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Promoting Science, Technology and Innovation for Development in Africa

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Introduction

1. In an unprecedented manner, Africa is experiencing very rapid growth in its social and economic life driven partly by fast technology diffusion and adoption. The continent is acquiring industrial technology at a very fast pace. For instance, imports of capital goods have increased nearly three times and royalties and licensing fee payments have increased almost six times between 2000 and 2008. This trend is likely to continue as Africa will have to acquire new and improved technologies to produce lifesaving treatments, increase access to modern energy and communication services, develop its industrial base and generate wealth and jobs.

2. In order to '*Unleash Africa's Potential as a Pole of Global Growth*', and in implementing the recommendations of the Second Science with Africa Conference (2010), special attention needs to be paid to innovation. Estimates suggest that 10 per cent growth in mobile phone diffusion results in 1 per cent growth in GDP. In Africa, that may be higher as some people will be connected to the global information system for the first time through the mobile phone. They get their news, market, political, cultural, business and family information much faster through the mobile phone. This one development could have a greater impact if Africa participated more in the design, manufacture, assembly and exports of mobile phone components and units, network infrastructure and exchanges. A true transformation from being a consumer to a developer and producer would be feasible. There are signs this is possible. In Ethiopia, Ethiopian Airlines is supplying electronic components to Boeing, one of the world's largest airplane makers. In addition, Ethiopian car-assembling firms have emerged and are successfully competing with established global players. Agro-processing firms have emerged in Southern and Eastern Africa and Africa's exports of pharmaceuticals have grown rapidly in countries such as Egypt, Kenya, Nigeria, Mauritius, Swaziland and South Africa. Africa is unlikely to emerge as a true growth pole if it neglects its research and development (R&D) centres.

3. Technology has served as a symbol of Africa's potential to innovate in the mobile phone revolution. Not only has the continent been the fastest growing market for mobile phone services, a number of mobile applications and technologies have been invented and applied on the continent. These include MPESA's '*banking the unbanked*' in Kenya, Dr Math's mobile tutoring support in South Africa and the mPedigree short messaging service (SMS) platform in Ghana. These initiatives are serving millions of Africans and are driven by the continent's intellectual capital, supportive business environment and the interest of the private and public sectors in adopting and using these innovations.

4. Consequently, it is important to point out that innovation not only takes place in the laboratories and R&D centres and firms but rather in the society at large. It is obvious that African countries have made significant strides in improving the general business environment. Entrepreneurship and the private sector in general have become key drivers of social and economic transformation in Africa. It is now time to take radical steps to promote innovation and claim the continent's rightful share of industrial and technological contributions by ensuring that science, technology and innovation (STI) play a key role in society.

The state of Africa's innovation policy environment

5. The overall innovation policy environment in Africa countries is underdeveloped and largely inadequate in terms of sustaining a dynamic innovation ecosystem. Some of the key areas that need special attention include promotion of innovation in the education system, and among small and medium enterprises (SMEs), innovation financing for experimental development, technology transfer and commercialization of research outputs, and monitoring and tracking of STI performance on the continent. The general improvement in the business environment, as has been demonstrated by the '*Doing Business*' survey of the World Bank, and the existence of key institutions offer opportunities upon which innovation actions, such as financing and public-private partnerships, could be based to promote STI.

6. For instance, governments can fund universities, colleges and R&D centres to serve as hubs for developing, adapting and diffusing technology in industry. These institutions offer a fertile ground for seeding, nurturing and developing an innovation society in Africa, given the constant flow of students that pass through to become leaders in the private and the public sectors. Some university faculties already serve as premier centres for technology development and transfer, economic and social research and training of corporate workers in Africa. With minimal support, they could take on a new mission for promoting innovation and managing support networks for innovators. Consequently, countries should seek ways to exploit foreign direct investment (FDI) to build a sound technological and industrial base, improve standards and speed up adoption of modern business management practices. A favourable innovation policy environment could ensure Africa's future competitiveness and sustainability of growth by facilitating diversification and transformation of its economy from its current dependency on natural resources to production of branded and value-added products and services.

