National Science Week, Pre-CHOGM S&T symposium for Uganda.

13 – 15 September, 2007.

Panel briefing papers.

The programme of this Ugandan symposium for science and technology is based around seven themes, each represented by a panel discussion with the following titles:

1. The centrality of science, technology and innovation to societal and economic transformation: examples from the local and international community.
2. Best practices in Technology Transfer for Social Transformations.
3. The science and technology continuum. From school to university.
4. Institutional arrangements for science, technology, and innovation: The Uganda Millennium Science Initiative (MSI) project
5. Community service & outreach (local, regional, international): how universities serve communities and communicate S&T.
6. Engagement between the tertiary education sector and the private sector in S&T: articulation of supply and demand – an industry perspective.
7. *(Creating functional linkages among STI, wealth creation and improved livelihoods.)*

The following "panel briefs" are intended as simple guides for panel members as they prepare their interventions in order to achieve a degree of overall coherence to each of the panel sessions. In preparing their presentations and interventions, panel members are invited to liaise with their Chairperson and other members of their panel to assure synergy between presentations. Modifications to briefs can be made by agreement with the Chairperson and other panel members, and in discussion with the symposium organisers.

All panels should aim to achieve a set of presentations that stimulates a coherent debate around the panel theme and which arrive at a set of conclusions, recommendations or strategies that can be delivered to CHOGM via the CPF, and disseminated to a wider audience.

Panel one:

<u>The Centrality of Science, Technology and Innovation to societal and economic transformation.</u>

The arguments in support of the theme of this panel have been made repeatedly in many reports and forums in recent years and the intellectual case has largely been won. The report of the Commission for Africa[1] and the UN MDG report[2] are two of the more prominent reports to argue forcefully for increased investment in science and technology to increase economic growth and to alleviate poverty. The Commission

[1] Our Common Interest. http://www.commissionforafrica.org/english/report/introduction.html
[2] UN Millennium Development Goals report: http://www.un.org/millenniumgoals/

made it clear that, while it is possible to govern without an effective science and technology base, it is not possible to govern well. In so doing it echoed the report of the Inter Academy Council[3] that "without an explicit national commitment to strengthening universities the goals of attaining a critical national capacity in science and technology cannot be achieved". Accordingly the Commission called upon the international community to commit funds to support the development of African centres of excellence in science and technology.

Box 1:

Economies change over time through processes of social learning that involve the generation, use, and diffusion of new knowledge. Governments act as facilitators in this process, while technological capabilities accumulate in enterprises. Enterprises are the mechanisms through which scientific and technological knowledge is transformed into goods and services, leading to economic transformation. The process is incomplete without inclusion of knowledge-based institutions. Economic transition therefore involves a mosaic of complex interactions with a wide range of players with knowledge at the centre[4].

Economic change is largely a process whereby knowledge is transformed into goods and services. In this respect, creating links between knowledge generation and business development is an important challenge facing Africa[5].

The renewed international focus on Africa, evidenced for example by the EU's adoption in 2005 of a New Strategy for Africa, along with the acknowledged role of science, technology and innovation in economic transformation, sustainable development and poverty alleviation has contributed to a step change in the perception of the potential of S&T on the African continent. Recent years have therefore seen a greater interest in S&T cooperation with Africa, through collaborative R&D programmes such as the EC Framework Programmes.

The last fifteen years have seen a transition in many African countries from conflict, to post-conflict, to stable democratic governments coupled with an emphasis on good governance. African leaders are themselves looking to embrace S&T for their economic and social development as evidenced by the AU Summit in January 2007 held in Addis Ababa, which put S&T close to the top of the agenda, and by Africa's Science and Technology Consolidated Plan of Action (CPA) developed by African Governments through the African Ministerial Council on Science and Technology (AMCOST) and NEPAD. The CPA identifies 12 flagship programmes that collectively reflect Africa's development priorities, its unique natural resources, and its established and emerging scientific strengths. New S&T partnerships are being forged between African countries and other regions of the world. As a consequence, across the continent new collaborative initiatives are being implemented that have the potential to contribute to alleviating the continent's profound challenges and lead to a significant transformation of Africa's standing in the global economy.

