

KWAZULU-NATAL PROVINCIAL ROADSHOW: 2017 SOUTH AFRICAN SCIENCE, TECHNOLOGY AND INNOVATION INDICATORS



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1. WELCOME REMARKS

Dr Mlungisi Cele, the Acting CEO of the National Advisory Council on Innovation (NACI) welcomed NACI officials, councillors and attendees to the KwaZulu-Natal (KZN) provincial roadshow, where Dr Azar Jammine presented the findings of the 2017 South African Science, Technology and Innovation (STI) Indicators report. Attendees would be invited to comment, provide input and ask questions. Dr Cele apologised on behalf of the Chairperson of NACI, Professor Cheryl de la Rey, who was unable to attend the event due to other commitments.

This was the second year that NACI shared the STI Monitoring report, but this event differed with previous events in the number of attendees and the higher number of participating institutions.

NACI is an advisory body established in 1997 to advise government departments on science, technology and innovation policy. It reports to the Minister of Science and Technology. Regional, provincial and local innovation systems had been identified as critical to the growth of the innovation system. Connectivity is essential and harvesting the benefits of solar technology needed to become a habit as it was crucial for sustainability. NACI monitors STI indicators annually.

2. PRESENTATION ON THE FINDINGS OF THE 2017 SOUTH AFRICAN STI INDICATORS REPORT: DR AZAR JAMMINE

The South African STI Indicators 2017 booklet and South African Science, Technology and Innovation Indicators 2017 synthesis report, which had been presented to the delegates on arrival, formed the basis for discussions. The shortened synthesis report had been developed to simplify the STI for use by analysts.

2.1 Introduction

In the development of the report, new insights particularly on entrepreneurship and business activity in research and development (R&D), and the importance of the fourth industrial revolution (4IR), were incorporated. Both significant opportunities and South Africa's substantial drawbacks were identified.

The introduction to the report reviewed the global and local factors that influenced STI, the relevance of STI on South Africa's position in the world and its competitiveness, detailed where to present the conceptual framework, and provided insights into the findings.

The former Minister of Science and Technology, Dr Naledi Pandor, encouraged development of a composite indicator to assess progress. Prof Anastassios Pouris provided valuable input into the definition of a set of composite indicators.

The framework categorised STI activities into three components: the public sector's enabling activities, firm-level innovation activities, and the economic and social outputs of innovation.

Global context

The scope of global innovation was expanding exponentially. The Knowledge Triangle, comprising the government, business sector and universities, continued to collaborate to encourage innovation.

Policy interventions increasingly included multiple goals such as industrial transformation, inclusive innovation and sustainable development. Consideration had been given to issues such as climate change and energy constraints. Complexity in the increased stakeholder base, multi-level governance and the search for synergies with the private sector were increasing. The importance of evaluation was highlighted.

Local context

Dr Jammine provided an overview of the government outcomes and highlighted the following:

- ▶ High-quality basic education was the single most important element. Education could assist people to command better-quality employment and higher incomes, which would add value to the economy and reduce inequality and poverty.
- ▶ Healthy living and a sense of security would influence South Africa's economic future.
- ▶ An efficient, competitive and responsive economic infrastructure network was required, as one of the major challenges experienced in the economy over the past few decades had been the growth in concentration of power in the hands of fewer and larger businesses, rather than the diffusion of structure through small businesses. Substantial innovation potentially existed in small business, but was not being effectively harnessed. Rural development and land reform issues remained a challenge.
- ▶ To reduce the number of protests against the lack of service provision, responsive, accountable, effective and efficient local government systems and public service were required.
- ▶ Environmental assets and natural resources, both global and local, needed to be protected and continually enhanced.
- ▶ Social protection mechanisms were required, particularly where unemployment was high.
- ▶ The change in leadership earlier in the year had created excitement around nation-building and social cohesion.

The National Development Plan (NDP) incorporates the NSI and addresses many of the issues identified. A policy structure was in place. Operation Phakisa was focused on accelerating achievement of the NDP targets by 2030 through transformational systemic change, including ocean economy, information and communications technology (ICT) in education, mining, chemicals and waste. The introduction in Gauteng of a waste disposal programme separating waste before disposal to increase the effectiveness of waste disposal was highlighted.

The shift in STI policy was highlighted, including:

- ▶ 2012 Ministerial Review Report.
- ▶ Review of the 1996 White Paper on Science and Technology.
- ▶ STI Institutional Landscape Review, which determined how to develop the institutions around which science and technology evolved.
- ▶ 2018 Foresight Initiative.
- ▶ Development of the new STI Decadal Plan.
- ▶ The Department of Science and Technology (DST), the Department of Trade and Industry (the dti) and the Department of Telecommunications and Postal Services task team for the government's response to 4IR. The minister had emphasised the need for coordination of STI among government departments.
- ▶ Department of Planning, Monitoring and Evaluation evaluation of all government incentives.

2.2 Conceptual framework

The report was based on the South African scorecard, whereas previous reports were based on the 2012 National Research and Development Strategy's Logical Indicators Framework.

