NEXT EINSTEIN FORUM

An AIMS initiative in partnership with the Robert Bosch Stiftung

WHITE PAPER

Laying Down the Groundwork for a Knowledge-Led Society: Policy and Practice

The present white paper will adopt the following structure:

1. **Introduction**
2. **Theoretical Background**
3. **Three Main Pillars: Expected Outcomes and Suggested Practices**
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1. Introduction

Africa is a continent with a growing consumer base, entrepreneurial ambition and homegrown innovation. With more than 314 active technology hubs in 93 cities in 42 countries in Africa[1], entrepreneurs on the continent are innovating in every sector from education and health to agriculture and energy, be it products or services.

Africa is increasingly becoming a generator of knowledge, innovation, creativity and technology, rather than being solely an adapter of trends produced elsewhere in the world - like it was mostly the case in the past. There is no doubt that this trend must not only be encouraged by African Governments, but it must also be accelerated with the implementation of specific proposed public policies. Why? Because the knowledge and creativity-based development model renders obsolete all other models of development as it has a unique feature that none of the other models does: its entire bedrock rests on bringing self-sufficiency, independence and self-generating mechanisms of well-being gains enshrined in each domestic economy, and that is for the entire African continent.

The knowledge-based development model can charter new territory for Africa – a territory where it has never succeeded in going before - a territory where an extremely knowledgeable, creative, skilled and educated young and dynamic African population combined with the implementation of science/evidence-based public policies by African leaders, finally brings societal well-being, that is well-being to every single citizen, on the continent.

The knowledge-based development model can do so in two specific ways:
1) it can ensure the continent's self-sufficiency, independence and self-generating mechanisms of well-being gains for all segments of its population rather than depending on outside help, and
2) it can, once and for all, lift all African countries out of the natural resources curse[2] or the Dutch disease or the paradox of the plenty by ushering them into an era where endowment in two new kinds of natural resources – namely knowledge and creativity -- is more closely correlated with societal well-being compared to endowment in oil and other natural resources.

One prime example of Africa embracing the locally created-knowledge trend is the disruption of traditional financial models by the introduction of mobile money transfers across the continent which have succeeded in connecting previously financially-excluded Africans to the formal financial sector. This African-born technology has now also been exported to Europe, North America, Latin America, India, etc. with success. The continent is also seeing the onset and rapid expansion of agriTech, e-Health and edTech, three solutions specifically adapted to the local needs related to some of the greatest challenges Africa faces: health, education and food security & sovereignty. Another aspect of the knowledge-based development changing old development pathways on the continent is the arrival of Western and Asian innovators and knowledge creators in Africa, those innovators being attracted by a more flexible regulatory environment on the continent. This has enabled Africa to welcome the first tests of newly developed technology in the West or East on its soil. Drone technology used for the delivery of medical goods as a transcendental solution

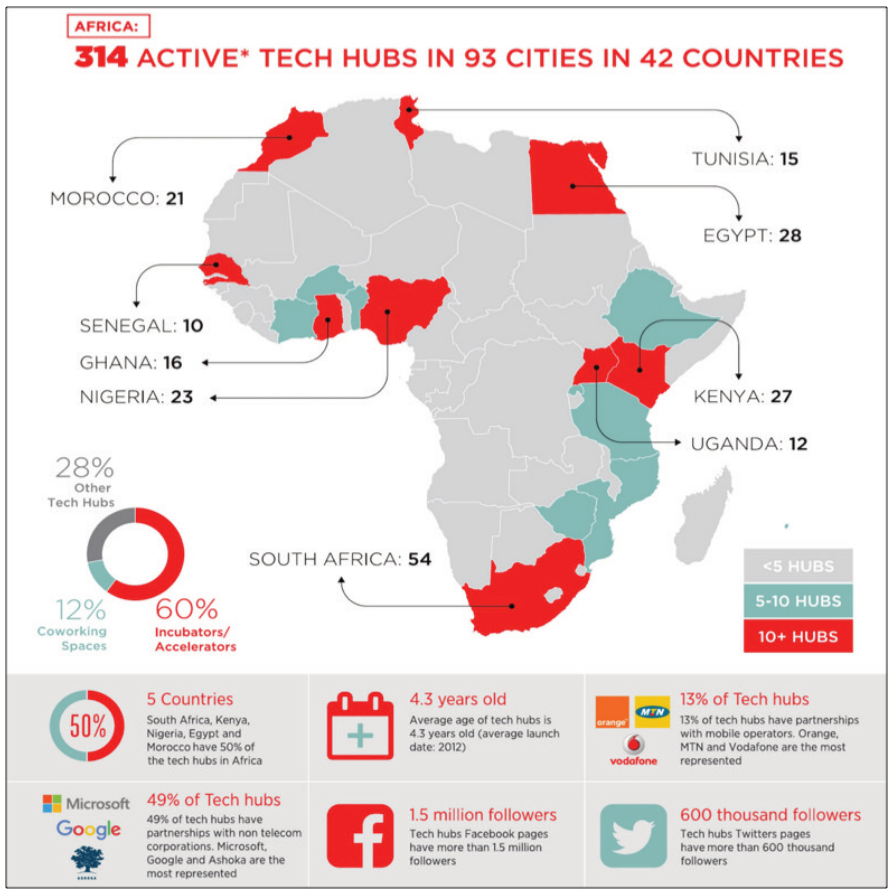
[1] http://www.visualcapitalist.com/africa-exploding-tech-startup-ecosystem/
[2] https://en.wikipedia.org/wiki/Resource_curse