7. There are signs that some of these issues are being addressed. For instance, the Draft Science, Technology and Innovation Policy and Strategy for Kenya seeks to promote and coordinate research, technology acquisition, adaptation and diffusion into the national development process and to mobilize, manage and disburse funds for STI. It seeks to establish the Kenya National Technology Acquisition Office (KENTAO); the National Innovation Agency (NIA), the National Commission for Science, Technology and Innovation (NCST&I) and the Kenya National Research Foundation (KENREF). Once established, these would bring Kenya's national innovation policy setting closer to that of South Africa where the Technology Innovation Agency (TIA) helps to commercialize R&D outputs, the National Science Foundation finances R&D activities and the National Advisory Council on Innovation (NACI) offers policy advice, among other functions. Such institutionalized measures could help Africa to become and remain competitive.

Innovation financing

8. Although R&D funding remains below the 1 per cent of Gross Domestic Product (GDP) that countries committed to implement, innovation financing is almost absent in many African countries. There are several ways of increasing innovation financing. The most direct way is to offer special grants, loans and guarantees for start-ups and new firms

as well as subsidies and tax incentives for pilots and trials. A recent survey in Ghana, Kenya, Tanzania and Zambia revealed the lack of government incentives and tax credits for start-ups from public institutions. Yet, large private investors already benefit from such incentives. Governments should extend these facilities to innovative individuals, start-ups, and existing firms to encourage them to bring their products to market. They should also facilitate individuals and venture capital firms that invest in innovative start-ups, incubators and S&T parks.

9. Governments could encourage foreign and large domestic firms to invest in laboratories, train and sponsor local students and work with national institutions to bring desired products, services and processes to market. For example, Illovo's Zambia Sugar and the National Institute for Scientific and Industrial Research (NISIR) partnered to bring vitamin-A fortified sugar to the market. The main objective was to reduce vitamin-A deficiency in Zambia. Similarly, foreign automotive manufacturers in South Africa teamed up with the South African Bureau of Standards (SABS) and the engineering faculties of some of the leading universities to establish the Euro Type Test Centre in South Africa. The centre is invaluable to exporters of automotive products to countries where international emission testing is a legal requirement.

Business environment for innovators and start-up

10. The general business environment has improved considerably. A number of African countries are now in the top 100 ranking of the *'Doing Business'* survey of the World Bank. Countries such as Rwanda have been ranked among the top performers in the world. Similar reforms to promote the emergence of innovative firms would be required especially in terms of technology acquisition, intellectual property management and spin-offs from public research centres. Currently, a number of R&D centres lack technology commercialization guidelines and institutional intellectual property policies. South Africa is one of the few countries that have established a national intellectual property policy to harmonize how publicly generated knowledge is commercialized and protected.

11. Other areas that need attention include competition and procurement policies. R&D centres and innovative start-ups should be considered first in the provision of public contracts. For example, the Dar es Salaam Institute of Technology had to compete with large firms to win the tender to install street lights in Dar es Salaam, Tanzania. Such institutions that are making significant contributions despite limited funding from government should be favoured in the provision of contracts. These contracts would serve other additional benefits such as training of students and helping the institutions to learn to innovate in the process. For instance, instead of contracting an established institution or firm to sequence the genome of an organism that infected oranges, Brazil created a network of over 20 research institutions and in the process trained over 200 scientists in genome sequencing.

