

**AN ANALYTICAL NOTE ON “TECHNOLOGICAL INNOVATION,  
ENTREPRENEURSHIP DEVELOPMENT, SCIENTIFIC RESEARCH AND  
DEVELOPMENT FOR ECONOMIC TRANSFORMATION”**

**INCEPTION REPORT**

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**AUGUST 2020**

### **Acknowledgment**

I wish to express my gratitude to the African Development Bank for giving me the opportunity to undertake this assignment aimed at preparing an analytical note on “Technological innovation, entrepreneurship development, scientific research & development for economic transformation” with focus on higher education.

## Acronyms

AfDB	African Development Bank
ATPS	African Technology Policy Studies Network
GDP	Gross Domestic Product
HESTI	Higher Education, Science, Technology and Innovation
HE	Higher Education
ICT	Information Communication Technology
HCS	Human Capital Strategy
R&D	Research and Development
RMCs	Regional Member Countries
TOR	Terms of Reference
SDGs	Sustainable Development Goals
STEM	Science, Technology, Engineering and Mathematics
TEVET	Technical, Entrepreneurial, Vocational Education and Training
JfYA	Jobs for Youth in Africa Strategy
UNIDO	United Nations Industrial Development Organization

## Inception Summary

This inception report for the preparation of an analytical note on “Technological innovation, entrepreneurship development, scientific research & development for economic transformation” provides the bases and guidelines on how the commissioned study will be undertaken to fulfil the Terms of Reference (TOR). It lays the foundation for the assignment by providing key information about the purpose and rationale of the study; the scope of work and tasks to be carried out; the methodology and approaches to be used for accomplishing each task; the implementation timelines; and the expected deliverables.

As detailed out in the TOR, the main purpose of this study is to provide an analytical note on “Technological innovation, entrepreneurship development, scientific research & development for economic transformation”. The study is premised on the fact that Higher Education Science, Technology and Innovation (HESTI); Research and Development (R&D); and Entrepreneurship development are strategic to the African Development Bank’s efforts in enhancing human capital for Africa’s economic transformation in the context of the Bank’s High 5 operational priorities. Examining the HESTI, R&D, and Entrepreneurship development ecosystem in Africa with a view to understanding the statuses, what works (successes), what does not work (failures) and why (reasons for successes and or failures) will provide the bases and impetus for developing and framing an analytical note on three selected broad priority areas namely: Training Infrastructure; Financing; and Governance. Whereas the Training Infrastructure aims to provide a deep dive on the current state, gaps and emerging infrastructure needs for HESTI, R&D and Entrepreneurship development for socioeconomic transformation in Africa; the Financing component aims to provide evidence and insights on the current state of financing, gaps and innovative mechanisms to finance HESTI and R&D in Africa; while the Governance component seeks to assess the policy environment, curriculum, management and administration, and underlying social issues (such as inclusion, gender, linkages, and networks among others) in the HESTI and R&D arena.

In addition, some crosscutting issues that will help in providing deeper insights and understanding of the above-mentioned priority areas will also be discussed. They include: Gender and equity in access to HEST; Harnessing HESTI and R&D to leapfrog technology innovation and entrepreneurship; Enhancing flexibility and responsiveness of HESTI and R&D; Linking HESTI and R&D to productive sector; and Regional centres of excellence, regional networks of knowledge and research. A diagnosis of these issues will be used to provide deeper emphases on the broad priority areas for the analytical note.

In order to accomplish the above purpose and targets, a multidimensional approach shall be deployed consisting of in-depth review of relevant literature on the subject matter; key informant interviews (KIIs) and focus group discussions (FGDs) with the relevant actors in the sectors; case studies linked to each of the broad priority areas; and validation of reports. All the approaches shall be inclusive with respect to geographical coverage, language, and current economic statuses of countries in Africa. The report that will be produced shall contain high-level recommendations to advance skills development in Africa with particular emphasis on the role of the AfDB.

## 1.0 Introduction

One of the aspirations of the Africa's Agenda 2063 is to re-position Africa in its growth and sustainable development pathway. This requires that Africa makes substantial investment in education with the core goal of developing human and social capital through application of Science Technology and Innovation (STI). It has been widely acknowledged that STI are indispensable for Africa's development with higher education expected to play a critical role in developing infrastructural needs in providing the required skills for employability, productivity and sustainable livelihoods (Addaney, 2018).

In the recent years, HESTI, R&D and Entrepreneurship development have attracted attention from various stakeholders due to its significant role in transformations particularly, in supplying productive skilled human capital. Several stakeholders comprising of international agencies, development organizations, public and private institutions have made huge contributions in supporting HESTI, R&D and Entrepreneurship development in developing institutional capacities to carry out research and training for socio-economic transformation in Africa. Similarly, African universities have responded in building infrastructural needs for HESTI, R&D and Entrepreneurship development despite numerous constrains including; funding, institutional capacities, quality concerns, weak research base and poor governance in the sector (Jowi et al ,2013).

Despite all the strategies in place, most African countries face shortages in human resources and capacity within the Science, Technology, Engineering and Mathematics (STEM) fields needed to support HESTI, R&D and Entrepreneurship development in providing enough skills for employability, productivity and sustainable livelihoods. The current trends in skills production particularly in the higher education show low percentages of graduates in STEM which does not match with the labour demand and has continuously posed challenges in re-positioning African countries to the growth and sustainable development pathways (African Economic Outlook, 2020). The poor quality of higher education (HE) in many African countries barely support HESTI and R&D in providing enough skills for employability among graduates. With outdated curriculum which does not adapt well with the labour market there is a mismatch between skills supply and demand thereby leading to many graduates being unable to get jobs in many industries. Low investments in ICT witnessed in many African countries with about 70% being unable to access internet and digital infrastructures have disadvantaged many youths and women in acquiring the required skills to harness the emerging new entrepreneurial businesses and other economic activities in generating employment due to low productivity (AFDB, 2019).

The African Development Bank (AfDB) as one of the key stakeholders in this sector has taken the bull by the horns to champion the sustenance of technological innovation, entrepreneurship development, and scientific research and development for economic transformation in Africa which is pursued through the lens of higher education. This is evident in their many supports to the RMCs but most specifically in the Bank's Ten-Year Strategy 2013-2022 (TYS), the Bank's High 5 priorities and particularly the Bank's Human Capital Strategy for Africa (HCS) 2014-2018 and the Jobs for Youth in Africa Strategy (JfYA) 2016-2025.

Similarly, and in response to the changing contexts within the higher education and the industry sector, the Bank intends to prepare its new Skills Development Strategy for 2021-2025 to guide it in achieving its High 5 priorities. Particularly, an analytical note that is designed to provide adequate insights to inform how the Bank can support the re-skilling/upskilling of Africa's workforce with demand-driven science and technological skills, strengthen relevance of R&D to industry, and build resilient enterprises that can weather economic shocks and pivot businesses to models that meet the changing demand of the changing market is required now more than ever.

## **1.1 Context Background**

### **1.1.1 Global perspective**

With the digital revolution taking centre stage across the globe, higher education science technology and innovation, research and development coupled with entrepreneurship development will be key in many countries due to its potential in economic development. According to Woetzel *et al* (2017), dozens of technologies will drive major economical and societal transformations in years to come with technological innovations expected to impact the economy between \$ 14 trillion and \$ 23 trillion a year by 2025, which will constitute one third of global Gross Domestic Product (GDP). According to the United Nations Industrial Development Organization (UNIDO, 2019), the major element bringing about the disparities both in income and social development existing between the developed and developing countries are rooted in the differences in their industrial development and use of technology.

Globally, many countries have made concerted efforts in embracing STI and R&D. For instance, China's STI is one of the most developed and productive in the world. The rapid advancement in training infrastructure, academic publishing and patents witnessed in China has made it become among the countries with best technological innovations. The country is targeting indigenous innovations and it has begun promoting modern science and technology as a self-strengthening movement, an act that has enabled it to become one of the leading countries in technology (Mok, Welch & Kang, 2020). In an effort to support innovations even more, the Chinese government devoted to allocate 2.5% of its GDP to R&D by 2020.