to the medical infrastructure deficiency in Africa is a prime example of this trend. However, Africa must of course balance the right measure of openness to innovation testing with the precautionary principle through randomised controlled trials.

Validated and replicated scientific evidence has now proven beyond a doubt that knowledge and science-driven development is key to the following success equation in a country: innovation → job creation → socioeconomic inclusion → societal advancement → well-being gains for the entire population of a given country. But, to experience this success equation, African governments must first take concrete, specific actions to produce and disseminate knowledge around the continent, from one country to the other, leveraging the positive domino effect. As such, the Next Einstein Forum (NEF), with the African Institute for Mathematical Sciences (AIMS), would kindly like to suggest specific strategies to be implemented by African governments so that all can brilliantly achieve the transformation of their countries into knowledge-led societies and economies. These strategies are centred around three main pillars:

1) How to improve countries' regulatory frameworks to enable knowledge-led societies, most specifically in two policy areas: industry and science,
2) How to foster the relevant skills and capacity for a scientific and creative culture to take root in Africa, and
3) How to design efficient partnerships and structured financing to build pillar 1 and pillar 2.

Figure 1: Active Tech Hubs in Africa



Source: Ecosystem Accelerator

2. Theoretical Background

Around the world, advanced economies have now made the move towards knowledge-based economies. The OECD defines a knowledge-based economy as an economy which adopts and leverages a greater use of "knowledge, information and high skill levels", as well as embraces "ready access to all of those by the business and public sectors. (OECD, 2015)

We now know that the knowledge-intensive and high-technology parts of OECD economies tend to be the most dynamic in terms of output and employment growth leading to poverty reduction and social inclusion. Although knowledge has long been a pivotal factor in economic growth, poverty reduction and inclusive societal well-being, economists are now increasingly – and, importantly, more directly - incorporating knowledge and technology in their theories and models so as to foster increased high-technology investments, high-technology industries, a higher education focus, as well as knowledge access for all.

As such, a systemic focus and its related investments in the following areas is key:
1) research and development,
2) education and training, and
3) new managerial work structures. A systemic view incorporating the flows and relationships between academia, industry and government in a perfectly organised web will also be determining in the success of the knowledge-driven development strategy adopted by African governments.

Specifically, pan-African, national as well as local public policies must now wholeheartedly give priority to improving the continent's human capital - always any country or humanity's greatest asset throughout time – and this must be done through the fostering of collaborative networks that enhance the knowledge distribution power of all national economies by simultaneously improving the African higher education system, especially public research laboratories and institutes of higher education, collaborating at once with industry, small and more flexible start-ups and financial partners, as well as transferring knowledge, both horizontally and vertically, to all segments of the population in order to advance the entire society in one great leap rather than fragmenting it and increasing socioeconomic inequalities through inequalities in knowledge, higher learning, science and skills.