ECA efforts to build an innovation ecosystem in Africa

STI policy advice and research

12. To aid policy advices to interested countries, ECA has developed the African Innovation Framework (AIF). The AIF is entitled '*Unlocking Africa's Future*' and identifies some of the key components that have enabled other regions to take advantage of emerging technological niches. It seeks to help transform the continent into the world's largest and most powerful industrial base through its rich natural resources and human capital. The *framework* recommends simple steps drawn from successful national and regional experiences. It uses expert advice intended to harness domestic and international resources to develop domestic absorptive capacity and stimulate existing institutions to become more entrepreneurial in character. ECA is currently working with the governments of Benin and Mali in developing their national STI policies and with the Economic Community for West African States (ECOWAS), on the ECOWAS Policy for Science and Technology. Requests have also been received from the Governments of Burkina Faso, Cote d'Ivoire, the Gambia, the Niger and Togo, and from the ECOPOST that will be launched in 2012. ECA has also developed tools to assess the STI comprehensiveness of the national innovation ecosystem and R&D and technology transfer performance of institutions. The tools have been successfully tested in Ghana, Kenya and Zambia and a technical advisory mission was undertaken to survey centres in Tanzania at the request of the Tanzanian Commission of Science and Technology (COSTECH) in 2011.

13. Emphasis and attention continues to be given to mainstreaming gender in STI activities as evidenced by a report on the status of gender mainstreaming in STI in East African Community (EAC) and the inclusion of gender mainstreaming in the STI Action Plan to be launched in collaboration with the EAC secretariat, in 2012. These outputs are critical in supporting gender-sensitive STI policy development and STI strategies for industrial development in Africa.

The Innovation Prize for Africa

14. Innovation flourishes in environments where success is celebrated, resources are mobile, experienced and successful members of society support emerging entrepreneurs and networks of technology entrepreneurs and support infrastructure exist, among other preconditions. Research has shown that the innovation and entrepreneurship support environment is still emerging or missing. In this regard, the African Innovation Foundation, a Swiss-based, not-for-profit organization, and ECA have developed the Innovation Prize for Africa (IPA) to respond to some of these needs and stimulate STI. This initiative responds directly to the resolution 887 (XLIV) of 2011, *Enhancing science and technology for development in Africa*, which invites African governments and the private sector to facilitate pan-African initiatives in support of African innovators and inventors.

15. The IPA is designed as a key vehicle for promotion of innovation in a number of sectors that are key to the continent's sustainable development over a period of five years, renewable. Its main objectives are to:

(a) Create a platform for identification of innovative concepts and projects submitted by applicants that could be supported by IPA;

(b) Stimulate innovation across Africa in key sectors of interest through the competition;

(c) Promote science, technology and engineering as rewarding, exciting and noble career options among the youth in Africa by profiling successful applicants; and

(d) Encourage entrepreneurs, innovators, funding bodies and business development service providers to exchange ideas and explore innovative business opportunities.

16. While the first- and second-place winners will receive \$100,000 and \$50,000 respectively, the top 10 innovations will be promoted in the media and supported to attract investment, access mentors, create partnerships and penetrate regional and international markets. It is in this respect that the award differs considerably from other similar efforts. Furthermore, the funding comes from the private sector and almost all the members of the technical advisory committee are seasoned and successful entrepreneurs. Their suggestions, coaching and vast experience are likely to make a major difference for the applicants who are largely emerging entrepreneurs and researchers, and for start-ups and spin-offs.

17. The first run of the competition attracted about 450 applicants from about 39 countries in Africa, as shown in the table below.

Country	Count
Algeria	3
Angola	85
Benin	11
Botswana	4
Burkina Faso	4
Burundi	1
Cameroon	11
Cape Verde	3
Central African Republic	1
Democratic Republic of the Congo	7
Egypt	63

Country	Count
Ethiopia	32
Gabon	1
Ghana	14
Guinea	1
Kenya	41
Lesotho	2
Liberia	1
Madagascar	3
Malawi	3
Mali	10
Mauritania	1
Morocco	4
Mozambique	5
Namibia	4
Nigeria	40
Republic of the Congo	3
Rwanda	5
Senegal	18
Sierra Leone	1
South Africa	16
South Sudan	1
Tanzania	11
Togo	3
Tunisia	26
Uganda	15
Zambia	1
Zimbabwe	3
Total:	458

18. The technical advisory committee has short-listed about 15 innovative initiatives and firms with which it will work closely to select the winners. The high interest shown suggests that Africa has a growing pool of innovators who, if nurtured, would produce successful technology entrepreneurs.

