

WRC 40-Year Celebration Conference keynote address – The role of research and a knowledge-driven economy in development

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Congratulations to the Water Research Commission on 40 years of really significant achievement. The programme of this conference testifies to a remarkable amount of highly-pertinent ongoing work. And no one looking through the *Knowledge Review* or the special supplement to *The Water Wheel* can fail to be impressed. Your field covers so many different areas of importance to society that, like the economist who was asked what his discipline involved, you could probably answer, ‘Everything,’ without stretching the point.

I have been an academic for slightly more than the 40 years we are celebrating, and I know that those years have not been easy. Our country has changed dramatically in that time. And the world is far from being the environment we knew 40 years ago. The changes, many of them welcome, all demand careful teasing out of their implications. I can only glance at a few of them and the adjustments of orientation they demand of us.

South Africa has changed. We are in a country which has been playing hide and seek with itself for much of the past 40 years. For almost the first half of that time South Africa was a racial state with totalitarian tendencies which failed to develop the nation’s talent pool. For the second half we have been a democratic state with an inclusive constitution, and for that we can be heartily grateful. However, not surprisingly, the democratic state continues to wrestle with race. The democratic state has indeed moved to recognise the neglected talent pool but has not made great progress in developing it. Firstly, it failed to recognise much of the potential in the developed intellectual and professional resources that it had as a basis from which to work. Secondly, our democratic state still leaves us with an education system which falls far short of what we need. This is not to say that nothing has been done. There have been some big advances. But the advances have to be at a much more rapid rate if we are to hold our own successfully in the world. For that reason, the emphasis in this conference on knowledge and development is particularly welcome. We need well-researched knowledge to inform our endeavours if we are to be able to envision who we are, what we can be, and how we get there.

Our world has also changed. A little short of halfway through our 40 years, the Berlin Wall fell. That marked the collapse of the Soviet Union and the end of the Cold War. In a moment, the world became a much bigger place.

- **The impact of the e-revolution**

The first feature of this post-Cold War world was that, in the easing of restrictive politics, the impact of the e-revolution began to be felt in earnest. Ten years into our forty

years, PCs were only beginning to find a market in the US. I had one of the first in South Africa, a Kaypro II, which I imported in 1982, the year *Time Magazine* named the home computer ‘Machine of the Year.’ My Kaypro had a stunning 64K of memory. The utility of the PC saw it developing rapidly over the 80s. But the huge advance of the World Wide Web (WWW) was only conceived in 1989. If I may quote from Wikipedia: ‘It is estimated that in 1993 the Internet carried only 1% of the information flowing through two-way telecommunication. By 2000 this figure had grown to 51%, and by 2007 more than 97% of all telecommunicated information was carried over the Internet.’¹ The situation continues to change rapidly. This year (2011) it is anticipated that the smartphone and the e-tablet (like the iPad) will outsell PCs worldwide. Two main reasons are portability and ease of access to the WWW. We are in an era of increasingly rapid exchange and processing of information and an increasing functional demand for rapid access. Such a development has huge implications for research partnerships and publication.

- **The emergence of the global knowledge economy**

The second feature of the new era, related to the first, is the rapid emergence of the global knowledge economy. The OECD (Organisation for Economic Co-operation and Development) in its *Glossary of Statistical Terms* describes the term ‘knowledge (based) economy’ as ‘an expression coined to describe trends in advanced economies towards greater dependence on knowledge, information and high skill levels, and the increasing need for ready access to all of these by the business and public sectors.’ A great deal has been written about this. Allow me to tease out three points:

- **Innovation**

The dependence on knowledge is by definition a dependence on excellent and productive research. But it goes beyond that. It is a dependence on innovation. Leading knowledge economy thinkers distinguish between **invention** and **innovation**. Invention costs money to produce new knowledge, and much laboratory research never moves outside the academic circle. Innovation also demands investment, but it seeks the practical relevance of the knowledge it discovers and applies that knowledge to producing profit or other social benefit. Innovation is not old-fashioned applied science or technology: it is a cutting-edge activity in which high-end research is undertaken in a heightened awareness of the need to see the potential significance

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¹ en.wikipedia.org/wiki/internet (accessed 29 August 2011)

of the new knowledge to practical or social needs. Because it is a cutting-edge activity, it normally generates new research as well. The old model of research to application as a straight line between laboratory and factory does not fit. The innovation model is conceived as a dynamic one in which there may be feedback loops at any stage of the process, setting up new research agendas to expedite improvement. The innovation research agenda is also regularly recalibrated in relation to social input. In this regard the notion of social innovation and of the 'living lab' as a means of creative engagement is worth looking at. Meraka, for example, has a Living Labs project which can be accessed at: <http://llisa.meraka.org.za>.