The components of the report were:

- ▶ Global and local trends and comparisons.
- ▶ Public sector activities, which were the enablers of STI.
- ▶ Firm-level activities and entrepreneurship.
- ▶ Innovation outputs to determine the results of innovation efforts.
- ▶ Selected key STI themes, such as 4IR, public sector innovation and local innovation systems. A thorough breakdown of provincial R&D initiatives and work was included.

Enablers included human resources, new doctoral degree graduates, the percentage of the population with tertiary education, open and excellent research systems, international scientific publications and the financial support of government and venture capital investments.

Firm activities included investment, R&D in the business sector, ICT investments, linkages and entrepreneurship, public-private co-publications - including publications on an international scale - and business funding of higher education where there were significant potential and intellectual assets, patents and trademarks.

Outputs remained focused on the balance of payments, being imports versus exports. South Africa was currently too reliant on imported technology and products. However, it was placed to perform well in 4IR, due to its mobile technology and internet usage. Potential was enormous to fast-track education and skills development to overtake many competitors.

2.3 Summary of the report

The South African Global Ranking on Selected Indices was presented.

- ▶ The country dropped from 47th of 138 countries in 2016 to 61st of 137 countries in 2017 in the Global Competitiveness Index, the main reasons being financial scandals and corruption identified in financial market development, in which South Africa had been one of the most highly ranked countries in the world. Financial market development deteriorated from 11th in 2016 to 44th in 2017.

A significant decline in the quality of South African institutions was noted, with international perceptions of the strength of the judiciary and media freedom having declined. A significant decline was also seen in goods market efficiency, from 28th in 2016 to 54th in 2017.

China and India were ranked higher than South Africa, where China was ranked at 27th and India 40th out of 125 countries, which indicated that South Africa was gradually lagging behind.

- ▶ The country's Global Innovation Index rating deteriorated from 54th of 128 countries in 2016 to 57th of 127 countries in 2017, being overtaken by other countries as the number of participating countries reduced. South Africa ranked better than Egypt and Nigeria, which were the other two largest economies on the African continent. It was ranked higher than Brazil at 69th, India at 60th, Egypt at 105th and Nigeria at 119th. China was ranked higher, at 22nd of 119 countries.
- ▶ Total early stage entrepreneurial activity were included, with South Africa ranking 6.9, compared to Brazil at 19.6, China at 10.3, India at 10.6 and Russia at 6.3. Russia was not familiar with entrepreneurial activity due to the previous communist regime.
- ▶ South Africa had a high number of entrepreneurs who innovated technology less than five years old, which indicated some pockets of excellence in technology and innovation that other countries did not have. This was evident in established and new entrepreneurs.
- ▶ South Africa showed the potential to overtake many other countries in ICT.
- ▶ The established business ownership rate in South Africa was 2.9, compared to 16.9 in Brazil, 2.5 in China, 7.5 in India and 5.3 in Russia, which indicated a lack of small business activity locally. NACI frequently discussed the need to differentiate between innovation in small businesses and in large businesses. A view had been expressed that there was significant innovation in small businesses, which was not being adequately harnessed.

The overall performance scorecard indicated a slight improvement in enablers in the number of people educated and encouraged to accelerate innovation. A deterioration was seen in businesses' involvement in research and innovation.

2.3.1 Enablers: public sector activities

The number of doctoral graduates, especially among people from previously disadvantaged backgrounds, was increasing, as was the number of black doctoral graduates against white graduates. South Africa had a low number of female graduates, particularly in STI. Only 44% of doctoral graduates were female,

with 18% in engineering, 23% in mathematics and statistics, and 31% in ICT. Higher female representation was noted in life and health-related sciences.

Controversy prevailed around whether scientific publications were an attribute, as South Africa had a 45.4% share of global scientific publications, which was significant considering the size of the economy compared to global economies. Although social sciences and arts and humanities publications had a low country share of publications, both ranked 18th globally.

South Africa had 0.37% of the world share in technology, ranked 40th, which was in line with the size of the economy.

Life sciences ranked 33rd and physical sciences 38th, relatively high against international standards. A view existed that the publications produced were not effective nor directed at innovation.

The major funders of research, technology development, product development and commercialisation were highlighted, which indicated flow from STI institutions into outputs on innovation.

2.3.2 Private sector activities on STI

Business expenditure on R&D from the private sector was disappointing, with expenditure increasing from R11 billion in 2007 to R13.8 billion in 2015. After making allowances for inflation, the proportion of investment had reduced and remained low despite several government incentives. The government's expenditure on R&D reduced from 27.3% (R2.3 billion) in 2007/08 to 3.6% (R0.5 billion).

2.3.3 Innovation outputs

Negative balance of payments in high- and low-technology sectors – 99.2%

South Africa had pockets of excellence at both high-tech and low-tech levels. Imports exceed exports. At a medium-tech level, South Africa's exports exceeded imports, especially in automotive and process engineering. The automotive sector had excelled in the development of technology. Criticism had been expressed that too many resources had been invested in the automotive sector versus other sectors. The issue needed to be explored further in future.