Engineering to improve healthcare and attract female students

19. In May 2011, UNECA launched a multi-year biomedical engineering project called '*Engineering Expertise to Improve Health Outcomes in Africa*'. The initiative employs an integrated approach that brings medical and engineering expertise together to address healthcare challenges. Biomedical engineering is not broadly offered in African universities and yet it plays a critical role in promoting innovations in healthcare in any country. Currently, a good proportion of medical devices in working condition (up to 16 per cent) are not installed and up to 20 per cent of devices that require minor repairs are not in use due to limited expertise. This is a large proportion of equipment that could save lives if the necessary skills were in place in African countries.

20. To address this challenge, UNECA and its partners seek to focus on four areas:

(a) A biomedical engineering curriculum for building engineering expertise and for attracting female students to engineering.

(b) Skills upgrade and refresher courses for biomedical technicians and users to reduce downtime and increase the lifespan of medical equipment.

(c) An International Design Competition for university students to instil critical thinking and problem-solving skills early in life as well as innovation and entrepreneurship in the youth.

(d) An Innovators School to promote networking, marketing and exchange of ideas on innovation, entrepreneurship and technology management in the biomedical field.

21. In the last eight months, the project has registered an increase in the number of participating universities from two to six drawn from Ethiopia, Kenya, Malawi and Zambia. Efforts to limit the size of the pilot project are coming under immense strain from member States and heads of institutions that want to see their universities participate in the pilot. So far, a draft generic biomedical engineering curriculum was adopted in November 2011. This is a major milestone that will permit the initiative to have a blueprint that universities can use to tailor their biomedical engineering programmes. The initiative has also received about eight projects from student teams at four participating universities. A number of them involve female students. Two universities in Uganda are interested in participating in the project as well but have not yet been officially admitted. The first phase of the initiative is supported by funding from the Republic of Korea and ECA and technical support from Boston University, USA.

The African Network for Drug and Diagnostic Innovations

22. The African Network for Drugs and Diagnostics Innovation (ANDI) is an innovative model that builds on the R&D capacity on the continent to drive health innovations to meet Africa's public health needs. It seeks to increase R&D collaboration among African institutions and countries and to foster public-private partnerships. Through a Memorandum of Understanding (MoU) signed in October 2010 between ECA

and World Health Organization (WHO), the ANDI secretariat has now relocated to ECA headquarters in Addis Ababa, Ethiopia.

23. The first ANDI Board was constituted in October 2010 and elected two co-chairs: the South African Minister of Science and Technology, elected as the co-chair to spearhead the science and technology (S&T) activities and the Minister of Public Health and Sanitation of Kenya, elected as the co-chair to promote the public health interests of ANDI. ANDI is also supported by the Scientific and Technical Committee (STAC) that reviews the activities and projects that ANDI supports.

24. Since then, ANDI has identified 32 African institutions as ANDI centres of excellence and these received awards at the Stakeholders meeting in October 2011. The ANDI centres of excellence are spread across the five subregions of Africa and are conducting R&D; and STI activities relating to drugs, diagnostics, vaccines, medical devices and traditional medicines. They will implement and support some of the ANDI projects as well as contribute to capacity-building on the continent.

***Support to the African Union NEPAD Planning and Coordinating Agency
African Union/NCPA Science Consolidated Plan of Action (CPA) review***

25. In line with the provision made for the flagship programmes and projects contained in the CPA to be reviewed after five years, ECA is currently working with the NCPA and African Union Commission for review of the Africana Science Consolidated Plan of Action.

26. The CPA review and alignment process is expected to facilitate the contribution of STI to Africa's development through increased productivity and efficiency of sectoral development frameworks. In addition, it will enable the African scientific community to design multisectoral STI programmes that are aimed at addressing direct developmental objectives. Policymakers at regional and national levels will benefit through increased availability of relevant information for evidence-based policymaking and decision-making in the allocation of resources for R&D.

