stop shop is not only about clearing regulatory barriers but instances around these investments that can translate into research, development and innovation.

Government is working very closely with the private sector in defining an agenda for particular priority sectors. This has been accomplished in advance manufacturing, waste, water and ICT and is viewed as an important support instrument because if the private sector understands that government is going to be investing in a particular area of focus, it changes their behaviour as well. He cited Sasol as an example in terms of cooperation on areas of mutual interest. Another example cited was in the ICT sector where

government started working with IBM. In his view, these are the kinds of investment support instruments which still need to do a lot to get right.

He mentioned that there are financial instruments which can be direct financial instruments and referred to a presentation from ***the dti***, where it was indicated that there is either open architecture incentives or sector specific incentive arrangements. He noted that the sector has both, e.g R&D tax incentive which is an open architecture incentive open to anyone who can apply and meets the criteria, i.e doing more R&D. There are also other sector specific instruments either by ***the dti*** or DST.

Incentive programmes such as the Manufacturing Competitiveness Enhancement Fund (MCEF) have a strong component on STI because they have an element of technology modernisation. The sector specific ones e.g the AIDC or the textile instrument have very little to do with S&T. The automotive one is under review and one of the things specifically being reviewed is looking the impact on STI and approach in case of a new programme to enhance its contribution positively.

The DST has a new instrument called sector innovation funds which are not with firms but with sectors i.e forestry sector, government sector, etc. This works through collaborative funding from both government and industry however, the industry kind of controls the research agenda. Government's role is to ensure that competitive R&D processes are followed so that it is not old-boys network. This is done through open calls that are jointly reviewed. It is a new instrument where about a hundred and forty million rand over four to five years has been invested and can be scaled up.

There are also technical and infrastructure support instruments of which some are particularly for new entrants, providing the ability to get into new markets. There is a technological gap, whether it is due to phytocentric conditions or product development support, hence a long standing programme which is called the Technology Stations Programme run by TIA. These are basic at the universities of technology and increasingly it is discovered that not many people are familiar with the capabilities that exist, despite being around for more than a decade. They provide support to small and medium enterprises and increasingly to big companies but on a pay basis. Cots for new entrants

are underwritten but the more established and those that have been benefiting need to start paying for their services. The useful thing about this is to bring together the kind of expensive equipment, infrastructure and technical capabilities that can support an industry. There have been recent talks about not referring to the technology stations as a specific programme but looking at the range of these facilities that are supporting SMMEs. It was indicated that there are about 67 of these instruments; simulation networks, ***the dti*** instruments, more business development instruments, etc.

In his conclusion, he noted that the most recent development is a discovery of a need for publicly funded translational infrastructures and that the ones the Minster mentioned were e.g the bio-manufacturing industrial development centre and the Nano-technology manufacturing scale-up facility. Recent facilities launched at the CSIR provide people with support to scale up their technology, to get it into the market from the laboratory, to look at product development and mixing in the case of BIDC. These are the kinds of facilities that once they exist they have the potential of supporting hundreds if not thousands of small and medium enterprises. The BIDC is now only supporting 19 SMMEs.

6.2 Mr Stavros Nicolau

Mr Nicolau gave an overview of the effectiveness of government STI support instruments. He began by focusing on the rating agencies and South Africa's current economic situation noting that the consistent theme is fiscal consolidation. He argued that industrialisation should be at the core of our economic policy and that to start achieving the growth levels of 5% and beyond as described in the NDP the question is – how does the country achieve that? He then proposed interventions such naturally boosting our manufacturing base in the country and unblocking both foreign and domestic investment indicating that there is a need to look at export platforms and export linkages.

He explained that his obsession with exports is based on models around the world with similar economies to South Africa, emerging post-democracy and that the ones that have succeeded are generally those that build strong manufacturing bases. He emphasised

that this is because one cannot divorce or isolate innovation from industrialisation and certainly not from building a strong manufacturing base in a country. He concluded that if the country could manage to implement these things correctly the discussion about incentives will fall into place and that what is key in driving this industrialisation, is the good industrial policy action plan currently available as launched two weeks ago by Minister Davies.

He noted that there are three key levers to drive industrial growth in our country, with a recurring thing back to innovation, hence their mention. The first one is around localisation in preferential procurement and unfortunately, SA has not done very well in that respect. He shared some of the comments from the BRICS Business Council discussions with the 4 Presidents, where President Putin of Russia was quite emphatic around localisation. Russia has decree that 50% of all pharmaceuticals will be procured domestically. Aspen invests in Russia and has really bought into the BRICS concept. As you start with a new business there you are confronted with a limited list of drugs and you wake up one Monday morning and your drugs are being taken off the shelf. In an attempt to question this decision, thinking that the drugs may not be working properly or the price is too high? The response is simply that these products are not produced locally in Russia. They insist on the company signing on a local partner to return the products on the shelf. That is how emphatic they are and the same examples exist in China and Brazil. Looking at Brazil's defensive tariffs, South Africa has not heard of any of that around defensive tariffs. In the final analysis his view is that the first lever of industrialisation is very important and requires a buy in to the concept of localisation. Localisation goes hand-in-hand with innovation and although the target is to spend a certain percentage of GDP on R&D and innovation, the real question is how to extract the best value from that investment made. To achieve this there is a need to be realistic around our R&D capabilities, skills and competency resource in the country.

There are two types of R&D in South Africa, viz: R&D where budding entrepreneurs assisted with their concept, they patent it and it is taken globally or regionally. Those are reasonably small but very important initiatives because economy is really built around SMMEs. This concept of relying on the big companies to create the jobs can only happen

at an SMME level. That type of R&D is very important but one can pose a question whether that is necessarily going to deliver the next cure for cancer? He noted that it might or it might not and if it will, it will take time to get there. It requires that we consistently keep working at that which will form part of the long-term ventures.

