

SYMPOSIUM ON SCIENCE, TECHNOLOGY AND INNOVATION INDICATORS FOR SUSTAINABLE AND INCLUSIVE SOCIO-ECONOMIC DEVELOPMENT – WHERE ARE WE? MAYORAL ECONOMIC SUMMIT 2017



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1. OPENING REMARKS

Professor Cheryl de la Rey, NACI Chairperson

A warm welcome was extended to all guests. Prof. de la Rey explained that NACI provides evidence-based advice to the government of South Africa on science and technology, particularly on innovation. These are crucial aspects of growing the national economy.

The symposium was pleased to welcome diverse dignitaries, officials, the media, and the public and private sectors. The main function of NACI as prescribed by legislation is to establish and maintain information systems, monitor and evaluate the functioning of science and technology and the National System of Innovation (NSI). One aspect is the role of science, technology and innovation (STI) indicators for sustainable and inclusive socio-economic development, which included the production of the 2016 STI Indicators report and the STI information portal.

NACI must report annually and provide data on performance on country innovation to facilitate dialogue on topical issues of policy and its implementation. This also responds to the fundamental question of how South Africa is performing in STI. The report further details progress and identifies gaps and opportunities needing greater effort.

The innovation portal is a newer endeavour that will provide a central repository for all innovation-related data and give stakeholders a single point of access to all NSI information. The portal is targeted at the government, institutions, public-private partnerships, non-governmental organisations, researchers, journalists and all citizens.

2. DEMONSTRATION OF NATIONAL STI INFORMATION PORTAL

Dr Mlungisi Cele, Acting CEO of NACI

Extensive work had been done to develop the portal, which will address gaps in the system through a central point to access all data on STI work. It will also provide access to other data sources, thus will have multiple uses. NACI has worked with numerous stakeholders to develop the portal.

NACI Senior Specialist Mr Petrus Letaba and his team demonstrated the pilot phase of the portal. It was explained that the portal is a central repository of data and information. It will contain a range of reports such as research and development (R&D) surveys, World Intellectual Property Organisation information on intellectual property, data on quality of life, and NSI information. Policy briefs and strategies will be included, as will information on funding and incentives.

Users of the portal will include those interested in technopreneurship who seek information on funding and incentives. Another advantage will be analytical contributions. The need is not only for a central repository of useful data, but to promote dialogue and analysis. An extensive list of all organisations and entities in South Africa working with innovation will be available to international users.

Also on the portal will be digital libraries, divided into themes such as agricultural sciences and health sciences. The University of Pretoria has provided extensive information on the Sustainable Development Goals (SDGs). There are many databases included in the repository. The pilot phase will demonstrate the technology using minimum datasets and information so that user feedback can be obtained and included, the portal then tested and upscaled in phase 2.

Discussion and comments

Question: How will the data in the portal be kept current, since that will be the key value add?

Response: NACI will employ young people to continuously update the portal content, but also to think about future content so that the portal remains relevant.

Question: Has NACI employed dedicated personnel or only part-time personnel, as this can be time-consuming work and it is crucial that it is constantly updated.

Response: NACI has two people and the Department of Science and Technology (DST) has a dedicated person to assist. Once the roadmap has been finalised (which will be influenced by the discussions in this meeting), the skills and competencies required will be identified and the structure finalised. In the meantime, people are working full-time on the project.

Question: How can the ordinary person contribute to the project or provide content?

Response: User feedback may be provided on paper, as in the meeting today, or by contacting NACI to suggest content or be an active contributor. A technical team works with the data and anyone who would like to participate can approach NACI. Public comment is welcomed.

Question: What is the timeframe and when will the portal be fully operational?

Response: There is a two-phase approach, with phase 1 available on the NACI site. There will be gaps in the information as explained. From April 2018, as part of phase 2, the portal will be expanded.

Question: When will the portal link to global modules and tap into huge datasets, as this would be essential for geographic information system (GIS) mapping and modelling?

Response: Phase 1 started with what was available, with a broad NSI in mind. Phase 2 there will include bigger data such as GIS.

Mr Letaba:

For such a portal to have real value, it will need to address and support the main concerns and challenges of the people in the system. When work on phase 2 begins, large datasets will be included. The team will assess when it has become fully functional, since in the coming two years, as much data as possible will be incorporated. However, the processes must also be subjected to rigorous testing, which could take some time. However, it is expected that all the key functions will be in place within the coming two years.