In the United States of America (USA), STI is the cornerstone of their economy and is considered as a dominant force in modern society and economic development. In an effort to strengthen the STI field, the Department of State executes public diplomacy programs that promote science to the public as well as implementing capacity-building programs that train the youths on how to become entrepreneurs in science and technology fields thus strengthening innovations (Yip, McKern, 2016). Through these investments, the USA has managed to remain among the countries that lead in STI in the world. The country has been able to have breakthroughs in medicine, engineering with recently SpaceX Company sending troops into space, the country has also been able to make breakthroughs in communication, transportation and territorial defence among other fields. The government has a strategy on STEM education where \$200 million is directed annually in grant funding to STEM education. The private industry also works to support the field by committing \$300 million annually (Coccia, 2019).

As at 2017, more than 200 colleges and universities had launched centres dedicated for entrepreneurship or innovation as members of the Global Consortium of Entrepreneurship Centres. The US-based data from the Association of University Technology Managers (AUTM), show that technology transfer from universities play a prominent role in economic development (Woetzel *et al*, 2017).

Additionally, Switzerland is another country that has made great progress in its STEM and R&D. It is recognized as the hub for education, science, technology and innovation. According to the 2019 UN Global Innovation Index, Switzerland was ranked the most innovative country. Science and technology have always been at the fore front in the country given the fact that it does not dispose any natural resources. The Swiss government invests heavily in HE by injecting 6% of their GDP, while their expenditure on R& D constitutes 3% of their GDP. Their scientists and researchers managed to produce 1.2% of all the scientific publications worldwide. The country has an organized way of conducting research where most of the research are conducted by the universities which are research intensive with modern technologies, research institutions as well as private company partnerships. Many of these countries with good STEM and R&D work well by collaborating with each other. For instance, many of the universities in Switzerland collaborate with universities in the US (Steinberg, 2015).

According to (Woetzel, 2017), institutions of higher learning should embrace the expanding role of driving innovations and catalyzing economic development through: fostering entrepreneurship as part of academic experience in the HE institutions. HE should create a culture which promotes and nurtures innovative thinking. As per the world Economic Forum (2020), science and gender equality were adjudged as being very important in helping the world attain the sustainable development goals (SDGs). For this reason, more policies and efforts have been put up to help inspire women and girls to study and work in the STEM fields. However, participation of women in STEM and R&D has not been optimal (United Nations, 2014). They still remain under-represented both in HE institutions and at the work places. Women make up around 30% of world researchers, despite being majority of world's population. When choosing courses, less than a third of female students choose technical courses like maths and engineering. At the work place, women in the STEM fields publish less and are also underpaid compared to men. These factors continue to widen the gap existing in the STEM and R&D fields. In Central Asia, women make up almost half of the researchers but drops to 18.5% in South and West Asia and less than 15% in India. Progressively, in countries like the Azerbaijan, Thailand and Georgia, women in research outweigh the men. In Latin America, Caribbean, and countries in Central and Eastern Europe, female engagement averages around 40% and 31% in North America, Western Europe and sub-Saharan Africa. Female enrolment in ICT courses across the globe amount to 35. 5% for mathematics and statistics courses and 8% for engineering, manufacturing and construction courses. To address the issues that challenge women in their pursuit in STEM courses, the root of the challenges should be looked into at both the individual, family and societal level. Policies and programmatic measures need then to be institutionalized to safeguard gender equity in STEM both in education and at the workspace (The AAS, 2020).

### **1.1.2 Regional perspective**

Africa as a whole lacks robust strategic plans on STEM policies which slows down its progress in attaining economic development. Despite Africa holding about 17% of the world's population, many African countries have backslid in STEM knowledge compared with other developed countries. In Africa, 19% of the global population between 15-25 years are youths with huge untapped potentials occasioned by lack of skills needed in the labour market. The shortages in STEM human resources, lack of electricity, low student enrolment and weak governance have deprived many of its youth gainful career opportunities. The rising skills mismatch and low productivity in the informal sector reflects the failure to tackle these formidable backlogs and will deprive the whole generation enormous opportunities for development. This is why it is important for Africa's education to reach new levels, particularly skills that can promote STEM jobs.<sup>1</sup>

The research capacity of Africa remains untapped when it comes to R&D. Many African scientists have proceeded to study at non-African universities and majority never make it back to their home countries for obvious reasons. The World Economic Forum (2020) states that Africa produces only 1.1% of global scientific knowledge which includes publications and other contributions. It is still unnerving that the continent has 79 scientists per million of inhabitants. Higher education in Africa is under-developed, with enrolment of women still being very low particularly in the science and technology fields. Currently, majority of African countries have shortage in capacity within STEM disciplines (Duermeijer and Schoombee, 2018). Inadequate investment in the HE has resulted in the institutions not being able to respond to the immediate skill needs. In many African countries, more than half of the investments in education are internationally funded and as such, puts the African continent strategically at a disadvantage in designing home grown solutions using HESTI and R&D for their complex developmental challenges.

In an effort to develop relevant skills required in the job market, there has been development of industry-based education training with the objective of providing specific employment into the labor market. The recent investments in HE and TEVET institutions have been very key in bridging the skill gaps (Bhuetel, 2015). The industries have strived to close the gap by linking STEM and R&D through offering industrial attachment opportunities where students get to practice and get hands on experiences about the theories that they have learnt in the classroom. Some publications made in some of these African countries have however contributed to the STEM fields.

## **1.2 Rationale**

The principal rationale for this study is premised on the fact that Higher Education Science, Technology Engineering and Mathematics (STEM) are strategic to the African Development Bank's efforts in enhancing human capital for Africa's economic transformation in the context

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<sup>1</sup> <https://thestempedia.com/blog/stem-education-in-africa-the-past-present-and-future/>

of the Bank's High 5 operational priorities. Most African countries face shortages in human resources and capacity within the STEM fields needed to support HESTI, R&D and Entrepreneurship development in providing enough skills for employability, productivity and sustainable livelihoods.

The current trends in skills production particularly in the higher education coupled with low percentages of graduates in STEM which does not match with the labour demand is a concern (AEO, 2020). For instance, between 2012-2016, higher education enrolment growth was 43% globally, however in the STEM fields where there are high prospects for jobs, it had an enrolment of about 38.5%. Subsequently, the education system has failed to support higher education in narrowing the skills gap, as it shows a systematic bias against women and girls in STEM/STI fields with considerable under-representation from the female gender. Furthermore, while Africa's contribution to scientific publication has improved, it is still limited with statistics from the Elsevier B.V *Scopus* database showing that Africa's world share rose only from 2.4% to 3.1% (AfDB, 2020).

Additionally, even where training program in sciences are available, training does not often match with the quality and soft skills needed in the industry thus leaving majority of the youth unable to land existing jobs. The poor quality of education and mismatch of skills witnessed in the labour market is as a result of the poor linkages between the industry and business in general coupled with poor mainstreaming of the culture of entrepreneurship in HE. Consequently, the rising prospects of opportunities in light of adoption of the digital technologies and improved literacy appears to be an immense opportunity to position Africa's Higher education strategically in the ecosystem. This is because HE plays a key role in the innovation and entrepreneurship systems by enhancing capacities, fostering technological innovation and transfers and building linkages with the private sector. The current COVID-19 pandemic has accelerated the adoption of technology worldwide. Over 75 million jobs will be displaced by technology by 2022 according to the World Economic Forum (2018). Currently, millions of jobs have been threatened as a result of the COVID-19 pandemic, with some jobs functions now suddenly extinct. At the same time technology has been a source of new jobs. It has been estimated that technology will also be a source of over 133 million new jobs - this is the opportunity that Africa must not miss (AfDB, 2020). Industries are now requiring higher-level of STEM skills as structural adjustments in the economy force businesses to move up the value chain. Subsequently, the pandemic has also exposed the reality that many African economies are not equipped with skills and technologies for resilience in crisis. This therefore calls for urgent actions by relevant stakeholders to reverse these trends.

The African Development Bank (AfDB) as one of the key stakeholders in this sector is committed to supporting enhanced technological innovation, entrepreneurship development, and scientific research and development for economic transformation in Africa. This is evident in their many supports to the RMCs and its further commitment to support the RMCs even the more. The Bank is preparing an analytical note on "technological innovation, entrepreneurship development, scientific research & development for economic transformation to provide adequate insight to inform how the Bank can support the re-skilling/upskilling of Africa's workforce with demand driven science and technological skills, strengthen relevance of R&D

to industry and build resilient enterprises that can weather economic shocks and pivot businesses to models that meet the changing demand of the markets.