There is an immediate crisis where the rating agencies during the next six months need to see where the growth will be coming from and we need to respond as a country. An example of Aspen was mentioned, where they realised that there is no use competing with the commodity pharmaceutical products where you fight out on price resulting in huge production loss. They decided to build a sustainable business which relies on finding a niche opportunity. In their search they conducted some transactions and the bottom line is that they discovered that sometimes one needs to buy that IP, improve on it, and bring it back home and then start producing out of your backyard. They acquired two thrombolytic products, one is a low molecular weight heparin and the other one is a heparinoid. They are now slowly integrating part of it back into South Africa and will produce a final product in the Port Elizabeth plant in a pre-filled syringe. Currently they have a cluster of strong thrombolytic products in their injectable thrombolysis basket. The leading company globally is Sanofi with 60% market share and Aspen is sitting at 13% market share but have their sights firmly fixed on overtaking the French, Sanofi.

With this approach one could start making a difference because if in five years' time they could get to a point where exports are around a billion dollars soon the trade deficit in pharmaceuticals will be wiped out in one fast swoop. Looking at innovation and R&D there is the component where you start the R&D from scratch, which is the former; but there is also the latter where you look at doing some clever deals internationally and then you bring it back home. What that does is that next time someone has an innovation, maybe a phase one or two around thrombosis they are likely to come back to Aspen.

The second industrial policy intervention is around incentives to stimulate either investment or market access. The view on that is mixed because incentives are often a one size fits all and the incentives that work best are the customised or tailor-made incentives by sector, e.g auto motive sector. There are exports job creation in that sector

attracting investment. It is easy to criticise everything in hindsight however that will result in the private sector, government and the country never getting anything off the ground. He emphasised that his message is based on the honest assessment of the incentives and however proposed an overhaul at an incentive level where they are customised and tailor-made noting that incentivising what the industry is doing works better and regenerates the business confidence.

The issue around policy coherence is very important if innovation is going to be tackled and if the country is to have the level of growth it requires. Everything always comes back to the skills issue but the real question is what does the private sector do to develop those skills? An example was given of what Aspen has done in the health care sector because they might want to look at a similar model and replicate it elsewhere. In late 2012 they got 23 private sector healthcare companies to do a social compact with the Health Minister which was along the lines of setting a fund where each of these companies contribute 0.75% of net profit after tax being paid, this included South African business.

This fund then together with the Minister agreed on three projects. One is a hundred medical students per year all from rural based communities with the hope that these students go back and work in the rural communities in time. The second was PhD and Masters Students in HIV/AIDS and TB research, and the third one was building management capacity. In the second one they funded two cohorts of PhDs and have already seen some of the post-grads come through. The total quantum that is being funded at the moment is in the order of 70 PhDs and Masters.

He noted that although they have kept a very low profile on this there may be a need to raise the profile because people need to know what is happening with these initiatives. Minister Motsoaledi set himself a target of a thousand Masters and PhDs over ten years. If one looks at that now you've got 70 over three years, it is not a bad proportion to be coming out of that initiative. In summary, his point was that there is a need to align the different incentives to the industrialisation mantra. The second point was customising and tailoring the incentives to get better outcomes and results and the third was that it all has to be underpinned by having the right skills base in the country.

6.3 Dr Chamunorwa Togo

In his opening remarks, Dr Togo gave an overview of government support instruments at a regional level indicating that their focus is on the implementation side in the innovation value chain. He noted that demand is created for the innovations in terms of commercialisation and to benefit the community. At the provincial level there is direct funding that is provided for research. In addition to the funding, they also celebrate successes in research, e.g. the Bio Tech Fundi Awards held annually to reward excelling individuals' i.e. researchers and/or students from Honours level, Professors, bio-technology entrepreneurs, etc.

The Provincial Department of Economic Development has attempts to create an enabling environment for industrialisation and realisation of the benefits from the inventions, e.g. the Gauteng Investment Centre whose role is to help businesses to do better by attempting to remove the stumbling blocks in doing business in Gauteng. A symposium was held with a team of Nordic countries in terms of the industries from Nordic countries to tap into what they can do to enable them to do business in Gauteng. The same efforts where done with the local industries and the Premier is visiting different industries to hear what the challenges are and how Gauteng Provincial Government can do better for business.

There is also the establishment of industrial development zones, e.g. the OR Tambo Industrial Development Zone, where all the companies would find clustered infrastructure which would make it easier for them to operate. They are very close to the OR Tambo Airport which would make it very close for logistics with regards to export. The Innovation Hub and the Automotive and Industrial Development Centre in Rosslyn is also part of the provincial government structures. They help the SMMEs to grow also linking the SMMEs with the industry because at times it does not make sense for an SMME to compete with big companies. Therefore, the approach will be for the SMME to produce raw materials that are going to be used by the big company and by doing so, they are able to fit into the value chain.

The Provincial Department of Agriculture conceptualised the biotechnology park and today there is Biopark Gauteng funded by ***the dti*** together with the Department of Economic Development. In first phase ten companies in the biotechnology sector were targeted and to date there are 41. Currently Bio Park phase two is being built and a feasibility study is being conducted for Bio Park phase three or the advanced bio manufacturing. The functionality of the Bio Park could not happen without the support from Technology Innovation Agency (TIA).

It was emphasised that more can be achieved if government departments work together. An example was made of a company which got a multi-million US dollar deal upon satisfaction of the international standards to supply to Brazil and that it turned down an offer from Russia to buy them out. The reason was that government has already invested in them and that they cannot betray the government and this investment has been going on for 20 years. He pointed out that there are some pockets of excellence and that even though the Innovation Hub wants to redress the past imbalances and boost the economy there is need for patience with regards to biotechnology companies because after 20 years they are reaping the benefits.

Another platform is the Open Innovation Solution Exchange where the private sector and the SMMEs are linked and can adopt the innovations from the researchers and commercialise them. There is also enterprise development and through establishment of the technology stations they have found it very easy to help the entrepreneurs, especially in the S&T sector because when they need to do prototyping they go to the technology stations. Start-up Support Fund is also made available and works as a leverage fund to get more funding from investors and TIA has seeded into that.