Such an initiative can work well only where there is a strong commitment from data generators. NACI must include key stakeholders on governance and management so that it is a shared project. If the portal materialises as envisaged, all publicly funded research on innovation systems will need to be included. The private sector must also be included as it generates extensive research under R&D processes and must be incentivised to share this. The value of the portal – as with any similar portal – lies in the extent to which it will be utilised and engaged with. When stakeholders can see the value in it, they will be keen to contribute. However, some kind of process or mechanism is needed to ensure that the collective value of innovation in South Africa is presented to the international community, not only from the public sector but from academia and the private sector. The private sector information could immediately commence with annual reports, for example.

Mr Sizwe Nxasana: Founder Future Nation Schools, Chairman National Student Financial Aid Scheme (NSFAS) and National Education Collaboration Trust

In staying relevant and current, there is extensive research, development and innovation in the private sector but because of the deep-seated silo mentality in South Africa, it is difficult to collate this. Aspects such as intellectual property are less complicated and can go to the central repository. There is much innovation in the private sector that is not registered, so the challenge is to motivate the sector to participate to contribute to the completeness of the portal. There has been extensive interest from most sectors but less from the private sector.

Professor de la Rey:

A whole layer of work addresses uploading of data and its governance issues. A comprehensive perspective on the NSI is needed, since much of the data resides with other organisations. Without agreements and protocols, data will not necessarily be accessible. The governance framework is thus important. The NACI Council will address this now that the technical work has begun. It will also look at intellectual property and its protection since it is a complex sector. The vision is a strong interface with other data sources and access to the data on government websites. This will have to exclude personal data that requires protection.

All work to date has been in-house and the small but dedicated team must be commended. There is a need for additional capacity but the exact requirements will be informed during planning. Assurances are essential that data governance and integrity will be secured. Data science is a rapidly evolving field internationally.

3. PANEL DISCUSSION: 2016 STI INDICATORS REPORT AND IMPLICATIONS

3.1 Overview of report presented by Dr Azar Jammine

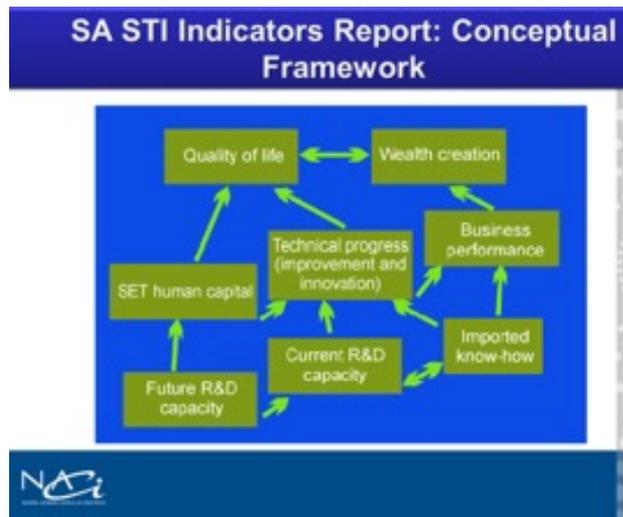
(The Powerpoint presentation is an annexure to this report.)

Certain issues dealt with in the report are crucial in forging a successful long-term outcome for the South African economy. NACI and the team led by Mr Letaba are acknowledged for their excellent work. The report is intended to be an annual publication that will provide an evaluation mechanism that draws on sequences and linkages, while each year identifying new ways of working. The NACI development of innovation scorecard is intended to track what is happening on the innovation landscape of South Africa in an aggregated manner.

Internationally, there is more transition in the world and things are moving faster than before. Keeping pace is challenging in a world in which innovation in science and technology is increasingly important. The mega-trends include growing unemployment, growth of mega-cities, climate change, migration, new wars, a multipolar world, increasing inequality and a hollowing-out of nation states. Many of these trends are already evident in different degrees. A world in transition is characterised by four main factors – mega-trends, grand challenges, transforming innovation and deep transitions, with a high degree of overlap among these.

Innovation is increasing exponentially and South Africa cannot be left behind. Innovation is important in addressing high unemployment, increasing migration into cities, climate change - especially on poor communities - and massive population growth. There is also increasing inequality in line with growing unemployment, especially among youth. For innovation to succeed, education must improve significantly as this will promote a mindset of innovation - this is not the only requirement for innovation but is central.