South Africa was a resource-based economy and some large resource-based companies had come to the fore. The technology balance of payments had been relatively positive as exports exceeded imports.

Detailed analysis of high technology components in exports as a percentage of imports – 22.6%

The ratio for electronics and electricals was 19.5% and the ratio for other products and equipment 23.1%. High ratios were recorded in areas such as power-generating machinery and

equipment, at 39%, electrical machinery and appliances, at 34%, transport equipment, at 45.6%, and professional and scientific instruments, which indicated a significant upward trend, at 34.8%. Ratios in these areas were substantially higher than in telecommunications and sound recording apparatus, with a ratio of 16.1%, and parts and components for electrical and electronic goods with a ratio of 18.4%. A relative improvement was noted in office machinery and automatic data processing machines. Medicinal and pharmaceutical products had a ratio of 18.5%, compared to 10.1% in 2007.

The social progress index – 66th of 128 countries

South Africa performed poorly on human needs, ranking 90th of 128 countries, and very well on opportunity, ranking 34th of 128 countries. The rankings were divergent.

Basic human needs – 90th of 128 countries

South Africa remained far behind other countries on basic human needs such as nutrition and basic medical care, water and sanitation, shelter and personal safety. A slight improvement was noted in 2017.

Foundations of wellbeing – 78th of 128 countries

Health and wellness was the lowest ranking in this category, at 110th of 128 countries. Access to basic knowledge still ranked 84th due to political forces, which obliged higher expenditure on free tertiary education for underprivileged students. However, expenditure per capita on basic education had declined by about 40% over the previous seven years. The focus should be on basic education, as positive tertiary results could not be achieved without a strong basic education foundation.

Opportunity – 34th of 128 countries

Personal rights ranked 37th, personal freedom and choice 33rd, and tolerance and inclusion 36th. The lowest ranking was 55th for access to advanced education.

2.3.4 Selected key themes in STI policy

Fourth industrial revolution

South Africa had the potential to excel in this area. The country had a strong foundation in investment in emerging technologies that were shaping the new modes of industrial production, particularly in artificial intelligence, internet of things, 3D printing and autonomous vehicles. The country scored low on nanotechnology and robotics. There were numerous publications on nanotechnology and South Africa produced more publications on internet of things than any other country.

The roles played by institutions in research on selected emerging technologies were noted. Research at tertiary institutions and the number of research initiatives to develop the economy and prepare it for 4IR was highlighted. The initiatives were broadly based.

Mobile devices presented an opportunity, but broadband rollout and the price of data remained significant challenges. Mobile broadband subscriptions per 100 inhabitants in South Africa ranked well, at 58.6 and 53% of local households had internet, which was among globally. Mobile cellular subscriptions per 100 people was 159.3, which was exceeded only by Russia, with 160 subscriptions. South Africa had areas of excellence that could be exploited. Fixed broadband subscriptions per 100 inhabitants was extremely low, at 2.8.

Regional systems of innovation

The 2015/16 provincial distribution of R&D expenditures was reflected. Gauteng accounted for 45.4% of R&D expenditure as a percentage of total South African R&D expenditure, followed by Western Cape with 22% and KwaZulu-Natal (KZN) with 10.3%. Gauteng accounted for 25% of the population, KZN 20% and Western Cape 13%. Rural areas were not receiving much R&D expenditure. The development of rural R&D and innovation should be debated to determine the appropriate expenditure. Views were expressed that the world was urbanising and expenditure in rural areas would be wasteful.

In summary

The incoming National Council of Innovation would be able to use the statistics to make appropriate recommendations to the government on improvements to the system of innovation and on overcoming the stumbling blocks. Areas of excellence should be strengthened.

South Africa was making inadequate long-term progress in STI education, with only 33 000 of 1.2 million pupils having started public school 12 years before achieving 60% or more for matric mathematics. To develop STI fully, the logical process involved in mathematics was imperative.

South Africa excelled in ICT and was well placed for 4IR.

2.4 General discussions

Dr Cele stated that he expected that through the conversations to follow, the concept of local innovation would be defined, as it was currently used interchangeably regionally and provincially. Nationally, a national innovation system was used. The notion of transformative innovation systems was being introduced as a critique of the national innovation system's inability to deal with social and environmental issues.

South Africa's understanding of the innovation policy and the national innovation system, introduced in 1996, had been identified as a weakness at global level. The country had not benefitted theoretically or practically from innovation in dealing with widening social inequality and damage to the environment. The concept of a transformative innovation policy, which intended to enable it to deal with social and sustainability aspects, had been introduced. The transformative innovation policy held that the way key stakeholders in the innovation

policy were viewed needed to be reviewed. The policy needed to consider the traditional and non-traditional sectors of the economy, including grassroots innovation, civil society and non-governmental sectors.

It needed to be acknowledged that systems were important in the way in which innovation was understood. As a result, the concept of inclusive development had emerged.

