Linking the South African System of Innovation with the Rest of Africa: Exploring the Challenges and Opportunities

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Department of Science and Technology (DST) Science seminar and Government Cluster Policy Workshop

Exploring the opportunities of an Africa-based System of Innovation

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The Department of Science and Technology (DST) held a Science Seminar in collaboration with the HSRC and Tshwane University of Technology on 1 November 2012 at the CSIR Convention Centre entitled "*Linking the South African System of Innovation with the Rest of Africa: Exploring the Challenges and Opportunities*".

BACKGROUND AND RATIONALE

This Department of Science and Technology Government Cluster Policy Workshop addressed the critical issue of interlinking the South African system of innovation with the fragmented economies in the rest of Africa. It is recognized that there is still a big challenge to bring about the structural transformation of the African economy in a general sense in efforts to build integrated, unified, networked systems of innovation in Africa through the application of science, technology, innovation and engineering.

Pertinent questions addressed were:

- What direct and indirect fiscal incentives will be required to drive an integrated innovation system within Africa?
- How could the integration of a wider technology transfer process be best introduced within an African context?
- What mechanisms are required for the assimilation of shared technology, governance systems and institutional collaboration on the African continent?
- What systems do exist for efficient innovation linkages between different African countries?

If the way the innovation system is evolving in Africa is roughly classify, there is no doubt that there is a differentiated picture where the interaction of the system of innovation characteristics is at different levels, quality and degree of existence. Such inequality calls for grounded appreciative research to establish the reality on the ground in order to facilitate the mapping and surveillance of the overall direction and dynamics of the evolution of the African National System of Innovation.

At the moment, some critical opportunities are emerging in Africa. Most pertinent is the opportunity that opened up with South Africa assuming leadership of the Africa Union (AU). It matters how this opportunity is translated to the advantage of the wider platform of nation states. The primary need is to concentrate on infrastructural networking, knowledge, economics and politics, standardisation and harmonisation in a sustainable manner. This will enable South Africa to provide policy advice to the AU and create the possibility of enhancing the AU activities across Africa.

New opportunities provide South Africa with the chance to initiate a strong effort to create a comprehensive African-wide system of infrastructure. Building infrastructure is not only about the technical capacity to network infrastructure systems; it is also about including the ability to create a fair political/economical system for networking. To date the African effort to interconnect with predictable and well-managed infrastructures has remained poor. This

needs to change. Africa needs a networked road system; it needs a networked railway system; it needs a networked telecommunication system; it needs to develop a networked infrastructure that interlinks Africa by land, air, and sea making it easier for an African integrated economic system to evolve. And it needs a unified African innovation system. The best way to start is to explore how South Africa can inspire the required unified system of African innovation.

This second DST Government Cluster Workshop of the 2012-2013 series explored how a link between the relatively developed National System of Innovation of South Africa can be interlinked with the other weaker and fragmented systems of innovation in the wider African neighbourhood. The exploration was aimed at generating new insights to learn and appreciate best practices towards an integrated African system of innovation.

Introduction and Welcome

The workshop was opened by Dr Hester Du Plessis on behalf of Dr Temba Masilela, Deputy CEO at the HSRC. Dr. Du Plessis indicated that the key outputs of this specific seminar will be to disseminate the research results of which our speakers will report on and to enhance linkages between the social sciences, humanities and the DST's human and social dynamics development grand challenge. The HSRC also intends to improve the networking amongst researchers, both locally and internationally and identify research gaps that could indicate new research agendas, not just for the seminar series, but for research projects within the universities.

Session 1: What can Asia offer African Science, Technology and Innovation for Development? *Dr Louis Turner, Asia-Pacific Technology Network*

Dr. Turner's keynote address described how Asian countries, led by Japan, China, Korea, India and Singapore, have been rapidly closing the gap with (and sometimes overtaking) cutting edge "western" science, technology and innovation (STI). His intention was to consider the ways in which Africa can learn from the Asian experience, and look at ways in which the two continents could actively cooperate.