The 17 SDGs form the baseline for the role of science, technology and innovation in promoting sustainable and inclusive socio-economic development.



The National Development Plan is the foundation for building the innovation landscape. South Africa is also strongly influenced by its membership of the BRICS grouping (Brazil, Russia, India, China and South Africa) as an alternative to advanced economies and former colonised countries. As a BRICS member, South Africa is keen to promote inclusive technological and scientific development to boost economic growth in the new world. There is a need to shift from broad policy to actual implementation, which is especially in South Africa, where debate and policy formulation are extensive, but implementation insufficient.

The main trends affecting sustainable growth include the aftermath of the global finance crisis of 2008/09, with its increased impact on unemployment, poverty and inequality, where inequality is a function of attempts to alleviate problems of the global crisis and high international debt. Other factors are water scarcity (a key challenge in South Africa), global climate change, energy, food security, disease threats (such as HIV/Aids), increasing non-communicable diseases and in particular mental health, low business confidence that is linked to political instability, and the positive and negative impacts of the fourth industrial revolution (4IR), which increasingly renders human capital obsolete.

The 2016 STI Indicators report provides information both encouraging and worrisome. The report is an annual publication on South Africa's NSI and provides a platform to discuss the state of innovation. The conceptual framework comprises eight aspects that interlink and influence one another. The report assesses innovation from 1996 to 2015 compares South Africa with other countries. There are new indicators in the 2016 report such as maths and science trends, capitalised research and development expenditure, information and communications technology factor productivity, and the extent to which the market capital of the Johannesburg Stock Exchange is linked to innovation trends.

Highlights and lowlights of the report:

- ▶ Multinational corporations are significant in technological innovation progress. Almost half of patents granted in South Africa are to non-residents.
- ▶ Foreign direct investment (FDI) as a percentage of gross domestic product (GDP) has declined since 2001, and the country FDI as a percentage of African continental GDP declined from 14% in 1996 to only 3% in 2015.
- ▶ School enrolment in science, engineering and technology (SET) is increasing gradually, although it remained low at 29.9% in 2015.
- ▶ Female SET enrolment increased slightly to 46.2% of all learners in 2015, and the percentage of females graduating in SET was encouraging at 50.6%.
- ▶ The number of scientific publications tripled, from 25 453 from 1996 to 2000 to 75 270 from 2011 to 2015.
- ▶ South Africa has one of the largest mobile cellular subscriptions in the world, as well as high internet and mobile penetration. However, the high cost of data remains a serious concern.
- ▶ That multinational companies play an important role is positive, but if FDI reduces due to political instability and dropping investor confidence, this will have a material impact.
- ▶ Industrialisation has reduced in recent decades, eroding the ability to produce own goods, particularly technological goods, and export, making the country increasingly dependent on imported technology.
- ▶ The human capital pipeline is seriously constrained due to poor education outcomes, low maths and science performance, and poor early childhood development. This results in fewer than 20% of learners in the education system achieving adequate maths and sciences results in their final school year (year 12), rendering many youth unemployable and unable to earn an income to reduce inequality and poverty.
- ▶ Trends in International Maths and Science Study 2015 shows alarmingly poor outcomes in South Africa, with only 1% reaching international abilities. The government must address this if the country is to progress.

- ▶ Non-fee-paying schools are the worst performers. However, when the best-performing schools partner with less-resourced schools in formal, structured programmes, benefits are significant, including an improvement in marks from 20% to 90%. This clearly indicates that learners are not inherently incapable but need better tuition and support.
- ▶ Private sector R&D is declining, but improving in higher education. The challenge is that these two sectors do not interact sufficiently and cross-pollinate to transfer skills, which reduces technical ability in the manufacturing sector, among others.
- ▶ Agriculture has shown great success through the development of technology. While the number of commercial farmers had declined by more than 50% in 2015 from 160 000 25 years before, food security remained stable due to innovative use of technology.
- ▶ The South African services sector has expanded significantly and is highly driven by competitive technology. However, heavy industry and manufacturing have shown consistently poor performance and the country is now dependent on imports.
- ▶ The success of R&D in multinationals operating in South Africa is countered by a reduction in FDI, where South Africa has fallen to second place behind Egypt, which is concerning. The mix of imports has not shifted significantly in two decades.
- ▶ South Africa has one of the highest mobile phone and internet penetrations in the world and this could be leveraged to develop educational expertise. Education no longer has to take place in a classroom. Schools should focus on developing social and community skills rather than just traditional education.
- ▶ Progress is seen in the services sector, particularly finance, but this is offset by reduced manufacturing and transformation of resources into effective exports.
- ▶ There is a serious lack of venture capital in South Africa and the limited and sometimes adversarial engagement between public and private sectors is concerning.