## **2.0 Purpose and Objectives**

The overall purpose of this assignment is to prepare an analytical note on “Technological innovation, entrepreneurship development, scientific research and development for economic transformation. Most specifically, the assignment aims to address the issues addressed under the Terms of Reference (TOR).

## **3.0 Scope of the Study**

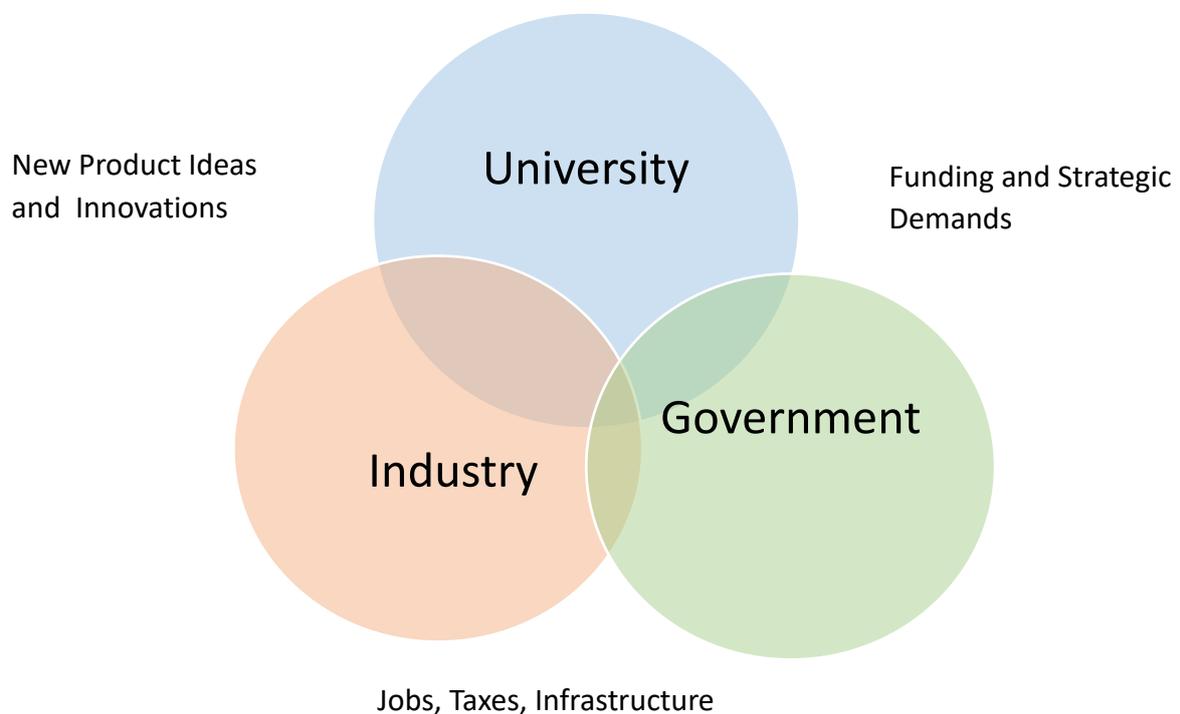
### **3.1 HESTI, R&D and Entrepreneurship development ecosystem in Africa**

The analyses will focus on three thematic areas namely: HESTI; R&D; and Entrepreneurship development. With respect to HESTI, higher education is important in providing skills that are needed in the labour market. However, there is currently a failure in the provision of these skills needed to support production as well as technological innovation which will come mostly from science and technological innovation. With the ever-changing state that the world is currently at, STEM studies and careers are becoming increasingly important for youth in African Higher Education institutions to be prepared to bring knowledge and skills as well as innovative ideas that can solve existing problems in the world, use information to their advantage as well as gathering and evaluating evidence presented to them for decision-making. These are the kind of skills that students develop in STEM disciplines in HE institutions.

Research and development are key factors for improving the competitive advantage in science and technology in HE. How much a government and the private sector in a country invests in R&D is a major indicator of their effort to obtaining competitive advantage. The failure to invest in R&D by the African governments in higher education makes it challenging for the scientists and researchers to develop homegrown, sustainable solutions to the African problems. However, with the recent increased investments in R&D by African countries, targeting inclusion of women and girls in the research world as well as in grants making will no doubt cater for the needs of women in this field. This will ensure women are motivated to take part in R&D , through joining courses offered in HE that are geared towards economic growth like the STEM fields.

Entrepreneurship development is recognized as an engine for economic growth while innovation plays an important role in the socio-economic development in countries. Entrepreneurship therefore favours the search for opportunities and innovation which impacts a country’s wealth. To achieve growths through entrepreneurship, there need to be interaction between information, training of human capital in institutes of higher learning and research centers, adequate access to funding as well as business opportunities relating to the market, customers and suppliers.

The triple helix model of innovation is based on the interactions between the government, the industry and research (university) in an effort to foster socio economic development. In this case, the government is the regulator in the market, the industry produces commercial goods and the university engages in basic research. As the interactions increase within the stipulated frameworks where each component adopts some traits of the other leading to rise of hybrid institutions. The linkages between the research and industry is very important in skill development in that, as the university provides education and basic research to learners, it should work to know what skills the industry needs by providing the research on which the industry would build upon in their production. On the other hand, the strength between the university and the government will only depend on the government’s relationship and its policy towards higher education in terms of funding and creating enabling environment. This will greatly impact skills development needed in the job market.



Source: Author

### 3.1.1 Higher Education, Science, Technology and Innovation

This theme seeks to understand the current statuses of HE with respect to Science Technology, Engineering and Mathematics. It also seeks to provide an overview on how HESTI facilitates skills development, productivity and employability.

#### a) HESTEM

Higher education will be key in producing STEM skills needed in the industry. The poor quality of education and mismatch of skills witnessed in the labour market is as a result of the poor linkages between the industry and HE. The current trends in skills production particularly in the higher education shows low percentage of graduates in STEM which does not match with the labour demand.

## **b) Technology innovation.**

With the global emergence of disruptive technologies typified as a '4IR' (Fourth Industrial Revolution) taking centre stage and its potential for transformation of economies and societies across the world, there is need for the higher education systems to respond to demands of 4IR in creating relevant skills. The insufficient infrastructure witnessed in the light of 4IR needed to improve HESTI and R&D in creating employability skills in the labour market may render many existing jobs redundant. The emerging needs for 4IR uptake include: internet penetration which entails fibre optic cables, broad bands (3G,4G, 5G); high quality internet speeds which are reliable; and affordability are key in driving technological innovations.

### **3.1.2 Research and Development**

This theme seeks to provide an overview of the role of R&D with respect to higher education. R&D has played a key role in enhancing productivity as it leads to discovering new ways of doing things. With low investment in higher education and R&D witnessed in most African countries there is inadequate support for HESTI and R&D required to produce enough employability skills. In many African countries, more than half of the investments in education are internationally funded and as such, puts the African continent strategically at a disadvantage. For instance, the African Union set target of 1% of GDP invested on R&D for African countries. However, available data shows that only three countries in sub-Saharan Africa have been close to achieving this target. The countries are Kenya, South Africa and Senegal which invest around 0.8% each (UNESCO, 2018). As at 2016, South Africa was using 0.8% of its GDP on R&D, Egypt's GDP expenditure on R&D as at 2013 was 0.68%, and Tanzania's was 0.53%, 0.29% for Mali in 2017, and 0.17% for Uganda in 2014. As at 2010, the expenditure on R&D in Morocco was 0.71%. These numbers show that R&D in Africa is still under developed and more efforts need to be put in place by the African governments and the private sector actors to ensure that the sector is significantly improved (Duermeijer, *et al*, 2018). There has however been significant growth in the investments made by African countries geared towards R&D growths. In South Africa, there has been investments in recent years for green R&D endeavours. It is seen especially where private companies especially in the mining sector have been investing heavily in R&D.

### **3.1.3 Entrepreneurship Development**

This theme will provide the information on entrepreneurial opportunities that is generated from higher education. Higher education institutions need to include educational programs for entrepreneurship that develop creativity and innovative talents which will generate opportunities for knowledge transfers and networks. Studies however show that there is a gap existing between what the institutions of higher education are offering schools and what students can apply in their lives to contribute to the growth and development of the economy. It has been established that a big portion of what is offered in HE is more theoretical rather than practical. Therefore, the students fail to prepare adequately for the needs of today's society. This becomes a challenge when they finish their learning institutions as they remain

stuck because they do not fit into the job markets neither do they fit in the entrepreneurship space (Jianling & Zheng, 2017).