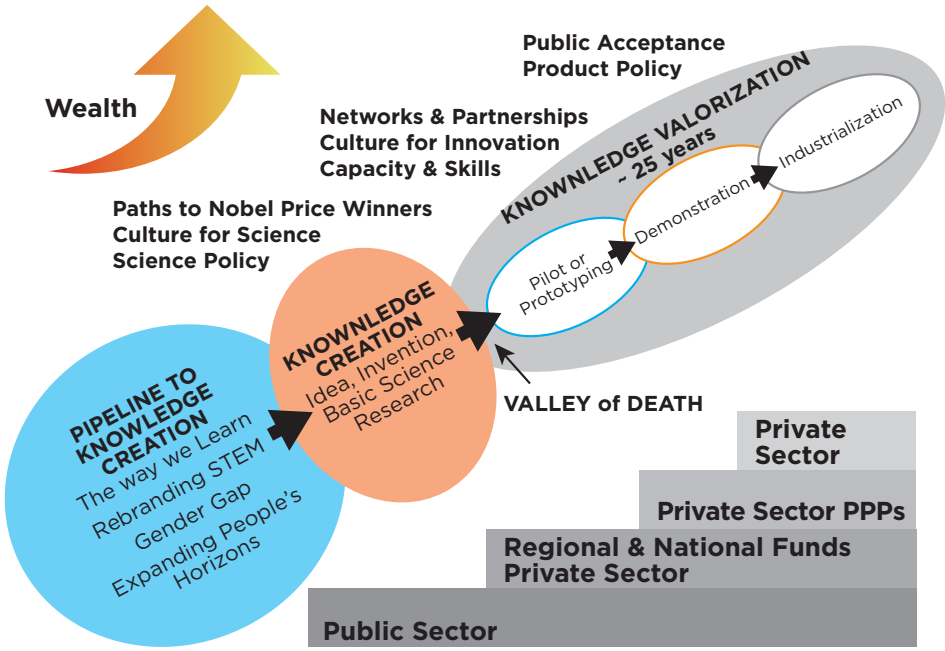
Knowledge travels around the world fairly quickly, as opposed to capital. All countries have access to the same pool of knowledge, and nations differ mainly in the degree to which they take advantage of this free public good by investing in physical plan and human capability.

Knowledge and the Wealth of the Nations. **David Walsh, 2006.**

This marriage of knowledge, science and a humanist vision of society, or, as we like to say, connecting science to humanity, with the aim of achieving the best quality of life for all Africans will require that all African governments implement the following Africa-focused threefold strategy as national strategy:
1) Improving the pipeline to knowledge creation
2) Developing and Strengthening knowledge creation
3) Valorising and Protecting knowledge while ensuring its freedom

The below graph summarises the three simultaneous and contiguous steps to be taken to lead African countries into successful knowledge-based economies and thriving societies.

Figure 2: The Knowledge Spiral Flow



1) **Increasing the pipeline to knowledge creation** is a multifactorial first step which includes changing the way we learn, rebranding Science, Technology, Engineering and Mathematics (STEM), closing the gender gap and expanding people's horizons to better understand the value of engaging in STEM studies.
1) **Knowledge creation** involves the continuous generation of ideas, inventions, innovation and basic science research, and a respect for facts as well as creativity in the population at large. One example would be to equip education institutions with adequate premises such as labs and to open dedicated spaces such as co-working areas or incubators.
1) Finally, **knowledge valorisation and protection** is a more complex, stepwise component whose approach consists of the transformation of an idea or an invention[3] into a product, a process or a service with an economic final outcome by reaching the market. Innovation can be incremental, disruptive or systemic, or a combination of two or all three of the aforementioned. The pathway from concept (idea, invention) to reality (market) usually include four distinct steps: 1) research and invention; 2) piloting or prototyping; 3) demonstration; and 4) industrialisation. Those stages lead to an increased technology scale or an increased Technology Readiness Level scale (TRL 1 to 9). Typically, research and invention range from TRLs 1 to 3, pilot or prototyping from TRLs 4 to 7, demonstration from TRLs 7 to 8 and industrialisation corresponds to TRL 9.

In said pathway from concept to market, the "valley of death" or "valley of hope" is the spatiotemporal point which determines whether ideas going through the innovation process will make it or not to the final market stage. The "valley of death" or "valley of hope" tend to make its apparition between TRL 4 and 7 during which stages innovative concepts can either be turned into working prototypes or fail to progress. Factors that determine success or failure include a lack of raw materials, a lack of understanding of the potential benefits, poor technical skills, inadequate infrastructure and lack of funding, amongst others. It is worth mentioning that African countries and other developing countries experience most challenges in passing the critical "valley of death" point, thus not sufficiently bringing inventions and innovative ideas to market. This is where African governments through adapted public policies can counter this unfortunate trend, e.g. through the fostering of technology transfer stakeholders as well as the implementation of intellectual property organisations.