Observations

- ▶ Key opportunities could be leveraged to improve education outcomes and economic growth, notably the use of technology, particularly mobile phones and internet.
- ▶ Strong R&D needs to be converted into tangible outputs in science and technology that will advance the country. There is a clear need for deep transitions and a fundamental shift in the economy, which has stagnated since 1996.
- ▶ The deficit in SET skills, particularly in design, engineering, entrepreneurship and management, continues to impede the functioning of the NSI and undermine economic potential.
- ▶ Critical mass for research capacity is building, although this is confined largely to a few prominent universities and is not seen across the academic sector.
- ▶ The private sector needs to become more involved in

promoting innovation, since financial support remains a crucial factor in creating a culture of innovation.

- ▶ STI's contribution to poverty reduction and the wider inclusion of all communities into the mainstream economy is inadequate.
- ▶ Upgrading the pipeline from early childhood education to improve SET outcomes in final year is crucial.

3.2 Mr Imraan Patel: Deputy Director-General, Department of Science and Technology

There are both positive messages and worrisome developments. It is very encouraging to note the changes in higher education in higher-level graduates and increased research. The number of females has increased and there is greater diversity of graduates, which is crucial in replacing an ageing scientific cohort. These positive developments must be strengthened and large-scale research programmes created to ensure the skills of young graduates are used. Policies to promote this need to be in place.

Concerning is the continuing poor performance on technical skills for basic innovation. This not only relates to innovators but is generally linked to maths and science. South Africa has the potential to become a leader, including in educational technology. There are some signs of growth, especially of economic recovery, but much more needs to be done to create products and services that will use technology more effectively.

3.3 Mr John Gabriel Goddard: Lead Economist Southern Africa, World Bank Trade and Competitiveness Global Practice

There are demonstrated strengths in South Africa in innovation, R&D, reflected by the country's three world-class universities, which are in the top 500 global institutions. This is an important achievement. Outcomes are strong in research and publication, patents being registered, and some education areas. However, the need is crucial for more improvement because poor results in the knowledge economy have serious repercussions. Top knowledge economy teams are to be found not in the United States or United Kingdom but in Hong Kong, China and Singapore. Huge investments have been made to reduce the disparities in those countries.

Translating the research and knowledge into tangible gains that will improve economic growth and create jobs is proving more difficult. Recent reporting on educational development in relation to productivity and growth indicates that since the global economic downturn post-2008, growth has declined, not due only to a lack of innovation.

3.4 Mr Sizwe Nxasana

The report confirms the urgent need to focus on education in South Africa, particularly maths and science. The poor outcomes are, to some extent, a correlation with poverty and inequality, which indicates the urgency of addressing poverty constraints. Early childhood education and development must be improved, as there is a direct correlation to improved educational outcomes throughout the school career. This is essential given the substantial inequities in society.

While maths and science outcomes have improved among female pupils and graduates, women continue to lag behind in science. The higher education sector needs to develop comprehensive ecosystems that will move away from the prevailing silo approach. Stronger collaboration is crucial. All stakeholders must collaborate to drive innovation across the region using existing structures and platforms. However, intellectual property is challenging when working across borders in the region. Future Nations Schools found little policy and convention alignment across the Southern African Development Community when it sought to establish a progressive educational option. Even within platforms such as the Office of Research and Application of Products for Industry, which comprises 18 countries, not all recognise the same conventions. Thus, it is difficult to promote innovation on the continent without protocols and governance.

Ms Gugu Cele, CNBC Africa

With intellectual property, education and curriculum content are not keeping up with innovation needs. How will the Future Nations Schools approach improve the curriculum and how will the government and business be encouraged to take a more innovative approach?

Response: Mr Sizwe Nxasana

4IR strongly influences the education needed. Future Nations Schools aims to work with a 21st century curriculum. It is predicted that within coming decades, 65% of young people will be doing jobs that do not exist in 2017. These will require whole new skill sets such as problem-solving and critical thinking that translate classroom learning into the real world. Resilience must be taught. Skill sets must be included in the curriculum. South Africa has to comply with the current Curriculum and Assessment Policy Statement so Future Nations Schools is drawing on international benchmarks to develop its own assessment tools, including coding, robotics and the arts. The creative arts are not included formally in the South African education system and tend to be overlooked, yet life sciences are key and need to be integrated with pure sciences. Innovation is needed to solve human condition challenges.