There are also areas of strong mutual interest, such as tropical and infectious diseases, the need for affordable drugs, agricultural research, minerals development and the development of mobile communications. In areas of bigs, science such as nuclear power and space exploration, Asia is a potential source of funding and technical help.

The four key points of orientation Dr. Turner noted were:

1. *Awareness of the speed and scale of development in Asia*. An example is the Zhonguancun Science Park (ZCG) in China where large multinational companies like Microsofts research and development laboratories, Sony, Google and a number of leading Chinese universities (Shingwa and Peking) are represented.
2. *A focus on the South Korean example*: South Korea was the Asian country taking S&T most seriously with the highest number of PhD graduates in the world. A comparison of Ghana and South Korea showed that the latter took off exponentially to Ghana, although they were roughly equal at the time of Ghana's independence. South Korea's per capita income is $22 424 per person, is double that of South Africa. South Korea generates highly successful companies such as Hyundai and Samsung, the latter running neck-and-neck with Apple as the world's leading company.
3. *Whats happening in South Korea is also happening in other parts of Asia*. The South Korean example is not unique - Taiwan, Hong Kong, Singapore are similar, with Indonesia, Thailand and Malaysia also showing signs of significant growth.

4. *Current science and technology (S&T) indicators* show that China has 20% of the world's researchers with a commitment to R&D spending growing annually and averaging 23% per annum (China 1.5% of GDP, Japan 3.7%, Korea targeting 5% in the next decade on R&D). With regard to patents, South Korea is producing 412.9 patents per 1000 researchers, whereas Japan produces 204 and the USA is only producing 63. China produces 22.4 patents per 1000 researchers, but growing rapidly. Asian economies are at the forefront of digital infrastructure (networked readiness) – with Singapore ranking number 2, South Korea number 10, Taiwan number 6, Hong Kong number 12, compared to South Africa at number 72, and China a surprisingly at number 51.

The first conclusion is that we are dealing with a catch-up process which has very little to do with fundamental research and big science and more to do with producing a culture which allows creative imitation, produces a society which can assimilate technology from wherever it comes and produces a business environment which can take technology and convert it to commercial products. For the catch-up process/innovation, it required the ability to take technology from elsewhere and convert it to what was needed[1].

A key question is "What kind of innovation is at the heart of the innovation system in Asia"? There is not a single Asian innovation system. Most of these countries have been export oriented, on the whole, with respective governments playing an important steering role. Individual countries have had different approaches to multi-national companies (MNCs) – some hostile, some friendly.

Dr. Turner explained that although there is no single Asian system of innovation, common themes exist viz:
- Export oriented – develop competitive industries on global markets.
- Government has played some form of active role.
- Countries have treated MNCs differently (Japan and South Korea do not like foreign companies coming in) but Singapore and Hong Kong positively welcome MNCs – Singapore has a policy of working with pharmaceuticals to become a biotech powerhouse.

China is somewhere in the middle – they welcome MNCs but encourage 'indigenous innovation'. The Chinese want to attract the aerospace industry, but place emphasis on technological transfer.

A critical question for Africa is "What could Asia contribute"?
1. Money - Could collaborate on anything in relation to minerals and agri-business.
2. Share experience with common problems e.g. infectious diseases and water/sanitation problems.
3. Source of benchmarking - if you dont know what they're doing, you won't know how far behind you are in terms of countries like China, Singapore or companies like Samsung, as well as the digital economy – South Korea:
   - Government policy – South Korea, Singapore, China
   - Science park and hubs/clusters - Singapore and Taiwan
   - Science parks – Chinese
   - Corporate fast following – Samsung
   - Digital economy- South Korea

Session 2: Strengthening South Africa's integration with the rest of Africa through the neighbourhood system of innovation conceptual framework, *Dr Angathevar Baskaran, Senior Lecturer at the Middlesex University Business School*

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[1] Samsung electronics in South Korea is the ultimate fast follower. Although it did not produce an Apple as an initial concept, it took someone else's new product, stripped the idea down, re-engineered it and improved it, which is not just simple copying.