A few years before, the Organisation for Economic Cooperation and Development (OECD) recognised that the innovation policy approach and the influence of global thinking had not considered developing countries. In a joint workshop, where the Human Sciences and Research Council (HSRC) expressed interest in learning from developing countries, it was noted that the global term inclusive innovation for development was different to inclusion of people in the innovation for development. As a result, work had been undertaken on social innovation and frugal innovation.

The inclusion issue was a matter that South Africans had to resolve. Discussions had been held with the HSRC about the work required to ensure that theoretically and from a methodology perspective, innovation for inclusive development was monitored. Global conversations were required on the development of indicators that would respond to innovation for inclusive development, in the South African sense. Work was currently in progress to understand this dimension of monitoring.

The OECD and other global institutions, such as the World Bank, had indicated that it was a difficult aspect that was not usually included in the traditional OSLO manual. The OECD was exploring expanding the understanding of innovation to include the South African context. Dr Cele expressed frustration at time being taken to resolve the issue.

2.5 Comments and questions from attendees

A common framework for innovation technology development was absent. The elements of the innovation scorecard considered included the enablers and activities that lead to outputs. The outputs included a chapter on social aspects in terms of innovation. Major discussion had taken place around the social focus derived from Maslow's law, which considered needs and opportunities, forming part of inclusive innovation. The STI policy had pre-selected key elements such as 4IR, local systems of innovation and public sector innovation.

Public sector innovation is another dimension of inclusive innovation, as through this sector, goods could be produced that not all parts of society could access. Much work was being undertaken in innovation for inclusive development. NACI would aggregate the outcomes to form a consensus.

2.5.1 Fourth industrial revolution

South Africa was determining the focus areas of 4IR. The eight work streams established by the government to determine future skills required included R&D and innovation. A parliamentary portfolio committee was leading a project to determine the basic outline of the policies required. Another process was being led by the DTPS, the dti and the DST task team.

Attendees were asked to recommend South Africa's priorities in reviewing trade and industry policies, ICT policies and areas that are impacted by digital issues.

Many people contested that 4IR would increase unemployment as automation of many processes would reduce the number of jobs available. Others stated that it was an opportunity to explore issues, such as those of culture. The benefits of automation were not clear to the local people and communities needed to understand the general basis of what they were doing to ensure that all parties were working towards a common goal. At a conference, students were asked why they drove nice cars, but threw their food and drink packaging on the ground instead of throwing it into dustbins. Students responded that they had been taught that if they picked up litter, they were un-employing someone. Today, picking up litter should be done through technology, not manually.

2.5.2 Addressing basic education, ICT, gender and morality issues raised by attendees

It was recommended that the report be replicated for a number of prior years, if the statistics and data were available, to determine the trends. The section in Dr Jammine's presentation where the inputs, actions and outputs were reflected and compared to the previous year, should be expanded retrospectively over a number of years. The impact on the outputs over the past year highlighted interesting dynamics. Many of the outputs would be impacted by lagging indicators. Comparison over a longer period would highlight the different phases of development and would be interesting.

2.5.3 Lack of female postgraduate students and degree choices

The social and economic status of many black females was highlighted. Female students entered their studies as undergraduates to achieve a qualification. Once qualified, it was important for a female graduate to find employment to emancipate her entire family from poverty. Females were more likely to give back to their families through employment. Males were generally risk takers and would follow their own dreams and continue studying towards their PhDs.

The South African PhD study of 2010 and other studies would be presented later in the week, focused on the experiences of female

postgraduate students. Several reasons were given for the lack of female postgraduate students, including inadequate funding to sustain the students, especially those responsible for supporting other family members. Often, the graduate was the first person in the family or generation to earn a higher degree. The pressure of having to support family members often discouraged female students from further studies.

Students who did not receive good-quality mathematics, science and engineering teaching during their undergraduate studies needed to spend more time on these subjects. The time needed for a technical degree influenced some to choose accounting or legal studies. The time needed to grasp difficult concepts for technical degrees highlighted the importance of proper training in basic concepts at an early age, when most children can learn very difficult concepts. The main role-players need to ensure that high-quality programmes are available early. Much time is spent developing skills, but using technology from China and other countries rather than developing local technology.

The ability to earn high salaries was driving study. Accounting and law graduates received instant gratification on completion of their degrees, earning high salaries. In the past, a person would establish a company, own shares, run the company and take care of employees. Today, many companies are owned by organisations in New York, London or Zurich and are profit-driven. This increased the demand for accountants and lawyers.

A study was recommended to determine the impact of providing the correct support at early ages. The current focus was on PhDs and masters degrees, but the small number of postgraduate students could not be viewed in isolation.

Research revealed that Grade 5 girls outperformed boys at mathematics. At Grade 9, there was no statistically significant difference. At matric level, out of the 32 000 students who passed with over 60% in mathematics, 18 000 were boys and 14 000 were girls. This indicated that girls lost the advantage as they progressed. More females were choosing life sciences rather than the stereotypical hard science of engineering, ICT and mathematics statistics. This gender dynamic was concerning due to the power differential associated with engineering qualifications versus other qualifications. Females could be incentivised to undertake engineering qualifications.

2.5.4 Impact of regulation

Regulation enablers should be reviewed as the regulatory environment was inhibiting innovation and development. Compared to other countries, the environment was over-regulated.