[3] There is a distinction between invention and innovation. Invention is the creation of something new that does not exist in the market. Innovation on the other hand, is the use of an existing concept or idea, improving it, and developing it into a commercially viable product.

3. Three Main Pillars: Expected Outcomes And Suggested Practices

We gently but urgently call on Presidents and policymakers from around Africa to devote time, energy and resources to improving three main priority pillars to usher the entire African continent into the knowledge-driven era and to enjoy its numerous benefits to the well-being of all pans of the population. Those main pillars are:

1) the regulatory framework required to foster knowledge-based societies, most specifically, the required industrial policies and science-based policies,
2) the relevant skills and capacity for a scientific and creative culture to take root on the continent, and
3) the partnerships and structured financing required to build pillar 1 and pillar 2.

This chapter will now detail the three pillars by advancing expected outcomes for each as well as a non-exhaustive list of suggested specific practices to be implemented so to serve said outcomes. We propose that these suggested practices be put forth for discussion, debate and planning during the NEF Global Gathering 2018 so to involve all and to harness the knowledge, creativity and ideas of each.

You can find an overview of the chapter below.

Chart 1: Overview: Expected outcomes for the three pillars

Pillar 1: Regulatory Framework

Outcome #1: A Pan-African integrated market for optimal flows of innovative products, processes and services

Outcome #2: A systematic integration of innovation and creativity in national, regional and continental legislations, recognising their science-validated increases in societal well-being

Pillar 2: Skills & Capacity

Outcome #1: A highly educated, knowledgeable, skilled and creative population, as well as national, regional and continental scientific-innovative ecosystems which are dynamic and adaptive with the aim of building the pipeline towards knowledge creation

Outcome #2: Leverage on the existing and growing African Brain Trust as evidenced by the Next Einstein Forum Community of Scientists and other existing institutions and initiatives.

Outcome #3: Significantly reduce the Brain Drain of African Scientists and enable a conducive environment to leverage on top notch African scientists trained abroad

Pillar 3: Finance & Partnerships

Outcome #1: The creation of Pan-African Research & Innovation Fund by Consortium to fund fundamental and applied research through grants and other mechanisms, transnational research projects, pilot and demonstration projects, incubators and accelerators and industry affiliation programs etc.

Outcome #2 The setup of a Pan-African Coordination Framework to support the Pan-African Research & Innovation Fund.

Outcome #3 The creation of living database to track research happening on the continent for improved collaboration and funding.

Chart 2: Overview: Suggested practices to achieve the above-mentioned outcomes for the three pillars

Pillar 1: Regulatory Framework

Science-based Practices and Policies

Practice #1: Adapt the design of grants and funding instruments for innovation in such a way that they bolster science effectiveness

Practice #2: Create a faculty programme for PhD Holders by recruiting African diaspora and other researchers interested in Africa to rapidly and significantly increase the number of university faculty members with Ph.D. degrees

Practice #3: Develop and implement programmes and incentives to encourage university staff to obtain PhDs while in service

Practice #4: Align university research topics with government vision and priorities for which funds are to be made available

Industry-based Practices and Policies

Practice #1: Promote the creation and set-up of market segments specifically for innovation

Practice #2: Set up an independent entity for technology benchmarking

Practice #3: Set up a regulatory monitoring entity

Pillar 2: Skills & Capacity

National Education

Practice #1: Set up a national educational system no longer solely tuned for mass production, but also for knowledge creation

Practice #2: Interweave sciences with arts, music, literature and languages to foster optimal creativity and well-being in students at all levels: primary, secondary and tertiary

Practice #3: For each dollar invested by the private sector in the innovation ecosystem of a country, we suggest that it also invests one dollar in the country's educational system

Practice #4: Implement free universal primary, secondary and tertiary (Bachelor, Master and PhD) education for all citizens who wish it

Practice #5: Implement free vocational education and training for those who wish to benefit from it

Practice #6: Implement the most optimal technological infrastructure in all schools

Practice #7: Monitor and evaluate educational change

Practice #8: Implement free night and weekend lifelong learning for adults who wish to benefit from it

Practice #9: Introduce transdisciplinary courses for all students

Practice #10: Put in place, where lacking, career counsellors/mentors for staff and students

continues...