Dr. Baskaran commented on two points from Dr. Turner's presentation viz:

1. The pre-conditions which existed before the Asian countries embarked on bringing in big science, technology and research and other strategies into play. There was massive investment in education, infrastructure, investment in bringing together the administration, all the kind of stuff which he rightfully said he can also see in some way in India.

2. There is no single Asian model. It is not a model but rather benchmarking, cross-country models. It is better to use cross-country kind of mapping and do benchmarking to go about it.

On the conceptual side, factors which are necessary to manage integration requires a systemic way of building social capital for integration and social innovation. Combining product distribution which is consistent with behavioural change and creation of human capital. Building of system networks, such as knowledge networks, digital networks, physical and cross-sector networks which are done sometimes in collaboration with neighbouring countries. On the practical side of this the emphasis is on linkages such as cross-border interactions amongst actors such as firms, research institutions, and government and NGOs. Cross-border linkages between supporting institutions e.g. universities, financial institutions; harmonization of implementation of objectives, policies and practices.

Dr. Baskaran believed that integration should take place where there is a natural relationship and natural links between South Africa and its neighbours. At present there are many doubts and mistrust as to how the innovation perspective can play a role in integration. South Africa is in a position to lead the regional integration although there are a lot of weaknesses and problems within South Africa and the rest of the Southern African region. It is also challening to lead when there is so much contradiction and problems within your own economy. The focus should be on how the innovation perspective will be useful at regional integration by creating natural links between economies. Thereafter the focus can be on the role of South Africa in regional integration by exploring the neighbourhood system of integration.

A reciprocal interaction between the regional economies is proposed which between South Africa, India and China and with the smaller economies in the neighbourhood. This interaction should be based more on the innovation perspective rather than static interaction which will lead to the relationship being much less transformative and less dynamic. If the economic linkages promotes knowledge, learning, innovation and confidence building which can effect value on manufacturers, research and productivity changes, the relationship will be much more natural and not threatening and not creating mistrust.

Traditionally, the literature on regional integration mostly talks about the free flow of goods and services, free flow of people, standardisation across various aspects of the economy. In reality this does nit happen due to restrictions and barriers being placed, creating a lot of mistrust. On the conceptual side, the factors which are necessary to manage integration are systemic ways of building social capital for integration, social innovation, combining productive distribution which is consistent with behavioural change. To better manage the integration of physical financial capitals issues related to the creation of human capital, system network building, knowledge networks, digital networks, physical and cross-sector networks which are sometimes done in collaboration with neighbouring countries need to be considered.

Dr. Baskaran concluded that a system of innovation perspective might be useful to find new frameworks for understanding and strengthening regional integration. When we think about integration, we mean specifically integration that facilitates or hinders the productive connections between economies, learning systems and productive activities. The system of innovation perspective is likely to shed light on the type of connections and interactions that take place. If the interactions take place on the basis of static comparative advantage where the

economies in the region transact what they already produce, then the relationship is likely to be non-dynamic and non-transformative. If the interaction takes place with economic linkages where the interaction promotes learning, innovative productive exchange, and facilitate value added manufactures and service exchanges, then the relationship is likely to be transformative and is more likely to include developmental features. On the practical side the emphasis should be on cross-border linkages between firms, corporations, universities, government and non-governmental sectors in the innovation system.

As lead discussant, Dr Rasigan Maharajh, Chief Director of the Institute for Economic Research on Innovation (IERI) made the following points:

1. Note the dualism in the South African economy – some challenges that we see as particularly South African challenges are not unique to South Africa as an emerging economy, but shared across the continent and developing world. We need to understand what underpins this. In terms of the notion of a brain drain, we should rather think about brain circulation within Africa and globally.

2. We should question whether the policy frameworks we set are agile enough and we should build into our policies opportunities to correct them over time. These policy frameworks should be robust in terms of principles informing them, but agile. The example of Zimbabwe shows that South Africa gained human capital from the crisis happening in Zimbabwe – how do we bring this into our economy without negatively impacting on Zimbabwe?

3. Alternatives – Business as Usual (BAU) won't work. Roadmaps of Dr. Baskaran show duplicity etc. but we aren't achieving any of the targets. Is it because it's trade-based and not an understanding around knowledge, learning, building innovation capabilities and competence building?