Learning entrepreneurship at university

There was still merit in obtaining qualifications. One may not be able to secure a job with a tertiary qualification, but prospects were better. With South Africa having many unemployed graduates, the importance of teaching graduates to establish companies or be self-employed was highlighted.

In universities in other countries, students were not trained to find jobs, but to become providers of employment. It was recommended that South African universities follow suit, offering even a six-month entrepreneurship diploma course after graduation.

3. PANEL DISCUSSION: KWAZULU-NATAL LOCAL INNOVATION SYSTEM

Four panellists were introduced by Dr Vijay Reddy - Prof. Sibusiso Moyo, Deputy Vice-Chancellor at the Durban University of Technology (DUT); Dr Deresh Ramjugernath, Deputy Vice-Chancellor at the University of KwaZulu-Natal; Dr Justin Visagie, Research Specialist at HSRC; Dr Sibusiso Manana, Head of Agriculture Strategic Technology at the Technology Innovation Agency (TIA) and Mrs Martie Milne, Provincial Planning, Research and Policy from the Office of the Premier attended.

The session would facilitate a better understanding of local innovation systems.

3.1 Prof. Sibusiso Moyo

Prof Moyo reported that one of the responsibilities was innovation and supporting innovation in terms of the university's strategy. A DUT workshop brought together different provincial role-players, including all universities, eThekweni, which hosts Innovate Durban, and the mayor's office. The provincial growth development strategy focused on various aspects of innovation, including skills training.

KwaZulu-Natal's private higher education systems played a significant role in innovation. During the workshop, private providers expressed their willingness to collaborate with the university on innovation and entrepreneurship. In the current university system, the activities of the government were analysed but the role of private providers was not.

Prof Moyo stated that the local regional system she referred to encompassed the entire pipeline of students. The university's business was to train the knowledge generation and determine how that knowledge could be leveraged to develop and increase youth employment. Universities could not achieve this independently and collaboration with all role-players was required, including industry and business. DUT had recently established an entrepreneurial desk in the Midlands and one in Durban. It had more than 30 000 students, not all of whom would be employed after their degrees.

DUT had pockets of excellence. Each year at the Durban July Handicap, DUT students won the design section. DUT did not focus just on engineering, science and mathematics - substantial innovation went into arts and design. DUT students were not trained to look for work, but to establish their own businesses. The models applied in the pockets of excellence of DUT, which taught students to be job creators and innovators instead of job seekers, could be applied to other areas of study.

Local innovation systems had to start at university, with synergies between government departments and other role-players connected to the curriculum. The curriculum's innovation should also be reviewed.

Engagements with role-players should ensure that students were exposed to industry, business and corporate experience before completing their degrees. Universities of technology programmes were designed to ensure this.

DUT's contribution to research and innovation focused on areas such as water, where a significant technology gap had been identified in waste management. In KwaZulu-Natal, waste management could be achieved in collaboration with the higher education sectors and partners. Systems would be developed for management of electronic waste and other types of waste. Most of Prof Moyo's generation used Asian technology. Companies such as Samsung had a presence on DUT's campus, where students were designing applications for them. Graduates should be not just users of technology but producers of technology.

3.2 Dr Deresh Ramjugernath

Dr Ramjugernath, also Chairperson of the Board of Innovation, Durban, reported that higher education institutions were mandated to produce graduates, undertake research and become involved in community development and that this focus was not appropriate, given South Africa's socio-economic challenges. Higher education institutions needed to produce graduates fit for purpose, particularly in the 4IR age. Unfortunately, universities and higher education institutions were still producing graduates for professions that are outdated or will be in a few years.

Higher education institutions could no longer continue to produce graduates in the way they had done over 100 to 150 years. Graduates must be prepared the jobs of the future.

There was no integration among the Department of Higher Education and Training (DHET), DST and the dti. DHET focused on quantities such as the number of graduates, PhDs and patents produced. Quality of the research produced was not measured. The number of PhDs produced had increased from between 1 200 and 1 400 a year 10 years before, to more than 2 000. Unfortunately, South Africa was not more innovated due to the quality of PhDs produced. DHET had not driven the quality of training and relevance of research, which were imperative. Higher education research should focus on socio-economic impact, which would drive a different type of behaviour and innovation system in the country. It should be aligned with the major challenges of the country, namely poverty, inequality, high unemployment and service delivery. It should address the objectives of the NDP. The higher education strategy should include the innovation and R&D ecosystems.

The University of KwaZulu-Natal was collaborating with other higher education institutions in the province and key government stakeholders, and building relationships among business, industry and academia.

Dr Ramjugernath believed that universities should review the 'quadruple helix', because society – a major role-players was omitted. Society played an important role in innovation and transdisciplinary research, which improve the probability of commercialising the innovation. The three tiers of government should be included to facilitate development of national policy and strategy. If provincial and local government innovation was not included, the national innovation system would not be successful. Significant actions and developments happened in local government and in wards, and national strategies should permeate all the way down to ensure proper implementation.