Ms Gugu Cele, CNBC Africa

Another urgent need is to change the higher education stereotypes, where too many young people focus on the traditional degrees such as a BA but are then not highly employable.

Response: Dr Azar Jammine

There is indeed an urgent need for highly capable teachers who can promote creativity among students. The challenge lies in how to promote a cohort of teachers to inculcate innovation ability among students.

Response: Mr Imraan Patel

The education discourse needs to shift fundamentally. Greater involvement from the private sector will assist. Many students drop out of university across South Africa and they could be given opportunities to complete their education through the use of technology. Greater creativity is needed, especially in how data is used within the system. There is much more that should be done to assist young people. One important initiative is the Harambee Youth Employment Accelerator, which uses statistics and other tools to evaluate youngsters' potential and ability rather than what has been learnt. This challenge must be dealt with collectively.

Higher-level skills are needed as part of a broader ecosystem. Internationally, all education systems are under stress, including in places that have worked especially well, such as Finland. Many approaches are being questioned. Singapore, for example, is exploring the use of lifelong learning with credits so that people can access more easily adult education. Education remains the primary challenge but requires appropriate policy intervention. Promoting innovative thinking requires greater collaboration among sectors, especially as people are living longer and often changing careers through their lifetimes. Hence the need for ongoing lifelong education.

Response: Mr John Gabriel Goddard

Technology is changing more rapidly, the industry demand for skills is shifting and keeping up is a challenge for every country. For example, the United States has seen a huge decline in manufacturing jobs, which has increased social challenges. It is important to see what types of skills are available in the labour market and what employers are looking for but cannot find. The paradox is that there is high unemployment in South Africa, 27.7%, which is even higher with those who have given up searching for work. Yet many jobs need to be done and skills needed that are hard to find. In a recent LinkedIn study to identify the 10 most critical skill sets employers need, nine of the 10 related to information technology. Governments are beginning to respond to these shifts.

In South Africa in particular, recent initiatives include the 4IR programme, the Gauteng Innovation Hub and M-Lab on digital entrepreneurship. There are also initiatives in townships that share digital skills for low-income households.

Ms Gugu Cele, CNBC Africa

While any jobs are under threat, a challenge is incentivising private sector involvement. This is also linked to the reduction in FDI in South Africa and the continental perspective cannot be overlooked. However, private sector R&D is key, which will focus on returns on investment and how to enhance sector participation in the portal.

Response: Mr Sizwe Nxasana

Innovation support for SMMEs is crucial and in South Africa, aspects to address include barriers to entry, lack of support, improved tax incentives and greater access to finance. Finance institutions should play a stronger role in promoting innovation. The tendency remains the triangle of big business, the government and labour and the three coalesce against SMMEs. Legislation attempts to address this, but limited finance and ecosystems remain challenging for SMMEs. For 23 years, the need to support SMMEs in innovation has been discussed, but little change has been seen. NACI statistics indicate that they are under-represented in investment in R&D. Ecosystems must be created that will enable SMMEs to report, support and contribute to economic growth.

Response: Mr Imraan Patel

SMMEs and business must disaggregate, as large groupings are not helpful. For example, there are small-scale SMME agricultural interests, but could the increase in agriculture relate only to commercial farmers or could SMMEs have played a role? This cannot be determined, which makes it difficult to assess whether there is adequate support for small farmers. In a recent private sector project on R&D of tax incentives, work was done with industry associations such as forestry and citrus to assess the differences. SMMEs and large industry should be more competitive – recent statistics appear to indicate that while jobs have been lost, new entrants should be identified. There is a range of programmes and initiatives for SMMEs but inadequate innovation programmes to reach a wide range of SMMEs. This means that only specific sectors benefit. Manufacturing, in particular, is being overlooked.

Response: Dr Azar Jammine

The views expressed are correct. The heart of the problem is structural weaknesses in the economy that have not allowed for increased economic growth and have contributed to an inequitable concentration of power in the golden triangle. This is aggravated by a lack of trust between those within the triangle who work in silos and don't collaborate. Big business must

engage more with the public sector and non-governmental organisations and not rely on public education to produce the talent pipeline that is urgently needed. The private sector does not engage sufficiently with public institutions to generate talent.