Session 3: Africa and the MDG on Improved Drinking Water Supply and Sanitation: The case of South Africa, Nigeria and Ghana, *Dr Oghenerobor Benjamin Akpor, Institute for Economic Research on Innovation (IERI)*

The aim of the presentation was to look at the access to water and sanitation in Africa and to review its progress. Dr. Akpor opened by saying every country has made some major commitments either political or financial to the realization of the provision of improved water supply and improved sanitation to its citizens. The global report shows that 70% of the world's population currently had access to improved drinking water supply as at 1990 and between 1990 to 2002 supply has actually increased dramatically. Despite this, when we look at the African context it shows that despite a global gain, African countries seem to be doing well if figures from all countries are combined. Individually with respect to African countries, most African countries seem to be doing poorly. From the current figures the current projection is that 254 million people in Africa will fall short of meeting the MDG target on water within the MDG year.

Challenges and obstacles in meeting the MDG targets include financial constraints, institutional problems, community involvement and inadequate maintenance. Challenges facing South Africa include the shortage of required skills in terms of artisans, technicians and engineers who are to be involved in such sectors. There is a challenge of governance at the local government level about who is responsible to provide water to different households. The challenges facing Nigeria include inadequate funding (largely explained by low tariffs and low utilisation rates) and inadequate sector monitoring. Challenges facing Ghana include the government not concentrating on sanitation from the beginning, available funds are inadequate to meet targets (largely explained by low tariffs and low utilisation rates) and rapid population growth and existing institutional capacity are problem areas too.

In the case of Nigeria citizens must realise that although water is the responsibility of the government, it cannot be free and people need to make some contribution and make some sacrifices to be able to make the system sustainable

because it is not just a matter of putting the systems in place, it is also trying to make sure that these systems that are put in place are sustainable. Of course the problem of corruption is still there and needs to be addressed.

For Ghana the issue of sanitation needs to be seriously addressed by government. They need to develop individual approaches to sanitation so that there will be delivery to households. There should also be clear policies for the management of the sanitation and the sanitation should be visible.

In conclusion, although political will and commitment exists together with major financial commitments, this has not translated into practice. Governments must include a water and sanitation service delivery plan into an economic development plan.

Session 4: The Critical Node of African Nanotechnology Network: Integrating South Africa's Nanotechnology with the Rest of Africa, *Dr Hailemichael Teshome Demissie, SARChI Research Fellow, IERI*

The big brother notion of South Africa is a reality as it is unrivalled on the continent on inventions and especially in the field of nanotechnology. The applications of nanotechnology in achieving the MDGs in terms of clean water access and water treatment is huge. An example that is already being used by the US army is a life strobe with a nanotechnology straw which allows a person to drink water from any source, as it only allows water through. This can have huge potential for clean drinking water access in rural areas.

At present nantechnology innovation is following the market, where it is being used in the development tennis racqets, golf balls, spill proof trousers and ties. In terms of using nanotechnology to achieve the MDGs: solar panels can be made using nanotechnology so that the solar panels could be cheaper and more durable, water can be treated using nano membranes and nanotechnology can improve diagnoses, screening and drug delivery.

The South African Nanotechnology Initiative SANI is not only a national network, as it has initiatives in India and Brazil. SANI is not a government initiative, but initiated by those interested in nanotechnology. Nanotechnology networks with advanced countries have been set up – BRICS, IBSA, European-South Africa Science and Technology Advancement Program (ESASTAP). South Africa gets the highest amount of funding from the EU next to India and Russia. The EU considers this as a way to get through to the whole of Africa since South Africa has the network with both the developed and developing countries. South Africa is therefore responsible for bringing them together.

Session 5: Locating the South African National System of Innovation in Africa, *Prof. Mario Scerri, Institute for Economic Research on Innovation (IERI)*

The starting premise of this presentation was that, in the context of the post-colonial political and economic fragmentation of the continent and within the post-nineties version of the globalised world economy, the economic integration of African economies was one of the main pre-requisites for development on the continent.

