ASSESSMENT OF STI METRICS IN AFRICA – NIGERIA

A Pre-Pilot Survey and Assessment of the Feasibility of Deploying the Web-Based STI Indicators Scoreboard for Nigeria: Stakeholder's Consultation Report

Submitted to:
AFRICAN CENTRE FOR TECHNOLOGY STUDIES (ACTS), Kenya
Contract No: ACTS/021/2021

Prepared by:
Professor Williams O. SIYANBOLA,
Centre for Energy Research and Development (CERD),
Obafemi Awolowo University, Ile-Ife, Osun State
Nigeria

April, 2021

Contents

EXECUTIVE SUMMARY

The "Assessment of Science Technology and Innovation (STI) metrics in Africa" is a study funded by the East Africa Research Fund through the FCDO-East Africa Research and Innovation Hub. The project aims to pre-pilot and test feasibility of the STI web-based scoreboard in three selected countries; namely, Kenya, Nigeria and Zambia. The STI scoreboard is an organized set of indicators that together give a quantitative overview of the state of a National System of STI. The overall objective of the study is to explore the metrics used by different initiatives that measure science, technology and innovation in Africa and provide an at the country level assessment of the quality, completeness and appropriateness. The deliverable of the pre-pilot study is to come up with a collection of indicators to be considered to form part of the web-based dashboard/scoreboard for Nigeria.

This project presents a good opportunity for stakeholders in the National STI system to access and utilise the indices on the scoreboard in making policy and business decisions, inform intervention programmes as well as benchmarking across sectors and countries; hence, the need to gather stakeholders' views and opinions on the project and also secure their buy-in by allowing them select the set of indicators to be included in the dashboard. Here, the primary stakeholders include the main actors within the national innovation system such as government, knowledge institutions, organised private sector, development partners, and financial institutions.

For this exercise, the stakeholder's engagement was organized over two meetings; first at the National Centre for Technology Management (NACETEM), Ile-Ife and second, in Abuja, Nigeria's Federal Capital Territory. NACETEM's role as the National Focal Point (NFP) and the implementing Agency for ASTII Initiative is recognized and hence the special invitation extended to the institution to fully participate in the stakeholders' engagement. In contrast, participants at the Abuja meeting were drawn from about eight (8) different institutions including the private sector and international development partners. At each of the meetings, key definitions of science and technology activities (STA), business innovations, innovation activities and indicators were adopted and this provided the boundaries around which the STI indicators were situated; hence, guided the discussion and the selection or otherwise of the indicators.

It is worth noting that the meetings adopted the 175 general indicators provided by ACTS as the working document. After due considerations of all the indicators based on conformity, relevance, quality, completeness and appropriateness, one hundred and thirteen (113) of the 175 indicators were found to be of good quality, complete, and appropriate, therefore retained. Furthermore, forty-two (42) indicators were recommended for deletion, eighteen (18) to be expanded and only two (2) for modifications. It was further noted that most of the indicators from the National R&D and Innovation Surveys previously undertaken by NACETEM are not reflected on the compiled list and therefore should be included. In addition, inclusion of five (5) ICT related indicators and new set of indicators with special biases for gender inclusiveness are also suggested for considerations.

Finally, considering the intensity of interests, commitment and the feedback received from the stakeholder's engagement, the idea of a web-based scoreboard is a welcomed

development. The meetings provided useful insights as to what specific indicators stakeholders would like to see on the scoreboard. However, a major challenge envisaged in the realisation of the project objectives is how to ensure continuous and timely availability of indicators from the identified sources, giving the ever-present funding inadequacies of the NIS in the country.

1 INTRODUCTION

1.1 Project Background

The "Assessment of Science Technology and Innovation (STI) metrics in Africa" is a study funded by the East Africa Research Fund through the FCDO-East Africa Research and Innovation Hub. The project is strategically important to deepen the understanding of data on STI indicators and to monitor them, particularly as it demonstrates the progress that African countries are making to meet STI goals. The rationale was the dynamics in the STI ecosystem and the changes in the specific targets of these apparatuses of National Innovation System (NIS). This phase of the project aims to pre-pilot and test feasibility of the web-based scoreboard for three selected countries; namely, Kenya, Nigeria and Zambia.