The university had reviewed several initiatives to see how it could collaborate with the four sectors in to develop a culture of innovation and entrepreneurship. People need to believe in being innovative in solving problems and developing technology.

Students at Massachusetts Institute of Technology, for example, had a culture of taking ownership of their lives, developing enterprises and not relying on the state to provide jobs. A mindset change was required in South Africa. A new culture was being developed at higher education institutions, but it should also be instilled in basic education. Students need to believe that they could be competitive, innovative and entrepreneurial, which was a career opportunity. Students need to realise that they do not need to find employment in industry, the private sector or the government.

Infrastructure should be created to support innovation, R&D and an entrepreneurial culture.

KwaZulu-Natal was making good progress innovation and had a provincial innovation plan, which included a review of the infrastructure in place to promote innovation and R&D. Innovation hubs and innovation parks the province could not compete with other hubs and parks across the country, thus had to find and develop their own value proposition and unique R&D innovation system.

Municipalities needed similar infrastructure and coordinating bodies to ensure that innovation systems and efforts were integrated to avoid silo mentality. Innovate Durban created the umbrella under which all innovation was to be performed and where all efforts and activities coordinated. This would build a critical mass of initiatives and activities that would drive and grow the culture of innovation, particularly among the youth, among whom it would be most effective.

The most effective impact of innovation systems would be in youth unemployment. The national unemployment rate was around 26%. Youth unemployment varied per area between 40% and 50% and up to 75% in rural areas. The innovation system needed to address this.

Municipalities were encouraged to create innovation precincts and a virtual network of infrastructure for innovation. Municipal actions should be integrated with the actions of universities, industry, the private sector, and provincial and national structures.

Throughout KwaZulu-Natal, innovation, entrepreneurship and research with socio-economic impact were driven through institutions' new strategic plan, which included building the culture and mindset of innovation and entrepreneurship and establishing scientific, innovation-aligned infrastructure. Each campus would have an innovation box to attract stakeholders. Building relationships with the government, private sector, industry and importantly, society would produce research addressing child discipline. Thus, research would not be done and then a use for it sought. Stakeholders would be engaged to understand the challenges and work would be undertaken to find solutions. When the outputs were complete, stakeholders would be able to apply the solutions immediately.

It was imperative to understand the normal ecosystems. National strategies will not be effective unless they can be translated into provincial and municipal strategies. Good infrastructure, networks and vehicles were required in regions, particularly in municipalities and wards.

3.3 Dr Justin Visagie

In the soccer world cup final, the Croatian team had twice the possession, three times as many corners and took double the number of shots at goal than the French team but scored half as many goals. The STI report was equated to this - despite all the indicators, inequality was out of control and poverty remained persistent.

Innovation should be considered in terms of where the benefits accrued and whether it was inclusive innovation. As great as it was to have high technology parks, schools needed to focus on innovation.

Significant property development was noted in Cornubia, but innovation that could benefit Warwick Junction and help it function more effectively was not considered. Honest consideration should be given to those who benefitted from innovation.

The South African Labour Development Research Unit released an interesting tool that would reveal where a household's income would put it in the distribution for South Africa. A household that earned R20 000 after tax was in the top 15% in earnings distribution and R40 000 5%. This highlighted the reality of inequality and poverty. Inclusive innovation needed to address the reality of the community.

The challenges of the indicators was emphasised through the innovation system's performance. The latest matric pass rate was around 79%, but education economists reported that pupils being held back in Grade 10 were ignored and 20% of schools performed well while 80% of schools did not. In-depth analysis was required to determine ways to promote inclusive innovation.

It was important to obtain support from business. A retail innovation forum held in Nelson Mandela Bay was highly successful, as 50% of the membership was business. The forum

preferred to hold breakfast or evening functions and avoided events such as this roadshow, which was held during productive times at which business focused on making money.

The innovation scorecard from 2010 to 2015, enablers and outputs were moving in the right direction. However, firm activities were moving in the opposite direction. It was imperative to gain support from business to ensure that a sustainable innovation system was built, as government resources were being depleted.

Of the total amount of gross innovation expenditure, 45% was spent in Gauteng and 10% in KwaZulu-Natal, the second largest economy. Government spending was driving the expenditure pattern. KwaZulu-Natal needed to understand the patterns of innovation expenditure and ensure that local innovation systems were aligned to, instead of working against, the economy. The South African economy was moving away from manufacturing towards service-type jobs. Inappropriate services jobs had grown in KwaZulu-Natal compared to Gauteng. In the former, retail, government and security guard positions were the top jobs. In Gauteng, the finance sector, engineering, architectural and building environment skills were growing strongly. KwaZulu-Natal needed to create jobs in the local economy, which needed an understanding of the local economy and how innovation could support job creation.

Durban was a strategic port and a highly strategic city. KwaZulu-Natal and Durban should strengthen linkages into the rest of the country. Their innovation strategy should consider these factors. Understanding the reasons and strategic levers for the dynamics was imperative.