### **3.2 Key priority areas**

The analytical work will be developed with emphases on three priority areas namely: training infrastructure, financing and governance while focusing on HESTI, R&D, and Entrepreneurship development. The priority areas form the underlying outputs and framework that the Skills Development for Employability and Entrepreneurship strategy will be built upon.

#### **3.2.1. Training Infrastructure**

In line with the three thematic areas (HESTI, R&D and entrepreneurship), this priority area pursues to understand what is the current state of ICT/connectivity, readiness for the 4IR, what can be done to accelerate the growth of STEM, entrepreneurship and R&D through adequate infrastructure. What are the key challenges and issues for consideration regarding maintenance of these infrastructure over the long run?

#### **3.2.2. Financing**

This priority area will provide evidence and insights on the current state of financing, gaps and innovative mechanisms for financing HESTI and R&D in Africa to adequately meet the desired objectives.

#### **3.2.3. Governance**

This priority area will provide an assessment of the current policies and how they are enhancing or inhibiting HESTI, R&D and Entrepreneurship, and how the bank can support curriculum development that meets the industry needs, how the bank can position itself in contributing to HESTI, R&D and Entrepreneurship development in Africa.

### **3.3 Cross Cutting Issues**

Further, the report will provide an overview on the following cross cutting issues as well as the key government priorities on these cross-cutting issues.

#### **3.3.1. Gender equality and equity in access to Higher Education Science and Technology**

This section will seek to understand how the Bank would support STEM and increase the number of women in STEM; which form of policy or /infrastructure will be needed to support women among others. This will be based on information and best practices from Africa or other parts of the world. The section will evaluate the relevance of the Bank's biennial STI forum and ways to improve it. Particularly, AFDB STI projects that have been initiated as result of this forums will be evaluated

**Case Studies:** AfDB’s STI projects in Angola-2015; South Africa- 2016; Tunisia-2017

### **3.3.2. Harnessing HESTI and R&D to leapfrog technology innovation and entrepreneurship**

This section will evaluate best ways of positioning universities to be excellent centres of development through provision of skills needed to leapfrog technology advancement and accelerated innovation for economic growth.

### **3.3.3. Enhancing flexibility and responsiveness of HESTI, R&D and Entrepreneurship development**

In this section, the study seeks to answer how to institutionalize exchange programmes in HESTI and R&D within and outside Africa to promote knowledge circulation and partnerships.

### **3.3.4. Linking HESTI, R&D and Entrepreneurship development to productive sector**

This section seeks to evaluate how knowledge exchange mechanisms such as co-location, R&D and collaboration would promote HESTI and R&D linkages with the industry. It will also examine approaches and lessons on how entrepreneurship can be mainstreamed as key outcomes of HESTI and R&D.

### **3.3.5. Regional centers of excellence, regional networks of knowledge and research**

This section will examine successes and failures among the regional centres of excellence and the regional networks of knowledge and research in Africa with a view to repositioning them for better performance in HESTI, R&D and Entrepreneurship development.

**Case Study:** Centres of excellence - Uganda HESTI, Carnegie Mellon Rwanda, Pan African University, Coding for Employment program, Nelson Mandela institute.

## **4. Study Methodology**

### **4.1 Methodological approach**

This study will review and analyse relevant existing studies complemented by specific collection of secondary information from various sources. Both quantitative and qualitative approaches will be used to analyse the data. The study findings will be based on the information and data gathered through literature review, analyses of relevant documents both national and regional as well as inputs from various stakeholders including the Bank’s review team. To carry out this study, the study proposes to adopt the following approaches:

- a) **Desk research:** A desk review of all grey and published materials from reports and other secondary information will be undertaken to collect information already available in the public domain. The documents will include (a) National skills development policies and strategies including annual education sector performance or statistics reports, national development plans, national statistics and census figures, (b) Reports on various HESTI

the desk-studies will be a report that will highlight important and pertinent information needed to inform policy.

- b) Data collection:** Owing to the on-going physical distancing measures to contain the spread of COVID-19, data and/or information will be collected remotely without interpersonal contacts using a mix of quantitative and qualitative methods. Both structured and open-ended questionnaire instruments will be used and self-administered. Key Informant interviews (KIIs) and focus group discussions (FGDs) with selected respondents will be used to elicit relevant information virtually to triangulate the data and information from desk research and obtain deeper insights and perspectives on the subject matter.
- c) Case studies:** A case study approach will also be used, since there will be no “field visits” to any of the African countries, some countries with best practices in the three priority areas will be selected to elicit in-depth information on any case example and good practices worthy of noting and sharing. There will be reliance on existing networks in Africa to collect the relevant information needed using interviews virtually from key stakeholders both in the public and private sector (digital innovators, higher education experts, enterprise support organisations, research centers) to inform the analytical note. In extreme situations where specific information is required to inform a case study, the AfDB Human capital experts in these countries will be consulted in order to get specific information should that be needed.
- d) Data analysis:** Each data collection method will result in various data sets being collated. The desk review will result in various notes being written. Each interview will be transcribed and detailed notes will be written up. The quantitative data will be analysed and results will be presented in summary tables, graphs as deemed appropriate. Qualitative data from the desk review notes, reports, virtual interviews will be analysed using narrative and content analysis.

#### **4.2 Limitations of the methodology**

There are a few limitations to the proposed study methodology, I will take into consideration in the process of carrying out the study and interpreting its findings. The first limitation is that some patchiness in the findings is expected due either to unavailability of data for some historical dimensions of the study, or to lack of access to respondents even for some contemporary issues. I will use triangulation and the Bank’s Human Capital expert to deal with these envisaged challenges. The second and related limitation concerns availability of quantitative and qualitative data. Where quantitative measures on HESTI, R&D and entrepreneurship development are missing but desirable for supplementing qualitative data, I will create categories or Likert-scored scales from the qualitative data. The third limitation relates to low response rates from the targeted respondents. Our target is to have a high number of respondents across the study countries. I will leverage my contacts in order to cushion against low response rates.

### 4.3 Comparative Advantage

Comparative advantage refers to the unique niche that the AFDB has in comparison to other stakeholders in skill development that are needed to support HESTI, R&D and Entrepreneurship development. This section will provide information on why the Bank should invest and where it should invest. From the preliminary literature, the Bank has adequate resources needed to support these initiatives evidenced by their continued support to the RMCs. Governments and development partners are not investing enough as evidenced. As such, the Bank comes in to fill this gap.

Secondly, the bank's continued initiatives and focus on STEM which are strategic to the Bank's efforts in enhancing human capital for Africa's economic transformation in the context of the Bank's High 5 operational priorities puts it in a better position than the other stakeholders. Lastly, the bank has been investing in the education sector for many years now and its impact has been felt across different sectors in Africa.

## 5. Deliverables

The following key outputs will be delivered from this assignment:

- a) **A Draft Inception report** with the Annotated Table of Content.
- b) **A Draft report** focusing on the three thematic areas.
- c) **A Revised draft 1 report** incorporating the revised inputs on the three thematic areas; and preliminary inputs on the six cross-cutting areas.
- d) **A Revised draft 2 report** incorporating updated inputs on the six cross-cutting areas
- e) **A Final report**

## 6. Work plan for the research study

	August (4 weeks)				September (4weeks)				October (4weeks)				November (4Wks)			
	wk1	wk2	wk3	wk4	wk1	wk2	wk3	wk4	wk1	wk2	wk3	Wk4	W1	W2	W3	W4
Draft Inception report and a notated report outline submitted				31.8.2020												
<i>Inception report and report outline reviewed and cleared by the Bank<sup>(a)</sup></i>					7.9.2020											
Draft report – focus on three key thematic areas			18-9-20													
<i>Review by the Bank<sup>(b)</sup></i>								25.9.2020								
Revised draft 1: report incorporating revised inputs on the thematic areas; and key questions detailed in section III										13.10.2020						
<i>Review by the Bank<sup>(c)</sup></i>											20.10.2020					
Revised draft 2: Draft 1 incorporating updated and/or additional key issues listed in section														10.11.2020		
<i>Review by the Bank<sup>(d)</sup></i>															17.11.2020	
Revised draft 3: Final report																30.11.2020

### Data collection timeline

Data collection, synthesis and analysis	20.9.2020-10.11.2020
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## ANNEXES

### ANNEX I: ANNOTATED TABLE OF CONTENT FOR THE ANALYTICAL NOTE

- i) Table of Contents*
- ii) Acronym*
- iii) Acknowledgement*
- iv) List of tables*
- v) List of figures*
- vi) Executive Summary*

#### 1.0 INTRODUCTION

Under the introduction, the report will provide acceptable definitions of HESTI, R&D, and Entrepreneurship development to guide the understanding of the concepts and putting them in perspective in this study. It will further highlight the relevance of the above three thematic areas in reskilling Africa's workforce with demand driven science and technological skills as well as to the industry towards changing demand of the current market.