◦ **Sharing knowledge faster and more easily**

The dependence on information means that new knowledge needs to be shared far faster and to be far more easily accessible. The relevance of the Internet is clear. However, this shift also requires a range of changes in the protocols regarding intellectual property and in the perception of the scale needed to be competitive. In this regard, our recent intellectual property (IP) legislation relating to state-funded research marks the very beginning of a conversation. There will have to be ongoing and very significant changes if it is not to stand in the way of our proper development. Sharing information as far as possible is integral to the success of companies (and research institutions) and to the building of local and international networks which take the whole operation up several notches in terms of scale. Let me give one example. After long negotiations, the IT (information technology) departments of the 3 universities in Turku, Finland, agreed to leave their campuses and go into one building in the Science Park. They were soon joined by Nokia, and then by other industry interests. The result? Their programmes are more attractive, because they have a much wider range of expertise to draw on, so they have grown their student intake. They have a wider range of expertise at their disposal from one another and from industry. Their freer information sharing and easier professional interaction has accelerated their productivity dramatically. And their relationships with the industry interests in the same building have seen to major advantages to the industry and a substantial increase in research funding and support. This is not to say that they share all information. But they share all but the most critical for their individual strategic goals – probably 9 times more than the conventional model would allow – and they are prospering as a result.

◦ **Skills and skilfulness**

The third dependence mentioned by the OECD is on high skill levels. Undoubtedly, this represents a standing challenge to higher education and research institutions. But it cannot be met by them alone. Nor is it desirable that it should. The sort of interdependence between industry and higher education mentioned in my last point is critical. The point is not industry taking over where higher education has failed: it is rather industry and higher education getting into the kind of respectful and mutually-advantageous relationship which takes both several notches up in their capacity to train and nurture our best talent nationally. The dependence on high-level skill levels is not on people

who simply have a large number of skills. The reference is rather to skilfulness or being able to deploy a repertoire of skills appropriately. You can have skills without being skilful. Universities can encourage skilfulness, but it takes practice to develop.

The mindset shifts required for industry and research institutions to move to an innovation emphasis, to developing effective and principled information sharing, and to privileging skilfulness are considerable. They involve seeing a dynamic partnership between research institutions and industry as the norm. They involve moving beyond the heroic individual institution to the network of institutions which can attain the scale required for rapid and substantial progress. And they involve a sense of advanced education as normally developed both in and beyond higher education institutions.

• **Government in the knowledge economy**

Government is a third, essential player in the knowledge economy. This has significant implications. The state needs to provide supportive policies and incentives, move fast in response to change, and be reliable, having built in some buffer against the contingencies of politics. It stands to reason that in a situation calling for joint effort, a controlling spirit in government would impede development. These insights into the relationships between government, knowledge institutions and industry have been repeated world-wide. South Africa has had access to them most consistently through COFISA, the South African – Finnish partnership.² The 3 players – industry, research institutions and government – are seen as in such an integral and dynamic relationship in the knowledge economy that they are described as the triple helix: the model being the double helix of DNA. In DNA, the helixes are bound together in a dynamic relationship without ever touching. Each has its own life, but it is a life which is impossible without the other. The same applies to the triple helix. Each element has its own life which must be respected, but it is a life which is impossible without the others. As triple helix relationships are relationships of trust and confidence they cannot be established by decree. However, they must be supported by firm agreements, dynamic policies and ethically-reliable practices. Forums to draw the 3 groups of players together to develop agreements and practical understandings, share information, serve joint interests, and enable continuous adjustment and improvement, have been found internationally to be particularly conducive to success. In the global knowledge economy, innovation is changing fast and such forums facilitate quick and effective responses. There is one final challenge which they may help meet: conventional indices of accountability and progress can obstruct the kinds of dynamic developments which characterise the successful participant in the knowledge economy. All 3 parties jointly need to develop and agree on ways of demonstrating responsibility and achievement that do justice to the larger, synergic vision.

Forty years on, we face a set of challenges which offer exciting possibilities, but which will not be ignored. South Africa

² See Tina James (ed.) (2010) *Enhancing Innovation in South Africa: the COFISA experience*. Department of Science and Technology, Pretoria.

and the world have changed in ways which demand our attention. But to give that attention we need to have our eyes open to African realities, both because we share in many of them as fellow Africans, and because our work – and especially the work of organisations like the WRC – is often transnational. My object in what follows is not to depress you. We need to look at our realities clear-headedly so that we understand and can direct others to understanding where we are strong and have made progress and what the challenges we face continue to demand of us. The object is to face the challenges, because failure to do so has us losing ground, often at an exponential rate. Besides, facing them can be exhilarating, calling on all our insights and expertise, and there are significant, encouraging examples from Africa of what happens when they are faced. Let us look, then, at some significant and daunting facts about our continent.