The Gauteng Enterprise Propeller is one of the incentives at the provincial level providing tailored funding for SMMEs. The City of Tshwane is a key partner in the automotive industry at the Automotive Industrial and Development Centre (AIDC) and one can see a lot of activity in this space. Government is providing an enabling environment to stimulate demand so that we can pull the inventions. However, one of the challenges on the front end in this sector is culture or perhaps policy alignment. As an example, in promoting

academics the yardstick is publications, it would be necessary to look at whether a product from a specific university has been commercialised and that has to be integrated into the promotion of those academics. Not all inventors are innovators but what is important is to work both from the inventors' side and to encourage the students to be innovators. Business development agencies should impart entrepreneurial skills to those inventors trying to convert them to bridge the gap from the lab to the product.

Questions and Discussion

An observation was made on a dire need for progress and prioritisation and it was proposed that perhaps it may be necessary to take 100% of available support instruments and put only 90% of that into the core priorities and then organise to be able to catch the others as the opportunities approach.

There was a comment that what was referred to in terms of Russia is by no means unique; e.g India would demand that you have a greater than sometimes 70% shareholding by the Indian public if you are going to do any business there. It was noted that this is the way the world works and that South Africa is very shy about engaging.

Another point raised was related to the issue of complexity. It was noted that there is a disjuncture because we are the people that give other people reactions on raising complexities and yet when we talk about innovation issues we demand linear pipelines. It was emphasised that linear pipelines do not work and that the requirement is therefore to work out how to embrace the complexity.

There was a comment that considering all the discussions the issue that begs attention is the distance between the CSIR and universities and that it is necessary to find a way of building areas of focus and structures that provide for research and innovation. An example was provided relating to a visit to a particular university where people have joint appointments i.e they spend half their time in the science council and the other half in the university. Students also spend their time in the university and in the science council. It was noted that these are things that can easily be done if there is the will to do them. Another example provided was around a visit to Berlin and it was noted that there is a

seamless integration between institutes, universities and industries. It was concluded that what has been done in South Africa is localising the whole science system and that the NSI is just an imagination which has not been created.

A comment was made with regards to the mismatch between the successful growth in the number of black African doctoral students and the very low proportion that seems to be going into the business sector as per Dr Jammine's presentation. The first point was that proportionately speaking many of the black African students seem to be coming up from the non-top 5 universities and so the predominantly white-owned business sector sees them as having inferior qualifications to those that come from UCT, Wits, University of Pretoria and KZN. The second point was the aspect about networking and the fact that black Africans do not have access to networking to gain positions in the same way as white graduates.

A delegate reflected on why graduates do not find relevance in the private sector. It was noted that as an example, Accenture hires fresh graduates every year. These are top-notch qualified people they look for from institutions of higher learning as the company struggles to find the kind of talent they are looking for. It was argued that the bottom line is that the talent that is coming out of the institutions does not match industry needs and elaborated on a point that if you are going to get a PhD graduate who is highly specialised in something that is not relevant, he is not trainable as he is very expensive and has high expectations but does not match exactly what the company is looking for. It was emphasised that there is a high degree of coordination that needs to happen between the private sector and our institutions of higher learning. The delegate mentioned how today the world is operating in the digital world and asked delegates to reflect on how many of the universities have adapted to the digital world to be able to deal with the fourth industrial revolution that is taking place given those technologies. It was pointed out that the challenge lies on the gap between private sector expectations and what is being produced out there and that gap needs to be closed in a very narrow way when the deeply specialised come.

A comment was noted from the private sector perspective that in some areas they have reached some level of stagnation. As an example, the intake of scientists in Sasol is in the order of between ten and fifteen per annum and that is a reality faced because there is no growth. It was noted that this number is very limited and hence there is a need to come up with much more creative ways in terms of how to create an opportunities for those coming out of universities. To bridge this, Sasol introduced an internship programme where all graduates are taken on a three-year programme on a non-permanent basis, to at least to give them exposure to the place of work. The other reality is the fact that graduates coming out of university are not necessarily ready for the place of work. There is a lot of training that needs to be done to get them to be ready to operate within the place of employment and there is not enough conversation between the private sector and the universities in term of how to bridge this gap.

A question was raised in terms of what should be done in this regard given the available funds. It was noted that this begs a question on design and distribution of funds and maybe it is one of the things at a policy level that require review.

A question was posed to government on whether enough is being done to make sure that the incentives / programmes are working, especially considering that the Minister is very well aware of the issues around R&D tax incentive whose recommendations will hopefully come through in the next round of Treasury updates. With regards to SPII, the budget is quite low and it is experiencing similar issues to what the R&D tax incentive experienced. It was noted that there is a very small team for processing of applications and that they have not even started looking at new applications from October last year, therefore SPII is not necessarily functional. There are good programmes in the country and the question really is whether government is doing enough to make sure that they are working and that the private sector can benefit from these programmes?

The Minister indicated that according to her, the question is not if government is doing enough but rather whether all stakeholders are doing enough. In South Africa the private sector is sitting on a pile of money and not investing in the country or its people. The real question she maintained is on whether the challenges we are confronted with are solely

the responsibility of the government? and how does a partnership and collaboration to address these problems look like? She cautioned against having a multiplicity of instruments that do not provide the level of impact that is sustainable and noted her scepticism of a pilot culture or project culture which is a South African way of approaching problems. It was emphasised that the country needs sustaining solutions that build skills and repository of foundation that subsists over time. The Minister noted that it is very clear that skills are produced at increasing numbers albeit not always adequate; lack the requisite workplace skills and other dimensions that are necessary. The impact of internships is visible and the question is shouldn't internship be systematised, institutionalised and widened because they actually deliver results?

Minister Pandor encouraged a shift in the way issues are addressed and the need to have a conversation about what works and how do we make it bigger and better as well as what does not work and how do we throw it out. She noted that there is a culture of continuously adding without reflecting on what is working so that we can focus on it. She mentioned the country's problem of the lack of role playing and throwing tantrums when government is seen to not be doing something. She encouraged being far more robust about making what works bigger and more impactful.