##### 1.1 Background

The context background will contain the broad overview of HESTI, R&D and Entrepreneurship development in the global and regional perspectives.

##### 1.1.1. Global perspective

This section of the report will:

- *Provide an overview of how HESTI, R&D and Entrepreneurship has been embraced globally.*
- *Provide the current data trends in STEM including women enrolment in STEM fields.*
- *Provide information on how industries are working with HESTI, R&D and Entrepreneurship in skill development aimed at reducing the skill gap between industry and HESTI.*
- *Provide an overview of policies and priorities in place in relations to HESTI, R&D and Entrepreneurship globally.*
- *Provide the percentage contribution of Africa to scientific publications globally.*
- *Show the correlation between and among HESTI, R&D and Entrepreneurship and livelihoods, employment and GDP.*
- *Highlight best practices from countries that have embraced HESTI, R&D and Entrepreneurship development including Switzerland, China, USA and how they are leapfrogging the benefits of HESTI, R&D and Entrepreneurship development.*

##### 1.1.2. Regional perspective

This section will:

- *Provide the status of HESTI, R&D and Entrepreneurship in HE in Africa.*
- *Assess the quality of teaching and learning in HE in promoting employability skills.*
- *Assess the commitment of HESTI, R&D and Entrepreneurship in development of all-inclusive (men and women) human capital development using STEM through the core functions of teaching and learning.*
- *Analyse the complexity between higher education and labour market with focus on STEM and how employers perceive skills developed from higher education in Africa.*
- *Present the contributions of scientific publications per country of focus in this analysis.*

## **2.0 HESTI, R&D AND ENTREPRENEURSHIP ECOSYSTEM IN AFRICA**

The report will analyse and examine HESTI, R&D and Entrepreneurship ecosystem in Africa in order to understand some of the major weakness and current dynamics between supply and demand in the labour market. Donor interventions and/or long-term strategies. The three thematic areas that will be analysed include:

### **2.1. Higher Education, Science, Technology and Innovation (HESTI)**

This theme seeks to understand what is happening in higher education with respect to STEM. Further, it will provide an overview on how technology facilitates skills.

Particularly it will:

- *Provide the current statistics in STEM, workforce of women in STEM in Africa specifically, the countries of focus under this assignment.*
- *Show the trends of women graduating in STEM fields.*
- *Examine how many universities are focusing on STEM in Africa.*
- *Examine why higher education institutions are offering high number of humanities fields in contrast to the STEM fields.*
- *Highlight how countries use ICT and STEM skills in providing, delivering, managing and administrating higher education in Africa.*
- *Provide an overview of the current capacities in HESTI in Africa.*
- *Provide an overview of the infrastructural status of HESTI in Africa.*
- *Highlight some of the best practices by various stakeholders in higher education science technology aimed at strengthening regional centres of excellent in ST in Africa.*
- *Highlight policy reforms in African countries aimed at supporting HESTI in producing skills.*
- *Highlight how the 4iR has changed work force and demand for skills. How can the Bank consider skilling for these changes?*

### **2.2. Research and development**

This section will provide an overview on how R&D enhances productivity, employability and sustainable livelihoods.

*Particularly the report will:*

- *Provide the current investment rates to R& D per country of focus in Africa.*
- *Provide the investment growth of R&D in the last 5 years in Africa.*
- *Examine how R&D is supporting livelihoods in Africa.*
- *Provide the contribution of Africa to scientific publications, patents, etc.*
- *Examine how R&D is enhancing productivity in the industry, business and in employment.*
- *Examine the current and emerging inventions in African countries.*
- *Provide an in-depth analysis of investment portfolios in research and development in Africa.*
- *Provide the correlation between R&D and GDP and how it impacts social lives.*
- *Showcase the level of involvement of the private sector in R&D and reasons behind such levels*
- *Examine the opportunities for public private partnerships (PPP) in R&D in Africa.*
- *Examine technology transfers and commercialisation of research.*

### **2.3. Entrepreneurship Development**

This section will highlight the impacts of HESTI and R&D on entrepreneurship particularly in business opportunities. The report will provide the following:

- *An overview of the current and emerging start-up business investments in Africa.*
- *Highlight new and emerging innovations in the entrepreneurship as a result of HESTI and R&D.*
- *Provide information on how industries are raising the level of STEM skills as structural adjustments in the economy to force businesses to move up the value chain (in the COVID-19 period).*
- *Provide how HESTI and R&D are enhancing entrepreneurial capacities, technological transfer and improvement of private sector linkages.*
- *Provide insights on how entrepreneurship can be effectively mainstreamed into HESTI and R&D.*
- *Provide insights on concept of entrepreneurial universities, and mainstreaming entrepreneurship in universities and its impact on the job creation, employment etc.*

## **3.0 KEY PRIORITY AREAS**

This section will analyse the three priority areas namely, training infrastructure, financing and governance with respect to the three thematic areas already described above namely; HESTI, R&D and entrepreneurship development. The essence of the analyses is to pinpoint specific areas where there are gaps in the priority areas with a view to identifying how these gaps can be addressed and the special role of the AfDB in filling this gap in Africa. This will form a major contribution to the proposed Skills Development Strategy.

### **3.1. Training Infrastructure**

This priority area aims to provide a deep dive on the current state, gaps and emerging infrastructure needs for higher education, science, technology and innovation (HESTI) and R&D for socioeconomic transformation in Africa. The ‘new normal’ brought about by factors such as the COVID-19 makes the Information Communication Technology (ICT)

infrastructure inevitable for the realization of the objectives of this priority as the pandemic rapidly transforms various sectors including transitioning learning to virtual platforms, disrupting supply chains and catalyzing digital commerce across the continent. Other support infrastructure such as power, equipment/ facilities, laboratories, etc. are considered.

Training infrastructure is an important aspect towards upscaling HESTI, R&D and entrepreneurship development in Africa. The lack of modern training infrastructure in most African higher education and research institutions have denied Africans the chance to grow its economic prospects and opportunities thereby depriving the youth of career opportunities in the job market. Many African countries have relapsed in STEM development compared with other developed countries. There are significant shortages of human resources in the STEM fields especially women coupled with the lack of access to electricity, poor ICT and internet access, and other modern equipment needed to support HESTI, R&D and entrepreneurship development in Africa. Investing in training infrastructure would lead to production of a generation of young professionals who can take charge in developing their countries. As such, there is need to build and rehabilitate existing training infrastructure and most importantly by linking HESTI, R&D and entrepreneurship development to the productive sector.

This section seeks to understand what the current state of ICT is in Africa, what can be done to accelerate growth of STEM, entrepreneurship and R&D. At the end of the analyses, it will provide insight on areas that the Bank will provide unique assistance for maximum impact. The following areas will be discussed.