Professor Scerri used the metaphor biological metaphor to describe the viability of systems of innovation from reproduction, which is self-sustainability. He noted that not all systems of innovation manage to do this. Some systems of innovation come out with breakthroughs against all odds, like Japan which altered the global environment within which we operate.

He argued that the NSI concept is not ideologically neutral and that the choice of ideology determines policy options and the choice of ideology must be explicitly articulated. The role of the state in the NSI needs to be explored. The question of getting the fiscal and monetary policy fundamentals right needs serious rethinking in a country with high levels of poverty and inequality, where fiscal and monetray policies should be seen as enablers. The role of the state

should be as guarantor of human capabilities investment, not just through education, but through the provision of basic needs for parents and children over a 20-25 year period.

The following conclusions were noted by Prof Scerri:
- Economies of scale and scope are a major obstacle to individual African NSIs
- Absence of integrated multi-state involvement market rationality reinforce existing gpoer configurations on continent
- A sub-contenental nationalist idealogy is a necessary base for emergence of system of subcontinental system of innovation

Session 6: Panel Discussion

Dr.Turner elaborated that building integrated networks and collaboration will take time, and decision-making will be politically influenced. Technology is moving so fast in Asia that there isn't the luxury of putting together the right systems. There needs to be direct engagement with global competitive challenges. Just as Korea went ahead without worrying about the rest of Asia, South Africa may, in its own interest, decide which of its sectors are best placed to leverage its global competitiveness – things moving too fast to spend too much time on architecture.

Dr. Baskaran commented that in selected sectors South Africa could excel, citing the exmaple of India's electronic revolution in 1970s and 1980s. South Africa could target the SMEs and markets, leveraging its investments in science, the Square Kiolmetre Array (SKA) and nanotechnology.

Prof. Mario Scerri noted that the Asian miracle happened in a very different world, when the global economy wasn't as open and protection was the norm. He believed that South Africa doesn't carry enough critical mass to be able to be a global contender in today's world. Huge countries like China or India can, or blocs which can combine resources. South Africa is too small to survive, hence integration has to happen and has to be based on ideological revolution.

Dr Rasigan Maharajh stated that to explore the opportunities we must appreciate the challenges – we don't have a blank canvas. We should look at alternatives. Appreciating challenges should not be a recipe for stagnation but must be a call to move forward. The world is not waiting for us therefore we must ensure that we build in and democracy safeguard in terms of how choices are made. Heritage foundation in the US – says the AU is the most opaque structure in understanding financial flows. There should be a better understanding with regards to whose interests they privelege and whose they disadvantage. New entrepreneurship both should be public and private.

Prof. Muchie elaborated that South Africa has the highest Gini coefficient, is low on GDP growth and low on FDI, but has neighbourhood advantage in Africa.

In response to a question on the role of the education system in South Korea being able to move so fast, Dr. Turner described the centuries old educational structure in the region - the culture values education far higher than most of the west. Japanese and Korean parents put an enormous amount of effort into ensuring that their children go to extra classes and study longer. The emphasis on education is immense and tied to cultural history which offers Asia a competitive advantage.

Dr. Du Plessis pointed out that South Africa has looked at all models including Europe, Asia and specifically India. The one aspect that had an impact on our first Green Paper on science and technology after it was published in 1996 was the importance of science communication and public understanding of science and the role it has to play in future

science planning. This role of science communication has diminished over the subsequent years, with very little attention being given to just the factor of science communication and the importance of that role. The Marikana event shows that South Africa still has a lot to learn about interacting with the multinationals.

It was noted that India is training approximately four thundered thousand engineers per year. These students are not just being absorbed into the system as engineers but they go for postgraduate training in different disciplines, so they have opened up their education system to facilitate different disciplines. Some of these students take different courses at the National Institute of Design which is their premium place for teaching design. These students graduate with their specialty in IT from an engineering point of view but they have got the design capability as well. This means that they are not depending on just Microsoft, as a father company to feed their expertise into the country, but home grown they are also developing a different kind of expertise where design now plays a role rather than just the technical capabilities. Students graduate with both design and IT – not only technical capabilities.