The need to develop a Pre-Pilot Survey and to assess the feasibility of deploying the Web-Based STI Indicators for Nigeria Dashboard is germane to the delivery of a set of relevant metrics that reflects the current realities of the NIS in Nigeria. The perceived existing gap in tracking and monitoring components of the NIS may be partly due to the low participation of stakeholders in the process of generating data for the indicators as useful opinions may be relegated. The absence of relevant indicators is often a major obstacle for the design and implementation of STI policies in developing countries (NPCA, 2014).

In formulating STI policies, scientific indicators play a fundamental role of providing reliable evidence for formulating national innovation strategies, thus STI indicators are crucial in the NIS (Siyanbola et al, 2016). They are also useful in monitoring the development and progress of the innovation system; evaluate the efficiency and effectiveness of allocated resources; and benchmark against set targets. Similarly, they can be deployed to good effect in forecasting technological trajectories and thus provide a glimpse into the future (Gault, 2010). Beyond that, relevant indicators provide opportunities for members of the public to participate in public policy debate, thereby serving as feedback to policymakers in the design and monitoring of evidence-based policy (NEPAD, 2005).

In this regard, and as part of the ASTII programme, AUDA-NEPAD and its partners have developed and selected key indicators for tracking the implementation of STISA (2024), which aligns with the goals of Agenda 2063 and the Sustainable Development Goals. The initiative has developed a scoreboard that can be used to track and monitor the science, technology and innovation ecosystem in Africa. Specifically, the STI scoreboard is an organized set of indicators that together give a quantitative overview of the state of a National System of STI. This study was jointly executed by the Africa Centre for Technology Studies, the Africa Research and Impact Network, the AUDA-NEPAD development agency, the Science Policy Research Unit (SPRU), Sussex University, UK and OTB Africa. The overall objective of the study is to explore the metrics used by different initiatives that measure science, technology and innovation in Africa and provide an assessment of the quality, completeness and appropriateness.

1.2   Aim and Objectives

The main goal of the project is to pre-pilot and test feasibility of the web-based scoreboard for Nigeria. The objective of the study is to explore the metrics used by different initiatives that measure science, technology and innovation in Africa and provide an assessment of the quality, completeness and appropriateness. The specific objectives are;

    i.   To conduct a pre-pilot survey as a requisite for Nigeria to select relevant STI indicators to form part of her web-based STI indicator scoreboard.

    ii.   To harvest views and opinions from a consultation with key stakeholders in Nigeria on the web-based STI indicator scoreboard.

1.3   Key Activities

    i.   Introduce stakeholders to the study initiative and the key parameters to be considered during the pilot-survey;

    ii.   Collect and collate stakeholder's perspectives/views on the web-based scoreboard;

    iii.   Broadly consider the list of general indicators and, specifically types of input indicators, output indicators, impact indicators, enablers and linkages indicators that should form part of the Nigeria scoreboard; and

    iv.   Extract from the general indicators a robust list of preferred indicators that would form the content of Nigeria's web-based STI indicators dashboard.

1.4   The Deliverables

The main deliverable of the pre-pilot study is the list of indicators considered relevant and suitable to form part of Nigeria's web-based STI scoreboard.

2 Past and Present Experiences of Collecting STI indicator in Nigeria

The need to develop STI indicators began at NACETEM in 2005. The effort led to the integration of Nigeria's STI indicators initiative into NEPAD-OST (now AUDA-NEPAD) ASTII initiative in 2008. NACETEM was officially designated as the National Focal Point (NFP) and the implementing Agency for the project by the Nigerian Government in 2008.

In 2010, the first round of surveys was completed during which Nigeria submitted both R&D and Innovation Indicators for publication in the first African Innovation Outlook (AIO, 2011). In 2014, the second phase of surveys was completed; however, Nigeria could only submit innovation indicators for publication in the second AIO (2014). A similar trend was maintained in 2018 as the third round of the surveys was completed, but again Nigeria could not submit any data for publication in the 3rd AIO due to management challenges at the National Focal Point (NFP) and the FMST.