### **3.1.1. State of current infrastructure in HESTI, R&D and Entrepreneurship**

Under this subsection, the report will provide the general current infrastructure in HESTI, R&D and Entrepreneurship development. Particularly it will give an overview of:

- *Status of human resources and capacity within the Science, Technology, Engineering and mathematics (STEM)*
- *Information on ICT in learning institutions*
- *Information on new and emerging infrastructure needs of Fourth Industrial Revolution (4IR) and rapid digitalization in improving HESTI and R&D. Particularly, it will give in detail on **internet penetration** which entails fibre optic cables, broad bands (3G,4G, 5G) in Africa; the status and **quality of internet speeds** which are reliable; and how affordable they are.*
- *How the administration and learning units including classroom and administration offices, workshop rooms are equipped i.e. ICT, electricity, etc*

### **3.1.2. Role of ICT-power nexus in HESTI, R&D and Entrepreneurship development**

Under this subsection, the report will provide information on the extent that connectivity in terms of the status of the ICT- power nexus in HESTI, R&D and Entrepreneurship development. It will provide information on:

- *How power /electricity access is attributed to technological advancement in HESTI, R&D and Entrepreneurship.*

- *How ICT connectivity is enabling youth and women in acquiring the required skills in fostering the emergence of new businesses and other economic activities in generating employment.*
- *How the lack of access to internet, learning devices-smartphones and laptops have inhibited learning.*

### **3.1.3. Best practices on sustained maintenance of HESTI, R&D and Entrepreneurship infrastructure**

This section will showcase best practices on sustained maintenance of HESTI, R&D and Entrepreneurship infrastructure around Africa and this will include:

- *How countries are upgrading and rehabilitating their infrastructure such as smart classrooms in HE as an emerging trend in a quest to deal with the COVID-19 pandemic.*
- *How institutions /governments have increased their investment in local technology entrepreneurs and innovations.*
- *How governments have collaborated with development partners to offer scholarships aimed at boosting STEM and R&D.*
- *How countries have implemented strategies through establishment of bodies to regulate and oversee all the research and development activities carried out within their countries.*

### **Recommendations for Bank's Support**

*The recommendations focusing on the areas of the Banks comparative advantage and complementarity with other development partners will be provided. The section will provide evidence on the comparative advantage, complementary and selectivity for “HESTI and R&D and Entrepreneurship development” that would yield maximum impact and scale.*

### **3.2. Financing**

This priority area aims to provide evidence and insights on the current state of financing, gaps and innovative mechanism to finance HESTI and R&D in Africa. The financing gaps witnessed in Africa's HESTI and R&D cause a major challenge in meeting its education and skill needs. With low investments in higher education and research and development witnessed in most African countries since 1980's Lagos Plan of Action, outputs from HESTI and R&D have not met the desired expectations in terms of skills, productivity, employment and sustainable livelihoods. In many African countries, more than half of the investments in education are internationally funded as such, puts the continent strategically in a disadvantaged position as we cannot dictate our own contextualized paths with donor funds. There is therefore need for institutions and countries to look for new approaches to improve funding in research and innovation (Ozor, 2015). Several financing models have been crafted to spur growth of technological innovations that are needed to contribute and support HESTI and R&D in creating employability, skills and productivity in the labour market.

This section of the report will provide evidence and insights on the current state of financing, gaps and innovative mechanism to finance HESTI, R&D and Entrepreneurship development in Africa in meeting the desired objectives. The following areas will be considered.

### **3.2.1. Innovative Financing Mechanisms**

Several critical innovative financing mechanisms aimed at bridging the financial gap in HESTI, R&D and entrepreneurship has been crafted in many African states. This section will cover the following issues:

- *How African countries have embraced domestic and global bargains to fill the financial gaps in dealing with their development projects including allocating a percentage of their GDP to R&D; allocating mineral export tax revenues to local mining projects towards STEM, etc.*
- *How institutions, foundations and philanthropists from developed countries support the development of STEM and R&D in African countries by providing grants and scholarships to enable more students acquire skills.*
- *How co-funding and corporate funding has reduced financing gaps.*
- *Provide information how grants have reduced finance gaps.*
- *How opportunities in Private Sector financing has supported HESTI and R&D and entrepreneurship development*
- *How opportunities in PPP can be harnessed in funding HESTI, R&D and entrepreneurship development*
- *The statuses of funding of HESTI by private sector.*

### **3.2.2 Current and emerging business models/trends in financing public and private HE**

The current and emerging business models for financing both public and private funded higher education, and research organizations witnessed in many African countries have led to new improved production of goods and services. This section will cover the following:

- *How research organizations in the African countries get their funding*
- *Emerging funding models for HESTI, R&D and entrepreneurship development*
- *Enterprises within public and private institutions with proceeds going into research and development*
- *Grants to public and private HE institutions*

### **3.2.3. Current/emerging financing models and best practices for HE in building skills**

Around Africa, several best practices witnessed in Higher education have been very instrumental in building skills that match industry needs. This section will cover.

- *Entrepreneurship training, second-chance training and digital skills/inclusion (and training high growth sectors) programs, short in-service training courses, and certification programs in Africa.*
- *How countries have set out funds to push for more awareness on STEM subjects through for example Tech-Women in a bid to fund and support women in STEM courses and STEM careers.*
- *New collaborations witnessed in African countries including co-funding training centres with industries and corporate funding of innovation and research universities aimed at building skills bank.*

### **3.2.4. Current/emerging financing models/best practices in research and development**

The private sector has adopted several models aimed at increasing funding in R&D. In many African countries, the private sector has established several grant schemes and innovation centers to build skills in HESTI, R&D and entrepreneurship. This section will provide information on:

- *How grant schemes have led to new technological innovations through awarding the best innovators.*
- *Countries where the private sector has established training centres.*

### **3.2.5. Diversification of funding sources for higher education**

Diversification of funding sources for higher education witnessed in many countries through cost-sharing mechanisms and student loan schemes has reduced reliance on government funding. In some countries, the private sector has come on board in financing the HE through providing affordable students loans. This section will document other sources of funding for higher education and lessons learnt from various countries that have succeeded in diversifying sources of funding in the higher education sector through cost-sharing mechanisms as well as in putting in place equitable, effective and financially viable student loan schemes.

The section will provide an overview of:

- *How private sector has come on board to provide private student loans*
- *The national students' financial AID Schemes in place that are supporting students in HE.*

### **3.2.6. Current and Emerging trends to scale triple helix model**

To scale up of collaborations in HESTI, R&D and entrepreneurship development for better quality results and closer public private partnerships between the research and industry have been initiated across Africa. The interactions between the government, the academia (the higher education) and the industry sector are being scaled up to foster economic and social transformations in African. This section will provide information on:

- *How Innovation and Information labs have acted as a catalyst for innovation and partnerships by supporting entrepreneurship, incubation schemes, new ideas generation, piloting and accessing best practices needed to support existing interventions with the aim of supporting the youth employment in Africa.*
- *How tech- giant organizations like Google and Facebook have invested heavily in tech hubs across the African continent and how can this be scaled in a manner where academia plays a critical role.*
- *In the case of MIT and Stanford, why are such centers not housed in African universities and what can be done to make African universities meet up with these standards.*
- *How adoption of smartphone and reduction of internet costs have led to increased number of hub techs across Africa.*

## **Recommendations for Bank's Support**

*Recommendations will be made for the Bank focusing on the areas of the Banks comparative advantage which will also be complementary with supports from other development partners.. It will provide evidence on the comparative advantage, complementary and selectivity for “HESTI and R&D and Entrepreneurship development” that would yield maximum impact and scale.*

### **3.3. Governance**

This priority area seeks to assess the policy environment, curriculum, management and administration, and underlying social issues (such as inclusion, gender) in the HESTI and R&D arena. The slogan that ‘policy/politics is superior to science’ underscores the need to provide an enabling ecosystem for HESTI and R&D activities to thrive in Africa. However poor governance structures and ineffective policies currently in place in most African countries do not support HESTI, R&D and entrepreneurship development in producing competent skilled human capital for employment, increased productivity and sustainable livelihoods. The education systems and workforce development strategies and policies in place are in need of reforms (AFDB, 2019). Issues to do with gender balance, curriculum management and administration need to be streamlined in a way that support skills development.

Over the years, institutional and policy factors including inadequate gender-friendly policy frameworks, and poor implementation of policies have continuously led to underrepresentation of women in STI and R&D in sub Saharan Africa (SSA). Consequently, due to poor institutional polices, research in most African countries continues to be male dominated with women accounting for about 28 percent of scientific researchers in SSA. Further, there are low representation of females in science at the World Academy of Sciences (13%) as such, governments in Africa urgently need to adopt policies that will stimulate R&D (Bridge International, 2019). Moreover, the African governments should collaborate with partners in creating education system that supports e- learning tools which is critical in producing skilled manpower. Further, the system should reconcile diversity and inclusion of marginalized groups by highlighting Science, Technology, Engineering and Mathematics.

This research report will provide an assessment of the current policies and how they are enhancing or inhibiting HESTI, R&D and entrepreneurship development in Africa, and how the bank can support the curriculum as well as position itself in contributing to HESTI, R&D and entrepreneurship development. It will focus on the following areas as indicated in the TOR.