But while the intellectual argument in favour of S&T may have been won, while Africa's development partners are intensifying their commitment to supporting S&T, and while Africa's leaders are themselves embracing S&T, progress towards practical

[3] Inventing a better future. A strategy for building worldwide capacities in science and technology.
[4] Juma and Yee-Chong (2005). Innovation: applying knowledge in development. A report of the Millennium Project prepared by the Science, Technology and Innovation Task Force. 194 pp. EarthScan. London.
[5] Juma, C (Ed) 2005. Going for Growth: science, technology and innovation in Africa. The Smith Institute, London. 129pp.

realisation of the argument moves ahead at slow and variable speed across the continent. Debate and commentary continues and the frustration is palpable, exemplified in this statement from an on-going on-line STI forum – "Africa's efforts to build endogenous science and technology systems for the service of her people continue, but with limited success. Science and technology as a subject area has also not received the enough political support and promotion in recent years. As a result, Africa continues to lag behind in developing S&T with devastating consequences for how the continent has developed and progressed"[6]. In a similar vein, another commentator says "S&T is not generally recognised as an important instrument for development by many [African] governments and that we need to position S&T as a development issue" [7].

Africa as a continent currently lacks domestic S&T capabilities and ability both to attract foreign direct investment (FDI) and to benefit from existing R&D outcomes by adapting them to the local context. The innovation capacity index is less than 15% in sub-Saharan Africa, as compared to over 50% in emerging economies and close to 90% in Western Europe. As Africa's economy revives therefore, there needs to be a concerted action on the part of Africa's partners to develop coherent and coordinated cooperation policies to maximise the benefits derived by Africa, and complement the strategic priorities already set up at national, regional and continental levels. S&T collaboration is of course mutually beneficially and will also strengthen trade, development and economic cooperation between partner regions. Furthermore, S&T collaborations are imperative if we are to collectively address global challenges: S&T partnerships promote interaction between the participants' knowledge systems and create excellent conditions for Europe's access to knowledge systems in partner countries to tackle problems of common interest.

Although the international development community is committed to increasing aid and to developing more meaningful partnerships, scepticism over the effectiveness of aid persists as the following statement posted on the on-line discussion list is illustrates: "Knowledge creates wealth and wealth is stored as money. The process is not reversible, which is why money can't buy growth. Which is also why program officers in donor agencies are wrong to think they're doing development. The whole aid industry is ineffectual because this elementary lesson is lost in the fog of excessive adventurism. We have seen over and over that every time the fog clears there is nothing lasting left in wave of donor expeditions. Time to step back and look at where growth comes from"[8].

The objective of this panel is not to present the case for investment in S&T because that argument, as we have explained, is already made. The panel should aim to provide tangible evidence, though everyday examples drawn from Uganda, the region and from the wider Commonwealth (remembering the line of communication to CHOGM), of where external or domestic investment in STI has led to improvements in the economy and to society. The Panel should analyse why, given the increasingly conducive environment for S&T, the rate of progress is not better, and aim to offer guidance to Uganda's development partners on the modalities and priorities for effective and equitable S&T partnerships that would result in continued gains to the economy and to society. What successful models exist within and beyond Africa that

[6] Taken from the Online Discussion List on Science, Technology and Innovation (STI) for Development in Africa. http://www.dgroups.org/groups/sti4d-africa .
[7] *ibid.*
[8] *ibid*

Uganda and the region could draw on to accelerate economic and societal transformation through investment in S&T.

Panel two:

Best practices in Technology Transfer for Social Transformations

Knowledge, Skills and Technology transfer: A panel discussion

In today's world there is a critical and strategic need to identify, develop and implement innovative solutions to help businesses and economies grow. Effective innovation involves knowledge, technology, skills plus the ability to transfer these into an applied environment. Any knowledge developed or improved in academic institutions may need extensive or intensive adaptation for it to transfer successfully into the business world. Without this applied context for knowledge and technology, it can be argued that they have only a limited impact on the transformation and development of society. People are often the only effective conduit for this transfer and so the deployment of transfer agents can be crucial to success, both for institutions and businesses.