Response: Mr John Gabriel Goddard:

A international study was recently undertaken on the rate of return on R&D investments, covering 600 000 companies. Rich data is available in South Africa. The rate of return in South Africa is comparable with advanced economies but depends on the sector. While the rate of investment is lower in South Africa, the returns are higher than in many countries. However, with small, medium and micro enterprises (SMMEs), there is a lower share of young firms than in other emerging countries, and barriers to entry and growth were identified. Companies need to become high-growth and generate employment opportunities.

Ms Gugu Cele, CNBC Africa:

What tangible outcomes need to be measured to grow the South African economy? The number of patents being registered is disappointing, for example. How best can the efficacy of SMMEs or innovation technology in South Africa be measured, particularly in tangible and positive outcomes?

Response: Mr John Gabriel Goddard

The World Bank focuses on reducing poverty and inequality, and improving prosperity. It believes that profitability is necessary for long-term gains and improved FDI, and for inclusiveness that will translate into human improvements and address the SDGs. Specific challenges experienced by SMMEs include a lack of viable payment solutions. This has been addressed via technology by Uber, among others. Another concern is job facilitation and matching. Population groups that have been underserved could be provided with simple devices and easy platforms to enable them to access work opportunities and services more readily. There are many positive outcomes to innovation, not just patents.

Response: Mr Imraan Patel

We should not only be measuring if there is innovation or not, but keep in mind that innovation is the means to an end. Innovation drives improved quality of life and creates wealth through a combination of local technology combined with external technology, and not only technology but business models. There are many good ideas but these are too often not translated into business models that make sense. Thus, measurement is more about the impact and contribution of innovation to a whole range of areas. Globally, there is extensive discussion about transformative innovation policy. Countries promote innovation but find that it is not translating into meaningful wealth creation. The SDGs provide a good framework, with some goals encouraging the market to consider innovation for social benefit, such as improved water solutions

outside the mainstream market. The measures must also speak to the impact. It is important for NACI to measure innovation for impact.

Response: Dr Azar Jammine

To promote and grow SMMEs, cultural and psychological aspects of society must be harnessed. South African society still struggles with the legacy of apartheid in an environment where there is a strong tendency to look to the government to supply solutions. That mentality permeates the new South Africa and places inappropriate and unrealistic reliance on the government to provide jobs and opportunities. Citizens must push for entrepreneurship, skills development and education, identify opportunities and focus on teamwork and innovation.

Discussions and comments

- ▶ How can the 2016 report be translated into innovative production, growth and job creation to address high unemployment? What kinds of interventions would draw on this information to bring about the needed changes in five to 10 years? The education curriculum needs to change to promote maths and science performance – then what revised institutional arrangements will be required.
- ▶ 4IR needs innovators and developers, yet many students who are innovators are lost because of their social challenges and because they don't want to be simply entrepreneurs. They are not always able to patent their innovations. To promote small business and innovation, young people must be supported to overcome social challenges.
- ▶ There is little reference to linking entrepreneurship with innovation. It may be that the research community requires greater exposure to the idea of exploiting knowledge and defining needs and then linking the two. Is it hoped that Singapore's success in economic growth be replicated or is the goal new knowledge that will not necessarily be implemented? Implementation must be strengthened as must focus on the SDGs as a key framework that incorporates the indicators to better measure implementation of the knowledge base.

Response: Mr Imraan Patel

It is not enough to focus on entrepreneurs, but a deeper conversation is needed on what it means and how to create the culture of individual entrepreneurs, since not everyone has an appetite for risk. The acceptance of risk will also vary – bankers will have a different risk appetite than developers in Silicon Valley. In South Africa, the apartheid legacy has influenced this. School talent is not adequately identified and supported, technical skills are not present and a new, enabling ecosystem has not been built. Time is needed for a talented young person to identify opportunities, mentors and funding pipelines. There are positive green shoots – especially with small-scale programmes – so the need now is to upscale programmes that reach 100 people, for

example, enviropreneurs. There is no shortage of programmes, but there is a need to streamline what works and collaborate more.

Opportunities are insufficient for people to express their new 4IR skills, but this is changing with new programmes and innovative niche ideas. Social challenges cannot be overlooked when identifying opportunities, such as required education or finance.