- **Africa lags dramatically behind the rest of the world in education and research.**

This affects its capacity to compete in a global economy, address its own very considerable challenges and build coherent national and regional communities from its very diverse population. South Africa and Tunisia stand out at the best end of the list, but in mathematics our very best group of school pupils still scores only what the *average* Singaporean does in international tests. There is a major challenge relevant to water scientists here. In the latest *Mail and Guardian*, Moletsisi Mbeki says: ‘Development is not just bricks and mortar; real development involves the *intellect and culture*. Mortar and bricks are just symbols.’³ In these terms, the education and research figures index a profound challenge to us as a nation and continent to apply our **minds and imagination** to making sense of our world and so to developing it to something like its physical and human capacity. In this regard, opening up new and richer ways of understanding aspects of our situation takes us forward and improves our chances. Africa needs thoroughgoing research on all aspects relating to water, from the perspectives of a range of disciplines in the natural sciences and the humanities. A few years back, I had the good fortune of a spell as Visiting Professor at the innovative new University of Linköping in Sweden. They have a major specialist research faculty based on themes. One of the themes is Water. The team of scholars and doctoral students, who meet regularly to discuss projects and progress, has anthropologists as well as hydrogeologists, lawyers as well as fluviologists, marine biologists as well as water chemists. After some initial strangeness in their interaction, they really appreciate one another and their capacity to nuance research questions and place their research in a realised human context. They foster interdisciplinary insights from a strong base in individual disciplines.

- **Africa’s population is growing at an exponentially faster rate than its capacity to produce food**

Within a subsistence economy, this breeds land hunger. Land redistribution may be possible and desirable in some cases, but it has a limit in the near future. Better agricultural practices among small farmers can bring some improvement, and more efficient, large-scale commercial

farming can bring more, but the graphs of exponential population growth and best-case agricultural improvement cross unpropitiously early. Jared Diamond’s brilliant book, *Collapse: How societies choose to fail or survive*, raises profound questions for us.⁴ The chapter on Rwanda teases out the complex causes of the horrific 1994 genocide, which saw 11% of the population killed in the first 6 weeks. The Hutu-Tutsi race issue was a strong mobilising force, but it does not explain the major part of the killings, where the most prominent factor was the relationship between population, viable land and food produced. Now, water scientists and agricultural scientists can help make the desert blossom as the rose, develop productive aquaculture, avoid problems like the degradation of good land through bad farming practices and the salinisation along the Orange River, and provide buffers against climate change and drought. I hope they will continue doing so with ever greater success. But their successes can simply blind the society to deep problems like population growth unless they do their work consciously within a larger context, and are explicit about the other variables in the situation. This is a major new challenge for science in the information society and the knowledge economy. There has always been a danger that science could be used to convince the world that the stark naked emperor is dressed in magnificent new clothes. Now it has to move beyond its own received paradigms or it will be used to suggest that the major problems are being addressed, when, in fact, crucial issues are being neglected, putting us all at risk. There is a more expressly political aspect which requires sustained attention. Politics is hardwired to focus on the local and the proximate. Water issues are often international and long-term. I need hardly tell this conference that water resources are finite and, with global warming and increased aridification, are declining in many areas of our continent. This makes transnational management of water resources a major imperative, and effective use of water a survival issue. The issues will not be addressed adequately unless the vision of longer-term planning and maintaining international agreements is held constantly and unavoidably to the fore. The beginnings of such thinking 40 years ago led to the founding of the Water Research Commission. But it is an international phenomenon that each shift or change in politics tends to set the system back to the default of local and short-term. In the knowledge economy, triple-helix relationships absolutely require that all parties hold the agreed and developing conditions for success up before one another, keeping one another on track. If they don’t, they will sink together. In the triple helix and in international relationships, we have to develop communities of practice which are focused on the major reason for being together.

- **Africa has the direst health record on earth**

It has more than a third of all TB cases in the world; about two-thirds of the world’s HIV infections, and over 90% of all people in the whole world living with malaria. I could go on. Health is directly keyed to development. Access to clean, potable water is a major factor in community health, and also in the capacity to be economically productive. It makes good sense. And we can be grateful for the progress

³Quoted in Percy Zvomuya, ‘More than just the second son’ *Mail and Guardian*, 26 August to 1 September 2011, p.12.

⁴Jared Diamond (2006) *Collapse: How Societies Choose to Fail or Survive*. Penguin, London

which has been made in providing such water to South Africans. Yet chemical and biological pollution make providing clean, potable water anything but a straightforward issue.

- Controlling and eliminating the anopheles mosquito, the vector of debilitating and often fatal malaria, requires the use of insecticides which in themselves pollute water and are concentrated in the food chain with an ultimately adverse effect on human beings.
- With 40% of Africans across the continent now living in cities which are not generally designed to cope with such numbers, informal (and so unplanned and unserved) human settlement close to streams and rivers inevitably leads to faecal contamination of the water with *Escherichia coli*, *Salmonella typhi* and other pathogenic bacteria.
- Poor agricultural methods not only lead to declining land fertility and erosion, but also to downstream pollution of the water supply with silt and phosphatic fertilisers.
- Mining inevitably impacts on water resources, and leach-out from recovery processes contaminates rivers with unacceptable levels of chemicals like arsenic and copper salts which are dangerous to humans and animals.