A delegate from the government sector supported the need for focus and prioritisation which requires effort by the parties. He shared his recent exposure to the work that the private sector is doing on the advanced manufacturing space in photonics and electronics noting that this took the better part of a year and half to come to agreed areas of focus, because as companies go through their prioritisation process, they change their investment decisions based on signals of what government is willing to do. These put the department in a better shape than ever before.

Another delegate reiterated the Minister's sentiments noting that it is not about government creating jobs. Government should be monitoring incentives better and this should be a collective responsibility with a collective effort and alignment. This is how one is more likely to start breaking down the silo effects that exist in the country.

A comment was made regarding localisation noting that it is disappointing to see at times that the country is too democratic. It was suggested that there is a need to become a bit more autocratic. What is really disquieting and disheartening is the production of world-class policies and instead of going ahead shoulder to the world as a society and implement the policy, we re-debate the policy and a year later we come up with a new policy. In the meantime, China and India are implementing their policies and we are debating the next version and then the next version comes out and we open up a new debate. When we do eventually get down to implementing there is more debate on how we are going to implement. There is realisation that mistakes will be made however, it is better to rather make some mistakes and learn from them than to do nothing. The bottom line is that making no mistakes means having no impact on society and the implementation of localisation and preferential procurement is a classic example of that. While South Africa is sitting back and having several discussions the imports are growing. It was emphasised that there needs to be less talking and more doing and to tune the mind-set of our country into one where we unequivocally support local and we live by supporting local. Supporting local does not mean that only government procures local because the other problem is that for local retailers it comes down to margin. It was noted that there is agreement in primarily defending the margin and to look after the shareholders and to have return on investments. However if the consumers are not expanded by creating more jobs and more opportunities it eventually catches up with the company in the medium to long term and the margin becomes the least of your worries. In other countries, like South Korea, the ordinary citizen understands what the over-arching goal as a country is and they will indicate that it is to grow their economy at x % by supporting local companies. When you ask a South African the same question the responses are different and multiple. The country currently lacks that mind-set and there is a need to raise our game when it comes to buying locally. Being proudly South African we need to live it rather than just say it.

6. Presentation on SKA (Dr Rob Adam)

Dr Rob Adam gave presentation on the Square Kilometre Array (SKA), an international effort to build the world's largest radio telescope. Its scale represents a huge leap forward in both engineering and R&D. As one of the largest scientific endeavours in history the SKA brings together the world's finest scientists, engineers and policy makers. It will use thousands of dish antennas and up to a million antennas that will enable astronomers to monitor the sky in unprecedented detail and survey the entire sky much faster than any system currently in existence. This will give it an unrivalled scope in observations exceeding the image resolution quality of the Hubble Space Telescope. Huge areas of sky will be imaged with unprecedented levels of sensitivity.

South Africa`s Karoo region and Western Australia`s Murchison Shire were chosen as co-hosting locations for scientific and technical reasons i.e from atmospherics above the semi-desert sites through to radio quietness which comes from being some of the most remote locations on Earth. The Karoo will host the core of the high and mid-frequency dishes ultimately extending over the African continent (i.e. hundreds and eventually thousands of mid to high frequency 15m dishes). Australia's Murchison Shire will host the low-frequency antennas.

The SKA is a global project and organisations from ten countries are members of the SKA Organisation i.e. Australia, Canada, China, India, Italy, New Zealand, South Africa, Sweden, the Netherlands and the United Kingdom (UK). The SKA Organisation`s headquarters are in Jodrell Bank Observatory near Manchester in the UK. Approximately 100 organisations and companies from 20 countries are participating in the design and the development of the SKA via industrial consortia, in an interesting model where the combined wisdom and experience of industry are drawn in to assist in the design, manufacture and construction of a top global science project.

The SKA is being developed in two phases between 2018 and the late 2020s. In phase 1 Australia will host the low-frequency instrument with more than 500 stations each containing around 250 individual antennas, while South Africa will host an array of some 200 dishes, incorporating the 64-dish MeerKAT telescope. Phase 2 will complete the

telescope arrays at both sites, and become fully operational in the late 2020s, with some 2000 high and mid frequency dishes and a million low frequency antennas. The SKA will already start conducting science observations in 2020, with a partial array and the MeerKAT portion of SKA-1 much sooner than that.

Three big questions in theoretical physics and astronomy are part of the reasons for the SKA, firstly, Big Bang; you start with something very, very tiny and uniform and today you have got something which is really big and lumpy. Lots of galaxies, different systems, clusters of galaxies, how? How do you get from something which is like a little ping-pong ball to something which is not like that at all? The second question is if there is a unified theory of the very large general relativity and also very small quantum mechanics. Those two theories do not talk to each other at all and have got nothing to do with one another. They are as if they were invented by different civilisations and there is no way at the stage of having a proper interpolation between the two. The third one is whether there anybody else out there? Are we alone in the universe? If we are not alone why have they not eaten us yet?

The SKA will be able to conduct transformational science, breaking new ground in astronomical observations to investigate:

- Einstein`s theory of relativity to the limits;
- How the very first stars and galaxies formed just after the Big Bang;
- The mysterious force known as dark energy, the discovery of which gained the 2011 Nobel prize for physics;
- The powerful magnetic fields which permeate the cosmos;
- Whether we are alone in the universe.

Current radio astronomy techniques can detect planets orbiting nearby stars. One can see out to 50-odd light years or so, and you can see stars, couple a hundred of them. We have seen what so-called axe planets around other stars are; you know that that is a planet. In providing the generalist's view of the levels of sensitivity of the instrumentation, he gave an analogy as follows: if there was another civilisation in one of those planets that we can already see and they were using aircraft radar, you will be able to pick that

radar up in phase 1 of the SKA and in SKA 2 if there were any beings watching television in those planets you would be able to pick up their signals.

Data policy will be based on scientific merits of scientists within the member states evaluated via a time assignment process. There will be a mechanism to ensure that access is proportional to the contribution level for each member state. Robust negotiation is going on at the moment about who contributes what and why, and that needs to settle down before we even have an SKA organisation. A provision will be made to enable access for non-member states at a level to be determined. The idea is not to bar scientists from other countries because they have not paid but have a wonderful scientific idea. There needs to be some way in for good ideas. Ultimately all data and data products will be made globally available after a suitable proprietary period; and it is the open part of the access.