#### **3.3.1. Policy environment on quality assurance mechanisms for HESTI, R&D and entrepreneurship development**

The quality assurance in higher education has gained significant momentum. This has been warranted by the growing public demand for better performance of higher education in relation to HESTI, R&D and entrepreneurship development. The mismatch between higher education graduate skills and the labour demand in the market has called for audit and reforms of policies and regulations by the governments in private and publicly funded HESTI, R&D and entrepreneurship to strengthen and ease cross-border flows. This section will therefore:

- *Examine the legislative frameworks in selected countries that are in place that aim to support HESTI, R&D and entrepreneurship development.*
- *Provide an overview of policies, administrative and institutional landscape of the HESTI, R&D and entrepreneurship development in selected Africa countries*

### **3.3.2. Administration of HESTI, R&D and Entrepreneurship development**

The management, delivery and quality of HESTI, R&D and entrepreneurship development requires that proper structures and policies are put in place in order to leapfrog its benefits.

This section of the report will:

- *Examine whether HE institutions continuously conduct regular internal and external surveillance audits to ensure they meet the quality management requirements in delivering HESTI, R&D and entrepreneurship development.*
- *Examine the mechanisms in place by the governments for quality checks in ensuring that HE institutions offer courses that are relevant to the job market and review compliance of HE institutions with the International Organization for Standardization (ISO) standards.*

### **3.3.3. Innovative approaches to collate and harness: market insights, data and statistics gaps in HESTI and R&D**

Many higher institutions and other research institution have developed new innovative approaches to tackle challenges relating to HESTI, R&D and Entrepreneurship by providing credible data and tools necessary in identifying existing research gaps aimed at supporting development of strategies to progress STI. This section will identify current /innovative approaches to collate and harness: market insights, data and statistics gaps in HESTI, R&D and Entrepreneurship. Particularly, it will provide an overview on:

- *How country-level policy discussions on STI policy should build upon country-level analyses of research performance and its link to institutional factors and education, research, and economic policies.*
- *How regional and international comparable information (on STEM courses) would be best accompanied by additional data collection on national research and research-based education sectors.*
- *How countries can use academic associations as data points to tackle challenges related to HESTI, R&D and Entrepreneurship.*
- *Innovative and real time approach to understand industry skills needs, talent migration etc.*

### **3.3.4. Curriculum to respond to industry skills needs**

Outdated curriculum which does not adapt well with the labour market has led to mismatch between skills supply and demand, and it has been cited as a costly feature in many African labour markets. This section provides an overview on the need for a curriculum that meet the needs of the industry. It will:

- *Document current reforms witnessed across countries in ensuring that academic programmes are highly relevant to the contemporary economic and social needs of*

*Africa which will equip the graduates with skills and competences of entrepreneurship and innovation.*

- *Provide an overview of some of the higher institutions of learning in Africa that have changed their education curricula to meet the labour market demands and the impacts such change may have had on skills, employment, productivity and sustainable livelihoods.*
- *Provide information how curriculums across African countries are adapting and keeping up with global changes in HESTI, R&D and Entrepreneurship development.*
- *Provide mechanisms put in place to ensure STEM courses learn more through practical rather than theory-based learning (competency-based learning).*

### **3.3.5. Best practices for strengthening the linkages among HE institutions, R&D organizations and the industry**

This section will highlight the best practices embraced in Africa in a bid to strengthen linkages between and amongst the HE institutions, research and development organizations, and the industry/private sector. The report will provide information on:

- *How the countries have established research agencies aimed at strengthening linkages between and amongst the HE institutions, research organizations, and the industry or the private sector*
- *How industry, university and research organizations are working together in developing training and partnership programs through internships, co-funding training centers with industries and corporate funding of innovation and research in universities.*
- *How higher education have increased reforms with a view to establish industry linkages for improved skills development*
- *How the industry supports HE institutions and research organizations especially in STEM fields*

### **3.3.6. HE positioning in delivering quality curricular, digital skills and lifelong learning trainings**

Emphasis on STEM studies with enhanced collaborations between the public and private sector in ensuring that skill development is in-line with the labour market is very important (AEO, 2020). This section will highlight how HE can be positioned to deliver quality curricular and gain accreditations needed to support extracurricular activities, digital skills and lifelong training programmes. The report will include:

- *An overview of how several countries have taken initiatives to prepare students at early stages of their education in equipping them with the skills required in the 4IR era.*
- *How governments have taken initiatives to emphasize STEM studies with enhanced collaborations between the public and private sector in ensuring that skill development is in-line with the labour market.*
- *An overview on how the countries have established research agencies mandated to institutionalize linkages between and amongst research institutions, HE institutions and the industry*

### **3.3.7. Equity and inclusivity in STI**

Equitable access to STI without discrimination to gender, disability and vulnerability will be key in upscaling HESTI, R&D and entrepreneurship development in Africa. This section of the report will evaluate issues to do with gender gaps in STI, people living with disability, vulnerable community and how the gaps can be bridged. The report will:

- *Document how countries are making efforts to encourage more females to enrol in STEM courses*
- *Provide information on governments' efforts in enacting inclusive laws and policies that accommodate women, youth, the vulnerable and people living with disability in the mainstream of affairs in HE, R&D and entrepreneurship development programmes in their countries*
- *Identify the initiatives in place that promote and motivate the female gender to be involved in STEM courses as well as in the research and development programs.*

### **3.3.8. Positioning ICT technologies for education management and service delivery**

The 4IR and technology boom have presented good opportunities to HE and R&D across the globe. Africa will not be left out to harness these opportunities especially with respect offering distance learning programmes and virtual training. Several countries have taken initiatives to prepare their students at early stages in their career by equipping them with the skills required in the 4IR era. In Kenya for example, the provision of laptops to children in the primary and secondary schools, introduction of e-learning platforms, and blended learning programmes which entails a combination of online and traditional learning have been initiated to prepare students adequately for HE, R&D and entrepreneurship development opportunities. This section will provide an overview on how ICT can enhance:

- *Service delivery such as teacher training and virtual universities,*
- *Government investment in the training infrastructures needed for HESTI, R&D and Entrepreneurship development in order to develop appropriate skills. This includes affordable and reliable power and digital infrastructures, and high-speed internet facility.*

### **3.3.9. Best practices in regional initiatives and its scalability**

Several best practices have been embraced by some countries and regions in supporting HESTI, R&D and entrepreneurship development. Intra-Africa collaborations in STI has contributed in ensuring that research and technological innovations are generated and scaled to support sector growth and economic development on the continent. This report will:

- *Highlight how the African Union's Agenda 2063 aspires to position Africa to become major knowledge and innovation force in the global economy*
- *Highlight countries that have ensured that they maintain high quality standards in HESTI, R&D, and entrepreneurship development*
- *Provide an overview on the Science, Technology and Innovation Strategy for Africa 2024 (STISA-2024) and how countries have fared so far in accomplishing its provisions*
- *Assess regional initiatives that have significantly promoted HESTI, R&D and entrepreneurship development*

- *Assess how countries have been able to realize the SDG Goal 4 on ‘Inclusive and quality education’ in Africa with emphases on STEM*

### **Recommendations for Bank’s Support**

*The recommendations will focus on the areas of the Banks comparative advantage and complementarity with other development partners will be provided. It will provide evidence on the comparative advantage, complementary and selectivity for “HESTI and R&D and Entrepreneurship and development” that would yield maximum impact and scale.*

### **3.3. Cross Cutting Issues**

The report will provide an overview on the following cross cutting issues.

#### **3.4.1. Gender and equity in access to higher Education Science Technology**

Women scientists and those in the STEM field play a vital role in scientific leadership including, their contribution to the development of the continent and its transformation. Despite their clear contribution to development, they remain under-represented in STEM. Over the years, there have been efforts put in place to encourage more females to join in the STEM courses in Africa as these for a long time have been considered to be male dominated fields. According to the World Economic Forum (2020), female students and employees are under-represented in the STEM related fields and courses. The female gender makes up only about 30% of world’s researchers, which is very low considering the fact that females make up a higher population in the world, the case is worse in Africa as female researchers only account for 5% of the total researchers and scientists. However, there have been improvements in recent years in countries like Cameroon, South Africa, Nigeria, Morocco, Senegal, Egypt, Rwanda, and Ethiopia which have shown an increase in the percentage of women researchers (UNESCO, 2017).