Pillar 3: Finance & Partnerships

Structured financing

Practice #1: Establish a central body that coordinates fundamental research funding across the continent (e.g. CARI)

Practice #2: Set up a Pan-African fundamental research grant scheme

Practice #3: Innovate and diversify the number of funding schemes (academy, governments and industry) for students to pursue PhD studies in Africa

Practice #4: Increase the level of funding for existing mechanisms for doctoral studies: scholarships, research grants, conference grants, etc.

Practice #5: Encourage a public practice with private actors by which for every dollar they invest in applied research, they must also invest one dollar in fundamental research

Practice #6: Establish a support programme for the prototyping and subsequent demonstration of most promising innovative technologies

Practice #7: Set up incubators, demonstration facilities & accelerators funding programmes for priority areas

Practice #8: Include pilot and demonstration projects in innovation funds

Practice #9: Foster industry association per sector

Practice #10: Promote the development of industrial sector vision and roadmap

continues...

Chart 2: continued

Pillar 2: Skills & Capacity

National Education

Practice #11: Increase and diversify the number of doctoral programmes including in-company PhDs

Practice #12: Improve capacity at multiple levels through training, networking and non-academic support

Practice #13: Introduce classes on gender equality, respect for women and respect for *their rights* in each grade at primary and secondary levels

Practice #14: Reduce class sizes at primary and secondary levels: limit the number of students per class at max. 20

Practice #15: National education systems must increase the number of primary and secondary-levels teachers they train to match the maximum number of students per class

Practice #16: Improve the quality of the training of all national teachers at the primary and secondary levels, especially in mathematics, sciences and linguistics where levels are insufficient

Practice #17: Implement trimester refresher trainings for teachers at all levels: primary, secondary and tertiary

Practice #18: Innovate and experiment with new teaching methods such as the Montessori and the Singapore methods

Practice #19: Use games, interactive learning, music, etc. in all disciplines at primary and secondary levels

Practice #20: (1) Introduce in-school homework rather than at-home homework and (2) Ensure that after-school lessons dispensed to children who need extra help are free rather fee-based so to reduce inequalities

continues...

Pillar 3: Finance & Partnerships

Partnerships

Practice #1: Foster smart partnerships articulated around innovation value chains

Practice #2: Develop partnerships and networks for PhD education, research and respected publications

Practice #3: Strengthen existing partnerships and network of research and university institutions within the continent so to encourage doctoral studies

Practice #4: Establish more strategic doctoral level-partnerships outside the African continent

Chart 2: continued

Pillar 2: Skills & Capacity

National Education

Practice #21: Encourage primary and secondary-level schools to all plant small gardens so to be able to serve healthy in-school lunches and snacks to low-income students

Practice #22: Include philosophy and humanities in teachings starting age 6

Practice #23: Include collective / societal well-being modules in each grade

Practice #24: Include environmental and biological health modules

Practice #25: Ensure high quality standards and expectations, as well as clear guidelines for PhD students

A Scientific and Creative Ecosystem

Practice #1: Build a research pipeline within universities in collaboration with industries and innovation ecosystems

Practice #2: Create an ecosystem to foster information sharing

Practice #3: Create research infrastructures to host African researchers

Practice #4: Encourage and trigger synergies and collaborations

Practice #5: Favour research and development of biomimetics

Practice #6: Implement 16 policy or societal area innovation clusters[4] in each African country

[4] The following 16 political centres correspond to 16 priority policy areas in African countries identified by governments, scientific organizations, research institutes, banks, multilateral banks and NGOs: 1) Preventive and curative health, 2) Education 3) Renewable energy 4) Waste management (e.g. energy waste management) 5) Precision agriculture for development / Food security and sovereignty 6) Environmental protection and natural resource management 7) Quality management of the environment air, water and soil / pollution reduction 8) Urban planning 9) Public transport 10) Infrastructure and construction, 11) Tourism 12) Arts culture Music dance Sports and entertainment 13) ICT 14) Community development and local governance 15) Inclusion of digital finance, 16) Cross-gender equality of opportunity and outcomes for all citizens should be created to ensure equal opportunities and results for all citizens of the 15 groups.

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