3.4 Dr Sibusiso Manana

Dr Manana stated that funding no longer appeared to be an issue. Coordinating the activities of innovation and technology development needed to be addressed to ensure that synergistic efforts to drive clear outputs. Resources should be streamlined to combine the trends of stakeholders and include business and the private sector as partners. Some of the main buyers of innovation and technology were hospitals, but they were not represented at innovation forums. Innovation should create value.

The focus should be on encouraging private enterprises to drive progress. Private business did not attend these events because they were making money. Dr Manana emphasised that stakeholders support the government in driving innovation and technology development to achieve NDP goals. The pay points of innovation and technological development should be determined and poverty, inequality and unemployment addressed.

3.5 Comments

Dr Reddy thanked NACI for the insightful and complementary viewpoints that provided an overall picture of the current situation and the work required. He believed that the STI report would enhance development, but that development would

not benefit all. STI indicators would address issues and motivate stakeholders to question the reasons for initiatives. Universities and provincial sectors should ensure that society benefits from innovation and technological development.

4. DISCUSSION, COMMENTS AND QUESTIONS

The attendees were asked to contribute from their perspectives and experiences and share ways to improve local innovation systems.

A representative from the Office of the Premier felt that the provincial development plan, which interpreted the NDP, emphasised strategic objectives and STI indicators used in the interpretation, and that academic institutions had a long way to go to create specialised academic institutions that added value. KwaZulu-Natal had climate and natural disaster problems. Higher learning institutions needed to research fire-resistant house-building materials. The province was fortunate to have large companies such as Toyota and should ensure that agreements were in place with these companies to educate students.

It was confirmed that the institutions of higher education, such as the University of KwaZulu-Natal KZN, had agreements with Toyota to train trainee technicians from engineering faculties to apply automotive engineering systems. This made the universities aware of the standards, that could be linked to innovation systems. The curriculum had changed, but the key model that drove student employment and skills training included community engagement. However, this could be improved.

The global definition of innovation was a new idea or invention coupled to commercial application or a need for which people would pay. Innovation without need would not be classified as innovation. The South African definition of innovation should mirror the global definition, except that local challenges needed to be understood and national and continental challenges addressed. It was queried whether NACI needed to develop a local definition for innovation.

In South Africa, the focus was on government outcomes, where the desired results affected government jobs and there was lower inequality and poverty.

The high number of PhDs, 2 000, did not affect innovation. Should research for PhD qualifications concentrate on social sciences, relative to other sciences that were encouraged by the current definition of innovation. No-one undertaking social sciences would be expected to produce innovation or programmes to address social problems, but research may produce innovation as it addressed and provided answers for social problems. The forum's view of innovation was something that was 'hardwired' and could be seen.

Innovation purely for profit or self-enrichment should be included, as a mix of innovation would take place in the country. With high unemployment, most people became entrepreneurs

to make a living and were not concerned about addressing unemployment or other challenges. Conflict in innovation arose when companies innovated to increase profits, such as mining companies, where labour was replaced with mechanisation. This forum viewed innovation differently from the way innovators did.

Nationalisation remained the core focus of innovation, although it was not necessarily focused on driving profits. The profit resulting from innovation was a component that determined the economic impact of the initiative. Evaluation of innovation went beyond monetary benefits to the more important social returns, which highlighted the importance of controlling expenditure, especially in departments such as the South African Police Service, the health sector and rail agents for the transport sector, where investment improved responsiveness and made business easier. Expenditure and innovation should improve service delivery, a major cause of unrest.

Significant funding was available in the government and corporate sectors. The Belinda Gates Foundation offered funding, pooling of funding was available from the African Resource for Innovation and other initiatives drove innovation. The business sector experienced challenges in finding projects to invest in that would be beneficial to business, which highlighted the importance of ideas and innovation for the correct reasons. Investment needed to drive value creation. Activities driven did not materialise as there was no demand from business. Investments were made in initiatives that needed to be shelved as the market was not interested. Attendees could review 'need point' to view technology created but not implemented.

University staff should work with society when funding was requested through TIA and the Industrial Development Corporation. Factories would be built to benefit society and uplift the economy. This type of innovation was not usually reported on.

Misuse of 'inclusiveness' in innovation was raised. This was globally considered inclusion for innovation development, whereas in South Africa it meant people were included in the innovation for development. It was questioned whether universities had incentives or programmes to drive masters degrees or PhD students to focus on projects that were inclusive and would ensure appropriate innovation.

Were there programmes or activities to assist communities that were working with exporting industries to produce products for export. This would encourage a wider international society. Imported products could be manufactured locally. A project that involved communities had been developed by Dr Paul Makwena, but was not successful.

Partnerships, synergies and integration were key to successful innovation and transformation initiatives. The challenges of business must be well understood to ensure appropriate innovation and R&D to develop solutions for the private sector and business. Cooperation among the four sectors was important to ensure the innovation system functions well and produces goods required.

Industry had started recognising the value of partnering with the government and was presenting initiatives to universities, which regarded innovation as a vehicle to track transformation for inclusive development. Industry was offering technology as part of the partnership. Smallholder farmers and small and medium enterprises should be assisted to provide quality services, to enable transformation in the industry.