*This section seeks to provide the following information in the report:*

- *Policies or /infrastructure in place that support women participation in STEM fields*
- *Initiatives geared towards gender equality and inclusivity in STEM fields (both in enrolment, R&D programmes and employment opportunities) in the selected countries*
- *How can gender-disaggregated data collection and management be sustained in HESTI and how can the disparity in rural and urban access to HESTI be bridged?*

#### **3.4.2. Harnessing HESTI and R&D to leapfrog technology innovation and entrepreneurship**

The African Union’s Agenda 2063 aspires to position Africa to become major knowledge and innovation force in the global economy. This can be achieved through technological advancement, research and development projects. Highly skilled human capital in the STEM and R&D fields are essential to deploy new technologies to meet the agenda’s goals. The United Nations share the same vision in their 2030 Agenda on sustainable development. Due to this goal and vision for development, Technical Vocational Education Training (TVET), HESTI, R&D and Entrepreneurship institutions play a very crucial role in developing human

resource that is of right quality, exposing new knowledge, improving technologies and innovations that are a requirement in order to transform Africa's economy.

The following areas will be covered.

- *Overview of how centres of excellence can be specifically strengthened to promote technology innovation and ensure youth employability and skills development*
- *Highlight how policies and private sector engagements would stimulate an enduring technology innovation, entrepreneurship and scientific research and development*
- *Highlight how investment in HESTI, R&D and entrepreneurship development have been embraced in an effort to strengthen the production of human capital through technological innovations*
- *Highlight how to protect new innovations through patenting and ensuring that the inventors remain with the intellectual property right and they get recognized for their work.*
- *How can TEVET institutions be specifically strengthened to promote technology innovation and ensure youth employability?*

### **3.4.3. Enhancing flexibility and responsiveness of HESTI, R&D and Entrepreneurship**

HESTI, R&D and Entrepreneurship development should be flexible enough in a way that they cut across global, national, sectorial and spatial dimensions when thinking of linking up education and economic development. The theoretical, empirical and policy work for HESTI and economic development should be able to be reviewed periodically and adjusted in a manner which connects with the current trends.

*This section will:*

- *Provide how to institutionalize exchange programmes in HESTI, R&D and Entrepreneurship within and outside Africa to promote knowledge circulation, brain gain and partnerships.*
- *Provide an overview on how African institutions of higher learning as well as research organizations should strive to work together within the regions; first through collaborations and partnerships before seeking collaborations with international organizations*
- *Provide information on how to position ICT tools and technologies to support resilience and continuous training and skills development during and post COVID-19*

### **3.4.4. Linking HESTI, R&D and Entrepreneurship to productive sector**

Over the years, there have been tremendous scientific and technological breakthroughs that have taken place in many tertiary institutions in developed countries. This has been achieved mainly because the private sector has been a major contributor. The government play a role in providing the critical mass of science, technology and innovation skills which attract both foreign and local investments, thus offering a good link to HESTI and R&D to the productive sector of the economy.

*This section will provide information on:*

- *Knowledge exchange mechanisms such as co-location, R&D collaboration, etc. could promote HESTI, R&D and Entrepreneurship linkages with the industry.*
- *Private sector has been a major contributor to tremendous scientific and technological breakthroughs*
- *Top and critical areas of investments in R&D sectors that have linkage with HESTI and the industry in Africa*

### **3.4.5. Regional centres of excellence, regional networks of knowledge and research**

Regional centers of excellence are key in enhancing capacity of the institutions in delivering high quality training and the capacity to deliver R&D in addressing regional challenges facing development. Building strong sector partnerships and networks will greatly impact knowledge and research. Building and strengthening regional and international academic partnerships will raise the quality of education in other institutions in the region.

This section will examine successes and failures among the regional centres of excellence and the regional networks of knowledge and research in Africa with a view to repositioning them for better performance in HESTI, R&D and Entrepreneurship. It will:

- *Highlight best practices witnessed in the region particularly on African centers of excellence project within the STEM fields*
- *Examine how centers of excellence across the region are enhancing capacity for the institutions to deliver high quality training*
- *Provide information on how these centres are enhancing capacity to deliver the applied research in addressing regional challenges facing economic growth and development, while strengthening the relevance of the education and research centers*

### **Recommendations for Bank's Support**

*Based on the findings from the cross-cutting issues, top recommendations will be proffered for the Bank's consideration focusing on the areas of the Banks comparative advantage and which will complement other development partners' efforts.*

## **4. Methodological Approach**

This section will provide the methodological approaches that will be employed in the development of the analytical note. They include:

### **4.1 Desk studies**

To achieve the study objectives, comprehensive desk reviews and analyses of HESTI, R&D and entrepreneurship development in the selected countries will be carried out. A review of all grey and published materials from reports and other secondary information will be undertaken to collect information already available in the public domain. This documents will include (a) National skills development policies and strategies including annual education sector performance or statistics reports, national development plans, national statistics and census figures, (b) Reports on various HESTI, R&D and Entrepreneurship projects and initiatives, (c)

Regional and sub-regional reports and policy documents on Higher education science technology innovation, (d) various knowledge and research work on Higher education science technology innovation in Africa.

#### 4.2 Data collection

A combination of qualitative and quantitative methods will be used to collect data. Both structured and open-ended questionnaire instruments which will be used to collect data and will be self-administered. Key Informants Interviews (KIIs) and Focus Group Discussions (FGDs) with selected respondents will be used to elicit relevant information virtually to triangulate the data and information from desk research and obtain deeper insights and perspectives on the subject matter. With the help of existing networks including from the Bank, targeted key informants and FGD respondents will be reached and information retrieved from them.

#### 4.3 Case studies

Case studies falling under each of the three priority areas from different countries will be undertaken. Countries with best good practices will be selected for benchmarking. This will be based on the information obtained from the desk studies within the countries of focus. Some of countries that will be selected based on the preliminary literature include.

<b>Priority area for case study</b>	<b>Indicative countries</b>
<i>Financing</i>	<i>Kenya, South Africa, Senegal, Nigeria</i>
<i>Training infrastructure</i>	<i>Kenya, Mauritania, Ghana</i>
<i>Governance</i>	<i>Rwanda, Tunisia, Mauritius, South Africa</i>
<b><i>Other countries which will be studied</i></b>	
<i>East Africa</i>	<i>Uganda, Seychelles, Burundi</i>
<i>Southern Africa</i>	<i>Zimbabwe, Angola, Mozambique, Malawi</i>
<i>Central African</i>	<i>DRC, Cameroon, Central Africa republic</i>
<i>West Africa</i>	<i>Liberia, Burkina Faso,</i>
<i>North Africa</i>	<i>Egypt, morocco,</i>

#### 4.4 Data analysis

Each data collection method will result in various data sets being collated. The desk review will result in various notes being written. Each interview will be transcribed and detailed notes will be written up. The quantitative data will be analysed and results will be presented in summary tables, graphs as deemed appropriate. Qualitative data from the desk review notes, reports, virtual interviews will be analysed using narrative and content analyses methods. A cross-country analysis on specific thematic areas will be done to identify best policies and practices for lessons learning and knowledge sharing.

## 5. CONCLUSION AND RECOMMENDATIONS

### 5.1 General conclusion

This section will synthesize key points of the study findings from the literature reviews undertaken through the desk studies, interviews from key informant interviews and FGDs as well as case studies in giving an analytical note on “Technological innovation, entrepreneurship development, scientific research and development for economic transformation” with focus on HESTI.

### 5.2 Proposed Policy and Institutional Recommendations

The information obtained from the study will inform the development of key policy and institutional recommendations in advancing skills development in Africa, and especially the role that the Bank will play in accomplishing this objective. The opportunities for the Bank in re-skilling/upskilling Africa’s workforce with demand driven science and technological skills, strengthen relevance of R&D to industry and build resilient enterprises will be showcased. The study will provide strategies that the Bank can adopt to scale up access for girls and women in STEM in the pipeline as well as ensuring inclusive infrastructure and training that caters for the needs. Emphasis will be made on the policy and institutional reforms that will be required at country and regional levels to improve HESTI, R&D and entrepreneurship development that will sustain skills development, productivity, employability and improved livelihoods. These recommendations will be designed to fit into the proposed Human Capital and Skills Development Strategy 2021-2025. Particularly, on areas of the Banks comparative advantage and complementarity with other development partners that would yield maximum impact and scale on HESTI and R&D and Entrepreneurship development.

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