Dr. Turner repsonded that the next step for India is to create software packages or games which will have a global presence in their own right. They have not yet fully exploited the cricket/Bollywood effect which is starting to generate significant regional and global presence.

Professor Sunday Ojo noted that Asians are hard-working while Africans have an entitlement attitude and tend to focus on 'what I'm getting out of system, not what I'm contributing to it'. He indicated the role of political leadership in creating an environment to encourage and keep people with capacity. He also questieoned if the present thrust of Chinese in Africa could really lead to true African development or is it a different kind of neocolonialism? He offered the example of poultry farming in Zambia, where the locals can't compete with the Chinese. Dr. Turner described how the Koreans were devastated by the war in Korea and were also coming out of a tough Japanese colonial regime. This inevitably meant that they really had to work hard to rebuild, thus creating a national sense of identity which has created a strong communal work ethic.

Dr. Turner also noted that the South Korean model is presently stressing the need to develop university postgraduate courses. The dilemma of where to place emphasis on education (secondary school or university) has not yet come up. The one major area that needs working on in Asia is the quality of universities which still lag on international indicators (with the exception of Hong Kong and Chinese ones). Much work needs to be done on improving the effectiveness of university education. Then there is the question of creativity, with a lot of debate about whether there is too much rote learning. Finally the question about big companies and their effectiveness in poverty reduction have generated serious debate South Korea about their reliance on these giant companies and the negative effect they have on small start ups. Taiwan have a much better record of encouraging small entrepreneurial companies which then go on to become quite big.

CONCLUDING COMMENTS

Professor Muchie's main point was that South Africa must be constructive and have constructive engagements with other African countries for partnerships. The basic education system is really bad despite large amounts of money we are investing in education in South Africa. The key question he felt policy makes in South Africa should address is: What do we need to address to ensure that we are reaping fruits of investment? The higher education system is good, but graduates do not match skills required by industry. How do we ensure that they are absorbed by industry? He welcomed South Africa's experimenting with science parks, and believed that the space created by these parks serve to exchange ideas between the private sector, universities resulting in the development of patents. Science parks are a creative way of dealing with higher education and could involve the diaspora.

Professor Muchie further elaobarated that we should look at developing a national policy for poverty eradication. The Chinese for example facilitate the availability of credit to build SMEs. This helps to support new graduates to get into

entrepreneurship, and create new jobs. The typology of universities have changed, with more innovation universities being established receiving private funding from industry, with industry involved in training.

Dr. Maharaj concluded that we should revisit the curriculum from primary to higher education and encourage mobility by encouraging exchange of students – send students to other African countries and see how we can gain from it. He emphasized the importance of history in reinventing nationalism, and pointed to the huge role for humanities and social sciences in science systems.

Dr. Baskaran commented that the integration outcomes we seek are socio-economic improvements, and won't be achieved through traditional approaches to integration. Instead they must be extended to include integration of South Africa linking to SADC using the Neighbourhood System of Innovation, not excluding trade. He stressed the importantance of strengthening the South African Natinal System of Innovation in South Africa, to integrate regionally and eventually result in the co-evolution of a regional system of integration. Dr. Bhaskaran also stated that the problem with regard to the quality of students is universal. The quality of students don't always match the level of investment and employability of graduates. India's experience showed that students weren't creative enough, which is necessary in a high-tech innovative world. He gave the example of employability in India where companies recruit from universities and then send them for pre-employment training. Some companies are actively working with institutions on changing the curriculum and finding a way to work with higher education institutions to train the students. Collaboration with industry is essential!

Dr. Turner commented on what a big gap there is between basic education in South Africa and the educational background of most of Asia. South Africa needs to do much work in improving this area. The higher education system is strong within African continent, but can further build on this by learning lessons from India for example, on getting the balance better. He further noted that while the Chinese are producers, they are also new international investors, in need of new resources. South Africa is a relatively small country within a global economy and it doesn't have fast growing markets near its borders. It can therefore push the idea of African integration, but must it must keep its eyes open on the booming gulf states, India, Malaysia, Thailand and Singapore with interesting markets and technologies.