How the government drove behaviour among higher education institutions needed review. DHET should consider subsidy incentives. Some ministers had acknowledged there was no proper integration between DHET and the Department of Science and Innovation to drive R&D all the way along the value proposition pathway to commercialisation.

Universities needed to change research behaviour for research outputs to address social challenges. They could offer incentives and initiatives. KwaZulu-Natal was currently driving research relevant to industry, the private sector, the government and society. Researchers should be rewarded for driving research that would produce solution-finding graduates.

The University of KwaZulu-Natal offered incentives whether DHET did or not, as the university's mandate was to deliver relevant research.

The province's universities were represented on all action working groups established, one of which generated information on skills gaps.

DUT liaised with the community and other stakeholders. One project, for example, involved work with traditional healers with considerable knowledge of indigenous systems and medicines. It was noted that when projects were championed by specific people, they may be abandoned when the people left. Sustainability of the national system for STI was important and initiatives should not rely on individuals. Individual champions was a challenge at DUT, where younger people should be included as project champions projects.

Major companies were no longer creators of employment. Innovation should create small industries that would duplicate the activities of large organisations to disrupt the market and offer new opportunities. The focus had shifted from investing energy in small, packaged programmes or projects to investment in a value chain approach, which had greater economic and employment impact.

Innovation examples

Attendees were asked to provide examples of innovation in which they had been involved or that emanated from IPD, DHET, HRSC or TIA, including the timeframe.

The history of innovation indicated that development was done by youth, thus more young people should be involved in forums of this nature.

Organisations were asked to present case studies or success stories at future forums.

The role of technical and vocational education and training (TVET) colleges in the innovation ecosystem was often overlooked as this sector was not highly regarded in the higher education system for adding value to innovation. This impacted investment in TVET colleges. In other countries, these organisations played a significant role. New inventions were often referred to graduates from the TVET system for manufacturing, for example a doctor who invented a new stethoscope would approach a person qualified through the TVET system to manufacture the design.

Corporates tend to focus more on shareholder returns than on reinvestment in the economy. Corporate investment that created jobs was in innovation and R&D that increased shareholders returns.

The sugar industry had difficulty sourcing the correct skills and was interested in strategic partnerships with organisations. Two research tiers had been created, one in Stellenbosch and the other in KwaZulu-Natal.

While addressing poverty, inequality and unemployment, retention of jobs was to be a focus. In KwaZulu-Natal, with 10.3 million, the two main industries were sugar, which employed 1 million people, and forestry, which was slightly larger. Many of these people were employed in rural areas. Retaining employees was challenging. The industry was considered to be interested in profits. However, before the event, during the previous week, industry leaders had met to review the five-year transformation plan, which included economic empowerment. Creating wealth in urban and rural areas was considered as was industry viability. It was recommended that engagement be strengthened between the industry and higher education institutions. Once key issues and drivers were understood, the industry could consider investment in innovation. The political environment was not currently conducive to sustainable investment. Several multinationals were not investing as the government was not addressing issues, thus opportunities were not viable.

DUT research indicated that numerous PhD graduates were foreigners, who returned to their home countries after graduation. South Africa had few PhD graduates, who were often in jobs.

DUT was working on innovation with social sciences. Publications were encouraged and produced, but these would not be known to those outside the sector. DUT postgraduate students had to have published with a supervisor a study on innovation.

Success stories

A product had been developed from conception to produce valuable protein foods for the poultry and fish industry, from quality-grade food waste. The first factory was established in an economically depressed area in Cape Town and employed 143 people. The technology was used internationally due to its

success and the innovation rolled out to India and the USA.

Another project produced products with food technology group Medemass. Commercialisation was underway.

Engineering electric sideway distributors for speakers had been developed and commercialised, an example of which was displayed at the forum.

It was noted that a patent couldn't be registered until it was established that a product could be produced. Two patents were launched this year.

Sometimes, brilliant research yielded nothing, while at other times, something completely arbitrary was produced and was taken into production and made a massive impact.

The Durban HSRC office was evaluating the Expanded Public Works Programme for the Department of Environmental Affairs, which had a real impact on policymakers in the design of goods.

The local perspective presented in the report was expected to inform analysis of the system of innovation, so that people would have a greater understanding of the system.

5. SUMMARY AND CLOSING REMARKS BY NACI

Mr Petrus Letaba from NACI thanked Dr Jamine for the excellent presentation on the SA STI Indicators report. Dr Jamine was completing his last year in the position as NACI council member after many years of service. The panel discussions and comments from the attendees, representatives of all stakeholders except the private sector, were valuable and insightful. The discussions covered the innovation ecosystem, partnerships and collaboration, changes needed to the higher education curriculum and teaching people new industry-aligned skill sets.

NACI learnt each year and the previous year's inputs had improved the report, by inclusion of a section on local innovation, where before it reflected only R&D expenditures. People wanted more information about the triple earnings activities, as greater knowledge would provide more information.

The NACI forum was not a 'show', but a forum that built networks needed in the innovation ecosystem.

The symposium closed at 12:25.