Response: Mr Sizwe Nxasana

The challenges of the many unemployed youth tend to be viewed as negative, when they present important opportunities. The youth are a significant demographic dividend for South Africa (and Africa) that remains largely underused. The challenge is mobilising the energy of youth to solve basic human problems of clean water, sufficient food and adequate housing. More sustainable cost-effective housing, food and water needs to be considered. Opportunities for this are not being leveraged because there is a tendency to copy more developed countries. There are initiatives to mobilise and skill the unemployed, not only to obtain employment but to create opportunities. It is crucial that people are empowered to think differently about their future while being given support.

Entrepreneurship and leadership should be key components of the curriculum. Higher-education institutions in the past eight years have commercialised R&D, and schools need to do the same; cascading down through the school system from a young age as the Future Nation Schools intends to do. Learners must know that they can be innovators if supported, connected to the real world and helped to think critically and solve problems. This approach then begins to shift mindsets, thus it is important to review the curriculum, not only vocational skills, but to restructure the whole approach to education.

Innovative and creative higher-education students need support and help to overcome social challenges so that they can implement their ideas and achieve their potential. Youth agencies do not always focus themselves appropriately and young people remain inadequately supported.

Ecosystems must be created to support the many entrepreneurial ideas that exist because success in innovation relates not only to the curriculum and how learners are taught and attitudes instilled, but to building ecosystems to support innovation. Diversity is crucial and immigrants important in countries that drive innovation. South Africa needs to think differently about innovation and how it is linked to and influenced by gender, ethnic and racial diversity.

Mr Patel mentioned the increasing intensity of R&D. In the forestry and agriculture sector, there is a high level of partnership with the government and innovative sector funding is available. It is anticipated that National Treasury will continue to supply resources for this work. Hybrid degrees should become more common - for example, anthropology and environmental sciences could be combined to better contribute to socio-economic needs.

The Academy of Science of South Africa, which supports agricultural training, has noted that the country's main challenges relate to poor maths and science outcomes. Even where young people do well in science, they tend to study engineering rather than agriculture. The quality of teachers of these subjects is not of international standard. Are we relying on an ageing workforce and ageing farmers to achieve the success that has been reported by the data, and what plans do policymakers have to address the crisis in agriculture proactively? Are the indicators merely academic or are matters being followed through to make meaningful changes for the country?

Response: Dr Azar Jammine

Agriculture provides important opportunities to absorb people in decent jobs, particularly the youth. Technology density statistics apply to commercial farming and not small-scale farming. In South Africa and across Africa there is huge potential to develop the agricultural sector to create employment and promote food security. Africa has the most uncultivated arable land in the world. The same science and technology framework has been used for 50 years and this is an opportune time to review it to promote greater innovation.

Response: Mr Sizwe Nxasana

In introducing hybrid degrees, the education system also tends to operate in silos and it is time to think differently about how subjects and interests are structured in faculties to promote better integration. This links to the importance of the arts, science and technology, and maths, and how best to connect components. For example, in school or university, there could be combined teaching, where different subject teachers collaborate in the same class to teach a specific theme. Educators should begin to think differently to promote better teaching outcomes. Many people across countries also become teachers for lack of other opportunities. The teaching profession requires an upgrade so that the best candidates choose it.

Response: Mr John Gabriel Goddard

The public policy challenge lies in leveraging the huge entrepreneurial ecosystem that exists for greater impact. Enabling public policy is important. Matching grants worldwide is a good instrument, with smaller grants made available to SMMEs at pre-commercial stage, but without profits to invest in the business. South Africa has a well-developed finance system and deep capital market, but gaps remain. For example, companies needing between \$350 000 and \$1.5 million to upscale cannot access finance. A regional pilot called Excel Africa is being rolled out to host 20 companies selected through an interactive process with investors that will be given a residency and access to finance.

To enable innovation, the cost of entry and growth should be reduced, facilitating trade and reducing the cost of trade to promote South Africa as a manufacturing hub. Information and

communications technology is crucial and there is generally good infrastructure, and a strong uptake of mobile subscriptions. However, the high cost of data – much higher than that of emerging market peers – continues to undermine growth. The government and regulatory mechanisms must address this.

Response: Mr Imraan Patel

Current budgets are being set and it is hoped that funds for innovation will be prioritised. In a tight fiscal environment, there are trade-offs, but the government recognises the importance of innovation for the country. The government's nine-point plan encourages a shift away from silos. In agriculture, agri-parks and farmer production hubs are being implemented, and investment is increasing, all of which need evaluating.