This panel will consider the need to develop systematic approaches to the transfer of knowledge, skills and technology in order to ensure maximum impact is derived from innovation and businesses improve their competitiveness and productivity through the better use of knowledge, technology and skills. It will consider case studies and hear about experience of knowledge transfer from different countries and from both the academic and commercial perspective.

Panel three:

The science and technology continuum from school to university.

(Panel members may wish to consult the African Union's Second Decade of Education (2006-2015) Plan of Action).

Box 2: The African Union's Second Decade of Education.

The African Union has a vision of an integrated, peaceful, prosperous Africa, driven by its own people to take its rightful place in the global community and the knowledge economy. This vision is predicated on the development of Africa's human resources. Education is the chief means by which Africa's citizenry are prepared for their respective roles in the attainment of this vision.

Africa entered the Millennium with an education deficit at every level, formal and non-formal. Conferences of Ministers of Education have continued to reiterate the need to increase access to education, improve quality and relevance, and ensure equity.

Education is a critical sector whose performance directly affects and even determines the quality and magnitude of Africa's development. It is the most important means we have at our disposal to develop human resources, impart appropriate skills, knowledge and attitudes. Education forms the basis for developing innovation, science and technology in order to harness our resources, industrialise, and participate in the

global knowledge economy and for Africa to take its rightful place in the global community. It is also the means by which Africa will entrench a culture of peace, gender equality and positive African values[9].

The fundamental importance of education to a robust science and technology sector and to a pool of skilled human resources is well understood. At the same time most commentators agree that the teaching of S&T in Africa is in a state of disarray, reflecting a malaise in the education system as a whole.

This panel has been convened to debate the priorities and mechanisms for the continued revival of the teaching of S&T in Uganda, and in the region, at primary, secondary and tertiary levels, as well as in the vocational and adult education sectors. The debate should be framed within the overall theme of this S&T symposium and of the wider theme of CHOGM. Particular attention may be drawn to achieving an education system with relevance to national and regional needs, and developing a holistic vision of S&T teaching at all levels that sits within the overall education system. The Panel may wish to be guided by the focus areas of the African Union's Second Decade of Education:

- Gender and culture
- Education management information systems
- Teacher development, education and training
- Tertiary education
- Technical and vocational education and training
- Curriculum, and teaching and learning materials
- Quality management

Additionally, panel members might consider roles for the international development community in reviving S&T education, and ways in which they might achieve optimum efficiency and synergy among themselves.

Interest in science and technology begins at an early age and primary school teachers need to make learning in these subjects interesting, relevant and fun. Yet enrolment rates in sub-Saharan Africa are low and there are strong gender disparities and inequalities[10]. Most countries in SSA are at risk of not achieving the universal primary education MDG, although enrolment had increased to 70% by 2005[11]. Education coverage in Uganda for example is expanding tremendously with a close to quadrupling of enrolment at primary and tertiary levels in less than a decade[12]. But while the goal of universal primary education has led to a rise in enrolment rates across SSA, it has not been matched by a similar rise in the quality of schools and teaching. Classroom sizes are large and many teachers inadequately qualified.

[9] African Union, August 2006. Second Decade of Education for Africa: Draft Action Plan. Department of Human Resources, Science and Technology. Available from UNESCO website: (http://www.education.nairobi-unesco.org/index.php?option=com_content&task=view&id=1559&Itemid=56

[10] 2003/4 UNESCO's EFA Global Monitoring Report, 4pp. Consulted on 25/06/07 at http://www.unesco.org/education/efa_report/zoom_regions_pdf/ssafrica.pdf

[11] United Nations. 2007. Africa and the Millennium Development Goals. 2007 update. Consulted on 25/06/07 at http://www.un.org/millenniumgoals/docs/MDGafrica07.pdf

[12] UNCST, Feb 2007. Uganda: Millennium Science Initiative Project: Implementation plan and operational manual.

Although the education MDG is limited to achieving universal primary education, the importance of science education at primary, secondary and tertiary levels of schooling in the creation of an innovative society cannot be overemphasized[13].

However, problems with the development of S&T capacity can be found at all levels of education. In Uganda, secondary level science education is constrained by a lack of laboratories and equipment, obsolete curricula and inadequate supply of trained science teachers. These poor conditions, along with disincentives built into the "A" level examinations and university admissions process have led to a widespread "science avoidance" tendency that runs counter to the country's long term human resources needs[14].