The SKA will require super computers faster than any currently in existence and the network technology that will generate data traffic at a comparable level to the current internet. So in other words, in the connection between those antennas you will have data travelling at a volume which is equal to the current internet volume. The MeerKAT is pouring two terabytes per second into the science processor where you chuck out a lot of rubbish and different bits of data which are repetitive of each other, etc. You chop it down to 0.7 terabytes per second and then into the archives you have got a line at twenty gigs a second and even that is quite big. With the SKA, it is going up by a factor of twenty or more from that; and SKA 2 is almost unimaginable.

Apart from being a sensitivity challenge with the manufacture of antennas and the coordination of the antennas, there is a huge data challenge. The team has copied SAN and come up with a tier system for data architecture and this is in terms of the bid that was put forward by both countries. Tier system consists of four layers; the tier zero is where all of the raw data goes into, and that in terms of the two bids Australia and South Africa, those would be in Cape Town and Perth. There is a huge opportunity here for our Centre for High Performance Computing to put itself forward as the host of that centre of that tier zero node.

The international board will make the decisions around technologies and the precise locations but this is put forward as a great challenge to provide what's required. The national requirements e.g a scientist interested in three of the six large surveys; that data will go into your tier one node as a country and there will probably be ten tiers in one nodes, different regions, and different countries around the world. From those tier ones there will be a further set of connections to tier two nodes and that is where the actual universities and science centres in different countries where the actual astronomers sit. Tier zero and tier one are machines largely looked after by people but the real intellectual action happens at tier two and tier three.

It was highlighted that in the planning there is even somebody sitting at home with a laptop that has a connection to his own institution noting that this is the architecture. He drew the simplified architecture for the delegates as an illustration of the concept and noted that the Institute for Data Intensive Astronomy (IDIA) which is cooperation between a range of universities, Western Cape, North West University, Cape Town and recently Sol Plaatjie University has been brought in as associate members of that partnership. Storage and sequence analysis and support for certain projects cannot be held simply by a few universities.

Data will be provided through the Centre for High Performance Computing to others since it was paid generally by taxpayers' money. This is an initial effort by interest parties to come up with a system to analyse it. African Data Research Cloud which is something which has come up through the AVN partnership is looking at getting European Union funding through the Development Directorate, DGDEV, to span out our computing power through South Africa and other African countries as a stimulant to development.

In terms of the architecture, SKA 1 Mid one goes to the Karoo Array Processor, tier zero and then a range of tier twos. What is envisaged is that one of them will be in the Northern Cape at Sol Plaatjie, possibly one at Wits, etc so you have got a rich architecture of data users throughout the country. A list of local players and initiatives was shared, i.e Centre for High Performance Computing (CHPC), South African National Research Network (SANREN) which will carry the data, Data Intense Research Initiative for South Africa

(DIRISA) which is a general data project putting together a national data architecture (not just in astronomy but through many other sectors run by the DST), IDIA, the Africa Research Cloud, a proposed Western Cape Data Centre, and the IBM Research Laboratory which is up and running as a partnership with Wits. A list of various areas have been put forward by the SKA office as new technology areas, i.e data storage and innovative retrieval, software development, high performance computing engine, machine learning, fast high resolution analogue to digital convectors, optic fibre signal transport in wideband and also renewable energy and distribution options.

In terms of how to unpack the Big Data focus areas and looking at visualisation a question may arise on how Big Data sets can be represented properly so that humans can see them and understand them as opposed to having lots of numbers. He noted that machine learning i.e teaching machines to think a bit like humans do, algorithms, better algorithms, analytics, how to manage unstructured data, network of sensors, power efficient computing, mass storage and high-speed streaming are all areas the specialists in SKA are currently looking at. Machine learning it is one of the areas that is most fertile in looking for connections between phenomena. This is needed in astronomy e.g if one is trying to find a black hole binary somewhere they seek the tell-tale signs of a black hole binary.

There are some more practical applications for radio astronomy frequency spectrum management and not for radio astronomy of all communication. The radio spectrum is becoming increasingly crowded and that is just an example of how the US frequency is chopped up and each of those little areas is for somebody. There is radio astronomy in some areas and in some areas nobody else can go to that as it is allocated to radio astronomy. Within each of these will be for different radio stations, television stations, aircraft communication, etc. The US military research organisation have put forward a grand challenge about managing radio spectrum cooperatively because not all systems are in use at the same time so that you can have a communication system between different users of the spectrum. What this does is use machine learning to manage radio spectrum cooperatively so that it is used much more efficiently and that is their grand challenge. Machine learning comes when dealing with uncertainty and they look for

patterns through e.g building up banks of probabilities. Astronomy and this application may seem light years apart for the average person but in fact the techniques used are very similar. You are looking for correlations between different data sets which are huge in magnitude; things that humans can get their minds around that can never happen. Humans are good at patterns. These techniques teach machines patterns.

In conclusion, he emphasised that machine learning and Big Data is not just for boring geeks in rooms with humming machines. He noted that there are different real life applications and huge opportunities for South Africans to transform our economy, the way of thinking and position in the world with respect to the opportunities in Big Data.

7. Panel Discussion: Impact of Innovation on Growth of Companies

Dr Mjwara introduced the three panel members: Dr. Thulani Dlamini (Sasol), Professor Roy Marcus (Da Vinci Institute) and Mr William Mzimba (Accenture South Africa). The purpose of the panel discussion was to get some insights on the impact of innovation on growth of businesses. It was noted that one of the challenging issues in the policy space is to continuously demonstrate the value of investment made in R&D and innovation. Delegates were therefore reminded that inputs received from the discussion are extremely important for the DST in the journey and attempt to show the value of innovation.