You will be talking about some of these issues over the next 36 hours. May I urge you to highlight their significance for the wellbeing of the whole society. Much conference talk is necessarily inward to the profession. However, recognising and speaking to a much larger potential audience heightens impact and helps a broader constituency make sense of the world in ways which advance our goals. People can have the facts, but unless they can see and imagine the significance of those facts they are likely to forget or ignore them instead of being guided by them.

- **Africa has poorly diversified and thus vulnerable economies**

Instead of making full use of its talents, it has tended to build national economies on commercial exploitation of non-renewable natural resources like precious and base metals, diamonds and oil. A serious implication of its low education levels is that it has exported raw materials rather than beneficiating them locally for much greater economic gain. Africa contributes a meagre 3% to the world's GDP. South Africa has made significant progress in surmounting this colonial pattern over the past 40 years. The joint study on *Economic diversification in Africa*, published in 2010 by the UN OSAA, NEPAD and the OECD,⁴ defines 'one of the major weaknesses of a number of African economies: their dependence on too few export commodities and one or two sectors' (p.6). South Africa is backed by huge mineral wealth, but 'a continued over-reliance on commodity-based sectors and heavy industry exposes the country to problems associated with insufficient diversification' (p.16). We do, however, have Africa's most diversified economy, and are

ranked second in Africa (after Tunisia) and 45th out of 133 in the Global Competitiveness Index (p.20). A number of plans are in place for much greater diversification. How does this relate to water research? Let me point to three of the many implications, because these all emphasise the importance of scale. We may be achieving wonderful things under each head, but are we meeting or even trying to plan to meet the scale of the need? First, economic diversification points to a continuation of the pattern of rapid urbanisation with the associated demand for clean water and water-borne sewerage. Is the answer more of what we have or should our thinking take a different route? At the famous Indian Institute of Technology in New Delhi, they have developed a small device suitable for a subsistence farm. It converts human and animal waste into methane (which is bottled under pressure to drive tractors) and sterile fertiliser. Water falls out of the picture. Secondly, economic diversification points to much greater industrial demand for water and an enhanced potential for pollution if use is not carefully managed. And, thirdly, it points to a growing need for electricity in a period when we are committed nationally to a clean energy programme, with 15% of all needs met through renewable sources by 2020 (p.25). These things are receiving attention, but whether we are thinking smartly enough or to scale is critical. Getting things right is tied to South Africa's definitively leaving behind the impress of colonialism and becoming a strong player in the global economy.

In his brilliant book, *The idea of justice*, published 2 years ago, Amartya Sen, the Nobel-Prize winning economist and philosopher, draws on ancient Sanskrit literature to make a fundamental distinction between 2 kinds of justice: *niti* and *nyaya*.⁶ *Niti* stands for 'organisational propriety and behavioural correctness'. *Nyaya* stands for 'a comprehensive concept of realised justice' in an actual context (Sen: p.20). *Niti* is about obeying the rules perfectly. *Nyaya* is about achieving what is holistically right in an actual situation. An interplay between them is necessary in any healthy society. You can't do without the rules, but, as the Romans knew, the law by itself is an ass. Unless the law is interpreted in terms of social realities it can lead to absurd or even evil decisions. As we consider knowledge and development in your context, we need to acknowledge first that good science requires *Niti*-like meticulousness and always will. However, it does not stop there. The practice of science in the knowledge economy and especially in a development context, must take us firmly into *Nyaya* territory where we keep our eyes on the big picture. Nor is this remote from classical science. In September 1861, Charles Darwin wrote to a colleague: 'How odd it is that anyone should not see that all observation must be for or against some view if it is to be of any service'.⁷ We never simply observe, or we would have no idea of the significance of what we see. The changes in our world and the clear demands of the knowledge economy that I have attempted to outline in this paper require that we significantly broaden the frame of our observation.

⁵ UNOSAA, NEPAD-OECD (2010) *Economic diversification in Africa: A review of selected countries*. A joint study by the United Nations Office of the Special Adviser on Africa and the NEPAD-OECD Africa Investment Initiative.

⁶ Amartya Sen (2009) *The idea of justice*. Allen Lane, London Quoted Philip Tobias (1991) *Images of humanity: The selected writings of Philip V Tobias*. Ashanti, Rivonia. p.103.

⁷ Quoted Philip Tobias (1991) *Images of humanity: The selected writings of Philip V Tobias*. Ashanti, Rivonia. p.103.