For several decades, development agencies have placed great emphasis on primary and, more recently, secondary education. But they have neglected tertiary education as a means to improve economic growth and mitigate poverty. Part of the reason for the inattention to higher education within development initiatives lies in the shortage of empirical evidence that it affects economic growth and poverty reduction. In contrast to this early view, recent evidence suggests higher education is a determinant as well as a result of income, and can produce public and private benefits. Whether as a consequence of this realisation, or of other processes, development perspectives on higher education may be changing.

In recent years, organizations such as the World Bank and major donor governments have begun to reconsider their exclusive focus on primary education and are now reaching out to secondary and tertiary education, as the balance between poverty reduction and growth promotion is adjusted within development assistance strategies. Higher technical education is increasingly recognised as a critical aspect of the development process, especially with the growing awareness of the role of science, technology and innovation in economic renewal. While primary and secondary education have been at the focus of donor community attention for decades, higher education and research have been viewed as essential to development only in recent years[15]. Moreover, a new view that places universities at the centre of the development process is starting to emerge. The concept is being applied at other levels of learning, including colleges, research institutes and polytechnics[16].

Nevertheless, In Uganda, where tertiary enrolment rates are increasing, most new students have gone into the arts rather than the sciences, partly because of a weak S&T foundation in the country, and the lower investment in equipment needed in the arts and humanities.

Two articles that have appeared in the scientific press (www.scidev.net) in recent days (June '07) may provide food for thought for members of Panel three:

1. The Gambia has announced the creation of its first science academy, which will address the shortage of scientists in the country. The academy will prepare students at primary and secondary level for university-level science,

[13] Juma and Yee-Chong (2004). Interim report of Task Force 10 on Science, Technology and Innovation. Millennium Project. www.unmillenniumproject.org
[14] UNCST, Feb 2007. Uganda: Millennium Science Initiative Project: Implementation plan and operational manual.
[15] Juma, C., ed. (2005) *Going for Growth: Science, Technology and Innovation in Africa*. London: The Smith Institute.
[16] Juma and Yee-Chong (2004). Interim report of Task Force 10 on Science, Technology and Innovation. Millennium Project. www.unmillenniumproject.org

technology and mathematics courses. Initiated by the Gambian president, Yahya Jammeh, the academy — based in the western town of Kanilai — is scheduled to open in September 2008. Construction will start in September this year[17].

2. The government of Ghana has finalised its education reforms and given a much-needed boost to the role of science and technology in schools. The reforms, which have taken two years to prepare, were announced last week (12 June) by the coordinator of the National Education Review Inspectorate Committee, Comfort Asomaning. They are intended to address both a lack of resources for science teaching and poor training in science for teachers. For the first time, students at kindergarten and primary level will be taught science, and in local languages. At secondary level, the emphasis in science teaching will be on innovation and problem-solving. Under the reforms, the private sector will contribute to private colleges and technical institutions in a bid to supply the scientific skills needed by industry[18].

Panel four:

Institutional arrangements for science, technology and innovation

The theme of this panel focuses on the dynamics, interactions and relationships between the physical institutions, the policies and the market system that comprise a country's or a region's science, technology and innovation (STI) system. The role and responsibilities of government, and governance, in enhancing those relationships and providing an enabling environment for STI is part of this theme, as is the system(s) of state/private funding for R&D. The Panel should draw on examples of successful models of institutional arrangements for STI, on sectoral or national bases, and from these provide a series of recommendations or strategies for Uganda and/or the region to pursue. Panel members are invited to also give consideration to strategies for support from international development partners, and to recall the overall theme of the symposium and of CHOGM.