Promotion of STI Networks:

27. In order to promote networking and sharing of information and research collaborations in Africa, ECA launched a number of STI networks:

- (a) The African Technology Development and Transfer Network (ATDTN)

ATDTN is composed of leading African agencies and offices responsible for technology development, adaptation, diffusion and transfer. The main goals of the Network are to generate economic and social value from R&D outputs, facilitate technology adaptation, diffusion and commercialization and to encourage investment in R&D.

ATDTN is initially composed of 34 leading African agencies and offices from 12 countries. These are responsible for technology development, adaptation, diffusion and transfer. An online platform that combines the advantage of open innovation with those of physical centres of excellence to offer virtual and on-site solutions has been developed to

support the network activities. Activities implemented through the network include *Biomedical Engineering for Improved Healthcare Outcomes* and *Innovation Centres*.

The Innovation Centres – an online platform for open innovation, sharing expertise and collaborative research were developed in 2011 and will be launched in 2012. The Network also supported the first International Workshop on Nanomedicine in Africa (over 90 participants) and facilitated a roadshow on Nanomedicine in Ethiopia. There is a pending request to ECA to consider supporting establishment of a Nanomedicine Centre of Excellence in South Africa to promote the use of Nanomedicine to fight neglected diseases that affect the continent and are of less interest to the private sector.

(b) *The African Inter-Parliamentary Forum on STI*

28. ECA launched the African Inter-Parliamentary Forum on Science, Technology and Innovation (AIPF-STI), that aims at: (i) strengthening new forms of STI governance through cooperation and dialogue among parliamentarians, policymakers, the scientific community, industry, the media, international organizations, civil society and the private sector; (ii) promoting harmonization of national legislation and relevant measures for promoting STI for development (STI4D); (iii) capitalizing on the effective role the media and knowledge brokers can play in communicating science to parliamentarians and the public at large; (iv) promoting the creation of an STI committee, technology assessment structure or other S&T support body in all African Parliaments; and (v) supporting continual STI4D capacity-building for Parliamentarians and their staff.

Research work/publications

29. A number of research studies and publications are enriching the literature in this area:

(a) *Assessing the African Innovation Policy Environment: A Survey of Ghana, Kenya and Zambia* (in press, 2012). This research paper assesses the innovation policy environment in Africa using eight key areas that influence innovation performance: general policy, education, business environment, financing, promotion, networking, innovation support measures for specific target groups, and monitoring and evaluation of innovation performance. This study reveals that Africa's innovation capacity exists but is poorly managed and supported.

(b) *African Innovation Framework:Unlocking Africa's Future* (in press, 2012). The African Innovation Framework (AIF) is a coherent analytical tool that policymakers can use to formulate and develop their innovation policies. It recommends ways in which African can transform from a natural resource-based economy to an industrial and innovation-based economy that will produce and participate in trade of high value-added products and services.

(c) *A technological resurgence? Africa in the global flows of technology* (available at http://www.uneca.org/istd/tech_resurgence.pdf). This study assesses the extent to which African countries are benefiting from and participating in the global technology market using a number of technology transfer proxies. It reveals that Africa

has registered tremendous increase in royalties and licensing fees, in imports of capital goods and business, professional and technical (BPT) services but is lagging behind in attracting foreign private R&D investment and in technology production and ownership (e.g. patents). It recommends simple steps that African countries can easily apply within their existing institutional set-ups and budgets to accelerate acquisition and use of foreign technologies.

(d) *Proceedings of the Second Science with Africa (SWA-II) Conference on Science, Innovation and Entrepreneurship* at:
<http://www.uneca.org/sciencewithafrica/swa2proceedings/swa2proceedings.pdf>.

(e) The *Proceedings* report suggests that countries seeking to unleash the power of entrepreneurship and innovation have to put the right policies in place, support measures and mechanisms such as appropriate intellectual property right regulations, and set up resources and partnerships, among many others. For this reason, it pays special attention to development of innovative policy tools and measures to build the necessary human capital, STI infrastructure and financial instruments. It also focuses on strategies that target underrepresented groups (e.g. youth and women) and that create international collaboration.