7.1 Dr Thulani Dlamini

In his reflection of the role and importance of investment in development, Dr Dlamini noted that one cannot argue that investment in innovation is absolutely critical for the growth and sustainability of businesses. Innovation is done to ensure that the business is able to retain a particular competitive advantage and to ensure that things that are done translate into increasing shareholder value. If one is not able to at least demonstrate from the two parameters the value of investment in R&D then from a business perspective you will not be doing it.

He gave the history and background of Sasol, its production levels and how the company over a period of 20 years was able to innovate around their particular technology, change

the catalyst, change the reactor completely and buildttwo plants in Secunda. Through innovation Sasol went from 5,000 barrels per day and to 140,000 barrels per day based on a completely new technology of cost built on the background IP that was taken from the Germans. Instead of starting with coal, gas is converted into liquid fuels and chemicals and this technology has been taken to the world. The technology is being replicated in Qatar, Nigeria, and there are projects in Eastern Europe and America looking at exploiting that particular technology. Sasol would not have been able to do this if it had not invested in innovation within the organisation. Sasol invests, over 1.5 billion Rand per annum in internal research and technology development programmers which is absolutely critical for Sasol in terms of sustaining the competitive advantage, ensuring sustainably and growing the business.

Reflecting on the issue of patents he commented that in his view, patents are important for a reason and that Sasol has a patent family portfolio of over 14 or 15 patents filed over the years. It is an important part of securing ability to operate as well as securing competitive advantage. It is not only patents that are focused on; there is a lot of know-how that is kept in house as part of the milieu of the capabilities to ensure that Sasol is able to continue to do the things it does.

In the chemicals industry it takes between 10-15 years to develop a technology. Sasol is in the process of commercialising a technology to convert ethylene to octane in Louisiana and invested over 15 years in the development of this technology to a total of 100 million US dollars. That is what it takes and it is the kind of thinking that business needs to have in terms of what is required to take an idea from the laboratory to commercialisation. Sometimes when one talks about partnerships they get stuck on a patent which at the end of the day, by the time you commercialise that technology, has very little value in terms of what is required to get to commercialisation. Patents are important but they are not the only thing and must be used for the reason that they are intended for.

He noted that from a private sector perspective there is a tendency to consider working with the public sector as some form of corporate social investment and Sasol is also sometimes guilty of this as well, that we only engage the public sectors on things that we

do not consider to be strategic for our success. He indicated a need to move away from that and ensure that the things that business does is relevant in terms of own sustainability as business and to ensure that that conversation takes place. To be able to do that requires a lot of alignment between the public and private sector in terms of what the priority areas should be.

The country should be clear and focused in terms of the sectors that need to contribute sustainably to what is growing this economy. Looking at the industrial policy action plan it is too broad and if that is the strategy for growing the economy, it goes from boat building to chemicals to arts and crafts. In his view, strategy is about choice and there is a requirement to choose the areas to focus on and then drive those relentlessly to make an impact.

The question is how to harness our collective genius as a country to get the system of innovation going where it needs to go. There is no argument that delegates know the value of innovation – it has been demonstrated in businesses, economies, countries. Everyone has seen what it has been able to do in creating what we call today, in the tech world, Unicorns, which is companies which have absolutely no assets but have market capitalisation in excess of billions and billions and have created equal system that is measured in trillions of dollars today, and most of them are less than 10 or 15 years old and that is all done at the back of innovation.

There is no doubt that innovation at this point of time equals growth and there is no doubt that for us as South Africans, or Africans, the one thing that can help us get out of where we are, the dark hole that we are in right now is by collectively harnessing our power to our collective genius through the capabilities that we can unleash by being innovative. The question he heard throughout the conversations is, “how can we bring together the various aspects of this ecosystem or this system of innovation in a way that it can be directed to where there can be major impact?” How can we make sure that all of our government institutions that we have spoken about earlier find a way of working in a way that can see, or innovation or innovators can find them and those government institutions

and private sector and people and initiatives and in the universities and many other places are orchestrated in a way that makes it easy for people to innovate.

In the previous year's innovation conference he launched a challenge to start an innovation movement as a country, and he still felt quite strongly about that. It was indicated that with this he is not referring to a political movement and/or a church movement or a government movement, but a movement of getting together and beginning to innovate – under the auspices of NACI which is tasked with getting the system of innovation going in the country.

There is a hypothetical prospective that says, "can we not just uberise this thing?" This refers to the platform economy right now and platforms are the way to go and they create value and specifically digital platforms create the collaborative environment second to none. Today poor people in remote and rural areas have technologies that can allow them to access these platforms.

An innovation platform that can as an example, allow a young guy or a young girl in the rural areas with an idea on how to change fundamentally their situation in that rural area e.g because there is a river that runs between the villages where they live and wants to know how he can begin to do fish farming by capturing what is in there and breeding it. They can go into this platform and talk about, "I want to breed fish and this species of fish" and somebody who knows about fish breeding can make a connection with that young person and provide them with ideas on how to breed fish. This is not about providing them with money but with ideas and the various options that they have on how to breed fish. That that same young person could then have access through the very same portal that talks about green economy and how you want more and more people to do fishing. One can imagine that a community that had only in its hands a river running between two villages will have a different economic perspective coming out of just the resources that they have.

Another example was provided in relation to a guy in Africa going on-line to learn about generating power through windmills. His reasons for talking about the power on this platform are that innovation moves away from being in the confines of large enterprises

with large R&D budgets to everybody. It becomes accessible to anyone, everywhere, anytime and if they need it to connect with people who have access to big computers and know how to crunch data to tell them what the impact of their idea can be, they can send their information there and somebody can give them the result and there is technology to do that and to crowd source things.

One does not have to be an industrial designer to achieve this. They have to come up with an idea and get other people that can connect through this platform that can do the design. If one wants to connect with the market, he could go to this platform and share his idea, etc. As the Minister indicated, this is not a government problem and delegates collectively know that it is not just a private sector problem either. It is a fact that the private sector has the money, they spend over 36 billion Rand every year through their R&D collectively. It is not enough, the country needs to get to about 2% which means collectively the spending should be between 75 and 80 billion Rand in R&D so, there is an innovation deficit right there. No wonder South Africa is lagging behind in many aspects of what we are trying to do from an innovation point of view.