[19]It has become increasingly clear that strengthened and coherent STI policies, and an effective national system of innovation and are required if a country is to harness the potential of science and technology for its social and economic needs. The operation of the market and the development of the private sector are necessary for the emergence of an effective system of innovation, but they are not enough on their own. Government action is also required. Innovation systems do not emerge automatically as a country industrialises, and market failures can hamper innovation and technological progress. In an ideal situation, the dynamics of research and innovation are strongly associated with business and industry, the users of scientific knowledge and technology. However, where the systems act independently of one another, or where there are inadequacies in the system through lack of infrastructure, policies or funding, there is a dislocation of supply and demand. The state needs to stimulate coordination between organisations in the private sector, improve the exchange of information between the private and public sectors, and strengthen institutions that

[17] Talent Ngandwe, 12 June 2007, Source: SciDev.Net.
[18] Talent Ngandwe, 18 June 2007, Source: SciDev.Net
[19] This paragraph and the following one are largely drawn from: Ahrens, J. (May 2005) Building science, technology and innovation policies. *SciDev.Net* R&D Dossier/Policy Briefs. http://www.scidev.net/index.cfm

foster learning processes, indigenous innovation and technological diffusion. The basis role of state is not to substitute for the operation of the market, but to enhance the way it operates.

To ensure the coherence and efficiency of STI policies' policy makers should be aware of several principles that have emerged over in recent years as the result of analyses and increased understanding of how innovation processes and technological accumulation works:

- developing successful networks between the state, academic organisations and industry, to increase the efficiency of the innovation system;
- fostering flexible research organisations that can adapt and meet changes in research objectives over the course of national economic development;
- self-sustainability, with an emphasis on temporary rather than permanent government support;
- competition among the organisations that form the innovation system, requiring a transparent (and predictable) market-oriented regulatory and legal framework;
- a lack of bureaucratic rigidity in research organisations;
- continuous evaluation;
- techniques for risk analysis and risk management;
- ensuring subsidiarity, in other words, that ST&I issues should be handled by the lowest competent level – so decisions on diffusion activities, for example, can be taken at the regional level. The role of central government will be restricted to mission-oriented policies — which focus on the development selected technologies considered to be strategic for a country — and to create a 'level playing field'.

The configuration and arrangement models of the S&T system acts as one of the main factors which contributes to condition the opportunities for knowledge production and absorption. Panel members may wish to include an analysis the Ugandan STI system, perhaps on a sector by sector basis (for example in heath, agriculture, engineering, biotechnology, ICT, sanitation) highlighting weaknesses and strengths, but at the same time, providing constructive commentary and practical remedial measures to address any weaknesses.

For many, national systems of science, technology and innovation must be considered in a regional context as few individual countries have adequate capacity alone. To what extent are individual nations prepared to relinquish sovereignty of their own systems in the interest of regional integration? Is it possible to combine national STI systems with regional STI integration?

Panel five:

<u>Community service & outreach (local, regional, international): how universities serve communities and communicate S&T</u>

The theme of this panel hints at the wider role played by universities and the tertiary education sector in society, the broader civic and community obligations, calling upon

the need to recognise that the benefits of higher education are also social. The presentations and discussion of this panel should focus on the roles of universities as service providers in terms of community service and outreach. Panel members may wish to reflect upon and share experiences from the region, Africa or worldwide of models that have successfully linked universities with communities for communicating new technologies that have made an impact.

In preparing presentations the panel members might wish to consider these questions:

1. What are the elements or conditions necessary for a university to effectively engage with and communicate S&T to communities for their transformation? In other words, how might S&T innovations developed at universities be translated into practice for societal use? For instance, if Makerere University Faculty of Agriculture has developed a soil test kit that can be used by farmers how can this technology be extended to the farmers through community outreach?

2. What models have been developed elsewhere to address this issue, and what are the challenges? In Malaysia, Singapore and in many universities in SE Asia there are different models which we can share and from which we learn. For example, Makerere University has embarked on an embryonic process of setting-up model villages where faculty and students are facilitated to translate new innovations developed at Makerere into practice, with a view to changing people's lives. Could such experiences be shared to consider ways in which such an undertaking might be strengthened and replicated?

Other questions that the panel might wish to address:

- How does community service and outreach fit within the model of traditional Africa universities established at the time of independence to build nations and populate the civil service?
- What are the current shortcomings in the regions' universities in respect of community outreach?
- Which are the communities that universities should serve?
- How could we embark on programmes to strengthen, scale-up and scale out successful outreach models to better serve communities?