SA Connect is examining high data costs and private sector initiatives are underway. Players have been encouraged to collaborate more given the country's financial constraints and this momentum needs to be maintained, especially recognising the many green shoots and how to leverage them into strong systems.

Discussion and questions

- ▶ Innovation is seen from a narrow perspective since the metric for innovation seems to be how many patents have been registered. Schumpeter, in his early work, identified five drivers of innovation, new technology being one. The view of innovation must be broadened.
- ▶ DST indicators inform the work but engagement is needed on new ways of measuring what is being done. Measuring impact is important. How can innovation be assessed in an indicator process that relies on existing datasets and not a new curriculum, not taking into account social benefits nor other aspects?
- ▶ A key challenge is transitioning undergraduates into postgraduate work. Many graduates are the first in their families to achieve tertiary education and are under pressure to earn money to support the extended family. This does not allow for unfunded postgraduate work. Yet their potential contribution to STI is crucial. Most existing postgraduate funding is for full-time study, but most potential postgraduate students need to earn an income. How can part-time sponsored students be included, as their contributions are essential to inclusive socio-economic development?

Response: Dr Azar Jammine

The indicators provide information retrospectively about what is happening but more landscape areas should be incorporated to identify gaps effectively. Neville Cummins undertook a study for NACI to identify such gaps and the innovation scorecard reveals weaknesses and strengths of current innovation systems and where resources are needed to contribute to an environment that supports innovation. There is a clear need for improved

collaboration and cooperation between public and private sectors. Developing and growing SMMEs and their innovative capabilities was also clearly identified. NACI has stated for some time the need for social innovation that will, for example, harness cultural heritage and move away from using only traditional Western approaches.

Ms Gugu Cele, CNBC Africa:

What do panellists see as the key learnings for 2018 and beyond?

Response: Mr Sizwe Nxasana

Innovation is not only technology, but also how to do things better across the spectrum, whether technologically or socially. First Rand, for example, drove an innovation culture around not only technology but the human aspects of the business, such as queuing in a branch of the bank or moving away from paper-based transactions. Small innovations must be rewarded. This leads to fresh thinking from all the people in the company. Staff should be encouraged to question every day how they can do what they do better.

On support for poorer or working-class students to encourage postgraduate work, NSFAS funds one certificate only, which is being discussed by the Ministerial Task Team on Higher Education. Students from households with an annual income below R150 000 need grants. The finance sector needs to be more creative in providing student loans. Postgraduate students who support families should receive additional support and proposals have been made to the department. As with all the challenges, funding is constrained. Existing donors such as the National Research Foundation (NRF) are also financially constrained. Providing an enabling environment that will support part-time postgraduate study is essential and it may be possible for the NRF and others to develop a pilot that solicits private sector funding.

Response: Mr John Gabriel Goddard

Many partners are keenly interested in the report and it will inform the work of the World Bank. Social entrepreneurship is a key aspect, as is improved access to finance. The report provides useful statistics for annual reporting. For example, in 2016, 28 South African start-ups received more than R100 million in venture capital. Most of the products funded were new to the country but not internationally. It is important to know where the funding is going and the return on investment. The World Bank is open to working with NACI to translate some of the results using administration data collected by tax authorities and customs, among others, and then provide new insights.

Response: Mr Imraan Patel

This journey to work with South Africa Incorporated started a few years ago. It is important to review data collectively and identify positive trends and what is informing them, then scale up. There are many positive interventions but not to sufficient scale. More stakeholder resources are needed to scale up and build on successful programmes, in both the private sector and the government. It is important to acknowledge when interventions are not working well, review them and identify what works and can be scaled up. There are many positive examples to draw on. Conversations must be continued and what is working well taken to scale to reduce poverty and unemployment. This is the commitment of the government, working with all stakeholders.

4. SUMMARY AND CLOSING REMARKS

Dr Mlungisi Cele, NACI Acting CEO

Great appreciation goes to all panellists and participants. With South Africa's wealth and resources available, there is a positive climate for growing the economy and addressing social challenges that continue to undermine growth.

Delegates are asked to take forward the positive experiences and draw on the innovation, hope and ability that exists. This is key to a shared future. Certain ecosystems resonated and at the next symposium in 2018, it is hoped that progress will be shared about these, the initiatives and the proposals that have been shared at this symposium.