The proposed platform is not something too technical or too difficult to build. It is simply putting things together in such a way that if one has money and want to invest with the best ideas, this platform will have the ideas already curated by a university, for example, that specialises in that field. Consequently, the university and people with money will be collaborating through that platform to curate certain ideas that are brought about by people from different backgrounds and different historic setups.

If there is a university professor that wants to talk about the SKA and its impact in terms of big data, all of sudden that information is available to everybody through this portal or through this platform. Information start to move, ideas start to be generated and they also start to connect with people that can do something with those ideas. Those people that are beginning to have ideas are beginning to see problems that they can use to solve using those ideas.

People that have money know where to go to find this talent it is no longer as complicated. All of our government entities now are integrated through this platform because now we

know who can find pre-stage zero or pre-feasibility type projects that are where we go. Who can find post-feasibility that is where we go.

He threw out a challenge to all to start thinking about how digital capability and technology can be used to create a simple platform that can connect everybody that is interested in participating in this innovation eco-system to make it a reality. In these forums, people engage in discussion and nothing comes off it, but if we look towards the platform – it will be possible to realise the goals. If one wants to Kickstarter, then through this program one knows where it starts, etc. That according to him is a platform that helps people to launch and to get their product manufactured. Out of this there could be a multitude of platforms that can be developed that can enhance and expand the eco system of innovation. Through this, unicorns can be created as illustrated by platforms like, Ubers, the Googles, the iPhones, the Apples, the Amazons, etc.

7.2 Professor Roy Marcus

Prof Marcus highlighted some observations from the 2015 Technology Top 100 DST project and explained the selection process. Over the last four or five years some wonderful innovations were seen, particularly in organisations who are struggling with the market at the moment and are constantly innovating and creating a different suite of offerings with the same kind of technology. There are small companies coming in with amazing growth as they are in fact employing people, and growing year on year basis.

He pointed out that over the last year, 70% of the organisations sourced technology outside of South Africa compared to 30% in the preceding year, noting that currently there is a greater reliance on global technologies with huge restrictions in terms of license. 42% of all exports are into Africa, which is encouraging and 47% of the organisations have no desire and interest to protect their IP; the reasons amongst others being the cost of registration and for defending such a patent.

In the Cape area, the country has lost about ten companies because of the cost of data and the lack of bandwidth. Data and bandwidth is a serious inhibitor for companies in the ITC sector. More worrying however, is a lack of faith in local technology and some of the

companies tell horror stories about particularly state owned enterprises that have actually funded the developer of technology and will in fact go outside of our borders to bring a competing technology? The mindset is that we are producing some of the greatest technologies in the world but it is not locally supported. Some of these Technology Top 100 companies are exporting over 80% of their product in globally competitive markets.

He welcomed the issue of government procurement policies. At the moment there is no concern as distinct from other countries around the world where you give favourable consideration to local technology. Government is not being asked to support technology that is not competitive; in the Solar Project, for example, there is no consideration to use local technology and therefore government procurement policies have to be bent towards saying, the first port of call is going to be what is home grown. Money is spent on R&D universities and yet we are getting very little out of it. There is no incentive for a university Professor to want to generate third stream income for the university.

One of the harsh realities about “fees must fall” is that some universities have now decided that it is about time they start to look at third stream income. In Israel and other countries around the world there are very special dedicated research funds called solution driven research and if you are willing to take some of your research and commit yourself to try to drive some commercialised products out of that research, you get generously supported by the government. As part of a nurturing process the young and small enterprises specifically should be assisted. It was indicated that there is so much goodwill to make things work in this country it is not solution driven research at all costs, it is both.

7.3 Mr William Mzimba

In his introduction, Mr Mzimba made reference to earlier speakers who talked about never wasting a good crisis noting that the best innovations have come at the time of crisis. The question is what is it going to be for us? There is so much good and so many exciting things that exist today. What needs to be done is to find them and give them resonance and channel them appropriately. He argued that there is too much happening in the institutions of higher learning in terms of innovation and that there are many policies that

the government put in place to support all of that. He argued that failure to integrate we cannot solve big things because if work is in silos South Africa can never conquer the world.

He supported putting a framework on how to implement the system of innovation in an integrated way noting that the results that will come from there would be surprising. Drawing from personal experience he indicated that similar conversations have tended to yield no results and cautioned against endless talk shop and moving to the do shop. The need for a much more forecast and sustainable approach in terms of how to drive such conversations to a point where something emerging can be seen was noted.

He suggested getting a few people together that are willing to conduit their time, energy and innovation around the matter to come up with a framework on how to implement the system of innovation in an integrated way. There was emphasis on the need to move away from binary thinking noting that although small and medium enterprises are contributing significantly towards growth, the view should not be that big businesses do not have a role to play. He concluded by saying that that at the back of a lot of what is seen happening in the small and medium enterprises the enabling environment is created by big business. He noted that investments are made in capacity development which ends up starting these small and medium enterprises and that there is a need to make sure this is taken into account in conversations.

8. Summary and Way Forward

Dr Mjwara summarised the proceedings noting that there are a number of take home messages commencing with the Minister's address where she challenged delegates to alter the way things are done in this country. Whether it is for the citizens or whether it is how the economy is impacted, the point is that the economy in its structural form will not take the country forward. In moving forward, delegates were requested to ask themselves what their contribution will be and how to benefit altering the trajectory whether of the economy or whether in changing people's lives.

He highlighted the fact that a need for partnership was emphasised by a number of speakers and that the partnership is not going to be well defined and needs to embrace that both the public and private sector need each other. During discussions the private sector wanted to sustain competitiveness and to work in some of the niche areas, but that can only be done if investment is in innovation and therefore the private sector sometimes does need public sector innovation.

He noted that the public sector needs to go back to see how they can make sure that the interventions are actually working. He referred to deliberations about a need at government level to look at the incentives and whether the open ended ones are probably not as good as the sector focused ones and maybe go back and do that.