Panel six:

<u>Engagement between the tertiary education sector and the private sector in S&T: articulation of supply and demand – an industry perspective</u>

Higher technical education is increasingly recognised as a critical aspect of the development process, especially with the growing awareness of the role of science, technology and innovation in economic renewal. Science, technology, and engineering education institutions should create indigenous capacity by training scientists, technologists, and engineers in relevant fields. Such a strategy will help address local concerns (such as health, food security, infrastructure, and manufacturing). In promoting S&T education in developing countries, universities can play a vital role in development, by both developing the country's national

innovation and its human resources.[20] The private sector (industry and enterprise) relies upon skilled professionals emerging from the tertiary education sector (including higher technical education) who are able to use knowledge to innovate, to develop technologies, products and services, thereby stimulating economic development, creating wealth and alleviating poverty.

It is widely reported and acknowledged that in Africa, universities and the wider tertiary education system, which should be training a pool of skilled human resources, are in a state of crisis, partly because of decades of neglect and under-funding. This has contributed to a skills shortage in much of Africa that is said to represent a significant constraint to growth and to the ability to compete in the global economy. Moreover, out-dated and irrelevant science curricula undermine limited resources and efforts of the education system by producing graduates without the applied skills and knowledge required by society.

Universities and other institutions of higher learning are key players in diffusing knowledge into the economy. But they can only do that through close linkages with the private sector. The absence of any systematic engagement between industry and the education system means that there is limited articulation of demand and supply. Achieving that could require major adjustments in the way that universities function in Africa.

Many of these universities will need to be changed from being conventional sources of graduates to becoming engines of community development, working directly in the communities in which they are located[21]. Other than providing education, a new view is emerging that places universities and research institutions at the centre of the development process. Higher education and research institutions have become a valuable resource for business, industry and society. In facilitating the development of business and industrial firms, universities can contribute to economic revival and high-tech growth in their regions. Higher education and research institutions integrate into the production sector and into society in many ways. They conduct research and development for industry; create their own spin-off firms; are involved in capital formation projects, such as technology parks and business incubator facilities; introduce entrepreneurial training; and encourage students to transform research into enterprises. This approach is based on the strong interdependence of academia, industry and government[22].

Considerable efforts are under way to reform existing institutions in Africa. Additional opportunities exist in the design of new higher learning institutions. The challenge today is community development. As a result, the new species of university should integrate into the communities in which they are located and seek specifically to promote economic transformation in their locales. This means not only that their curricula will need to be adapted to local needs, but also that students should be expected to spend part of the time working with local communities. The focus of the new species of university will be to produce graduates who are trained to create enterprises and therefore generate jobs while adding to the growth of the economy. In addition to training, universities would need to function as incubators for businesses

[20] Adapted from: Juma and Yee-Chong (2004). Interim report of Task Force 10 on Science, Technology and Innovation. Millennium Project. www.unmillenniumproject.org

[21] Rowett JS and Sawyerr A (2005) Universities in African economic renewal. Association of Commonwealth Universities. Draft paper

[22] This and the following 2 paragraphs are drawn and adapted from: Juma, C. ed. (November 2005) *Going for Growth: Science, Technology and Innovation in Africa*. London: The Smith Institute.

and social enterprises, in addition to the traditional practices of linking enterprises and civil society organisations to universities.

Business enterprises are the most important engines of economic change. While learning occurs in a variety of institutions, enterprises are the most critical locus at which learning of economic significance takes place. In other words, technological capabilities of economic importance accumulate at the enterprise level.

While much is written about the short-comings of the education system, there are fewer accounts of the private sector and industry speaking with a united voice in support of educational reform to meet national and local needs. This panel offers such an opportunity. What is the evidence for the disarticulation between the supply of human resources and knowledge from the education systems on the one hand, and the demand for applied skills from enterprise and industry on the other. What are the causes of the absence of engagement between the two sectors? To what extent does the private sector rely upon local graduates, how does enterprise meet its need for skilled staff, and are there sectoral differences? The Panel may wish to assess the extent to which the assumed disarticulation represents a real constraint to economic and social transformation, to review current strategies employed to address the issue and to propose realistic mechanisms for reform, drawn upon examples from the region and beyond, if indeed, **in the view of panel members and in the view of industry**, reform is needed or indeed desirable.