It was noted that there is a need for government to develop holistic coherence and make sure that there is integration in the message given as illustrated through discussions on public procurement for localisation. When local innovation is excluded it defeats the very same purpose the DST is trying to drive. There were also suggestions about priorities and the question on whether the country is prioritising. Specifically, the industrial policy was cited as too broad and that maybe few areas need to be chosen.

Comments were raised for the private sector to think about public sector innovation and what can be done to absorb PhDs with an ultimate goal of beginning to get more business expenditure and R&D as a percentage of GDP as the ultimate goal.

The university and science council sector will have a lot of things to think about and if the data that was provided about the research conducted in the public institutions, what should be thought of is to have a balance. The knowledge generated is continuously measured by publications but there is a need to look at the way in which some component of our public system, e.g. Universities of Technology together with the science councils have their ear on the ground in terms of the needs of the private sector.

The challenge is the balance between the idea that you do not produce people with specialist knowledge, but producing people who can respond to commercial request to say these graduates are not relevant. What should be done is having internships,

perhaps post-docs, which bring the private sector ready type people. One of the key things that remain a big challenge to government especially DST is trying to engage with the Department of Higher Education and Training on how to design a package of incentives to incentivise university Professors and researchers to allow publications and other instruments of knowledge generation to be incentivised in the same way as the know-how and patents, which is still a big issue. The DST does not view this to be in the debate, but is trying to have those debates written into government and in partnership with colleagues DHE.

In concluding, he noted that the DST is taking very seriously is that there should be less talk and more doing and that. Out of the discussions a series of questions and the conversations today has posed is how we then in a structured way begin to take some of these ideas forward. With some of the work that NACI has been asked to champion by the Minister and the DST taking over that work will be in a better position to share with the delegates how this conversation will be taken forward under, of course, the partnership between the DST and NACI.

9. Closing Remarks (Dr Mlungisi Cele)

In his closing remarks, Dr Cele thanked all speakers and panellists for embracing the opportunity, communicating and promoting DST entities and solutions needed to consider moving forward. He also thanked NACI councillors in attendance noting that they are the real principals and owners of the work, the secretariat for organising the event and everybody that was able to participate.

He noted that NACI, working with the DST has been asked by the Minister to reflect on progress made since the 1996 White Paper. The first phase of the review was completed and discussed with the Minister. Gaps were identified and a process is under way to find a way of addressing them. He indicated that once these are addressed the review would be complete and depending on the Minister's approval, it will be shared with the NSI community for further input. The idea of conducting the review was to enable the system

to craft the new White Paper. Part of it will be to articulate a new vision or to reaffirm the current vision.

He noted that some delegates called for prioritisation and strategic choices to be pursued in the next decade or twenty years to come and indicated that the process is coming where that prioritisation and determination of aspects that have worked in the system and not worked and which of those must be pursued further. There will be communication and invitations to participate in various ways as the DST works through the next phase of developing the new White Paper and ten year plan.

The White Paper deadline is 2017 and the ten year plan is expected to be produced by 2018. As part of that there is agreement that there is a need to conduct a mini-foresight exercise to help crystallise the type of priorities that may need to be pursued in the next decade or so and once finalised, it will be communicated with stakeholders and a platform will be created through which everybody in the system could be able to participate. In concluding, he thanked all the delegates and extended an invitation as NACI to collaborate with everybody in the system noting that all stakeholders in the system can add value.

APPENDIDX A: PROGRAMME

Chair: Dr Phil Mjwara

08:30	Registration
09:00	Opening remarks and introduction of the Minister of Science and Technology
09:10	Address by the Minister of Science and Technology, Mrs Naledi Pandor, MP
09:30	Presentation of the findings of the 2015 STI indicators booklet, Dr Azar Jammine: NACI Council Member
10:00	Discussion
10:20	**Tea break**
10:50	Panel discussion on government support instruments for science, technology and innovation, with Mr Imraan Patel (DST) and Mr Stavros Nicolau (Aspen)
12:00	Presentation on the Square Kilometre Array and opportunities for big data
12:30	**Lunch**
13:30	Panel discussion on the impact of innovation on growth, Dr Thulani Dlamini (Sasol), Prof. Roy Marcus (Da Vinci Institute), Mr William Mzimba (Accenture SA)
14:40	Summary and way forward, Dr Phil Mjwara, Director-General: Science and Technology
15:00	Closing remarks, Dr Mlungisi Cele: NACI Acting CEO

Appendix B: Attendance List

The DST/NACI Business Symposium on STI was well attended. As shown below, the 103 delegates that attended were from different government departments and agencies, public high education institutions, private sector and the media.

Institution	Number of Delegates
Academy of Science for South Africa (ASSAf)	2
Accenture SA	1
Agricultural Research Council (ARC)	1
AIRBUS DS Optronics	3
Altech UEC	1
Altron	1
Anglo Gold Ashanti	1
Ansys Ltd	1
Aspen Pharmacare	1
Blank Canvas INTL	2
CNT	1
Catalyst Research Solutions	3
Centre for Science, Technology and Innovation Indicators (CeSTII)	1
Citrus Research International	1
Council for Scientific and Industrial Research (CSIR)	3
Da Vinci Institute	1
DCD Protected Mobility	3
Denel	1
Department of Science and Technology (DST)	19
Econometrix (Pty) Ltd	1
Environaid Consulting	1
ESKOM	1
Free-Wifi	1
Ibert (Pty) Ltd	1
IERI (Tshwane University of Technology)	1
Mail and Guardian	1
Mvuyelwa Solutions	1

National Advisory Council on Innovation (NACI) Secretariat	13
NIPMO	5
North-West University (NWU)	1
Plastic SA	1
Pretoria News	2
SASOL	1
SACNASP	1
SiMODiSA	1
South African National Space Agency (SANSA)	5
South African Revenue Services (SARS)	1
Technology Innovation Agency (TIA)	4
The Times	1
The Innovation Hub Management Company	6
Tiger Brand	1
University Of Pretoria (UP)	2
Universities South Africa (USAF)	1
Water Research Commission (WRC)	2
Total	**103**