The current situation is that the fourth round of surveys has begun and in steady progress in all the participating countries. Indeed, Nigeria has completed the National Innovation Survey (2016 -2018) and currently undertaken the National R&D Survey (2019). For the first time, Nigeria has also extended the innovation survey to the informal sector. The data obtained is expected to be published in the fourth AIO in 2022.

Table 1: Historical Perspectives on Nigeria's Country's Report on ASTII Initiative

Year	ASTII Activities	Nigeria's Participation	Remarks
2005-2007	Pre-ASTII	Conducted a survey to assess innovation capacity in the manufacturing sector	The survey result was published as monographs and report widely discussed
2008	Selection of National Focal Point, and training Contact Persons	NACETEM was appointed as the national focal point	Preparations to collect STI indicators began
2009 - 2010	Collection of first set of indicators by National Focal Points (NFPs)	Collected R&D and innovation Indicators in 2009/10 (reference years 2007/08 and 2005-07 respectively)	Country's report published and data also published in AIO1 (2010)
2011 -2014	Collection of 2nd set of indicators by NFPs	Collected only Innovation Indicators in 2013 (reference year 2010)	Funding was grossly inadequate; however, innovation data was published in AIO2 (2014)
2015 - 2017	Collection of 3rd set of indicators by NFPs	Nigeria did not participate and AIO3 was published	NACETEM's funding was stopped due to implementation of Orosanye's Report
2018 - date	Collection of 4th set of indicators by NFPs	Innovation indicators collected Innovation survey extended to Informal sectors R&D survey ongoing	Funding restored

3   METHODOLOGY

3.1   Stakeholders Meeting/ Engagement

Indicators become effective when they are rooted in the policy process, and are watered by continuous engagement between key actors including policymakers, statisticians and the public (Siyanbola et al, 2016). Indicators inform public policy debates and generate discussions within policy departments, thus establishing the need for stakeholders' engagement.

The STI scoreboard is an organized set of indicators that together give a quantitative overview of the state of a National System of STI in participating countries. The web-based STI indicators dashboard for Nigeria is perceived to be a need-driven product that should be an outcome of stakeholders' opinions/ views, hence the need for the present engagement. Beyond that, it represents a good opportunity for stakeholders in the National STI system to access and utilise the indices on the scoreboard in making policy and business decisions, inform intervention programmes as well as benchmarking across sectors and countries. It is therefore appropriate to gather stakeholders' views and opinions on the project and also secure their buy-in by allowing them select the set of indicators to be included in the dashboard. The subsection 2.1.1 that follows presents a detailed analysis of stakeholders that are germane to the project in Nigeria.

3.1.1   Stakeholder Analysis

The stakeholder analysis is a collaborative process of identifying key people or institutions within a geographical boundary and beyond, and organising them into groups based on their knowledge, influence and interest on the subject matter. In this case, it involves mapping of key stakeholders relevant to the development of a web-based dashboard on STI indicators. Essentially, the primary stakeholders would include main actors within the national innovation system such as government, knowledge institutions, organised private sector, development partners, and financial institutions. (Please see in figure 1)

Figure 1: Key Stakeholders' Institution in Nigeria NSI

The stakeholders could be further broken down as presented in Table 1.

Table 1: Mapping of Selected Stakeholders

SN	Stakeholders Group	Actors
1	Government	Federal and State Governments
2	Knowledge Institutions	Universities and Research Institutes including National Centre for Technology Management (NACETEM), African Institute for Science Policy and Innovation, Obafemi Awolowo University (AISPI-OAU), Federal Industrial Research Institute Oshodi (FIIRO) etc.
3	Organised Private Sector	Manufacturers Association of Nigeria (MAN), National Association of Chambers of Commerce Mines and Industry (NACCIMA), National Association of Small-Scale Enterprises (NASME) etc.
4.	Development Partners	UNESCO Nigeria Office, AU-STRC Nigeria Office, ECOWAS Nigeria Office etc.
5	Finance Institutions	Central Bank of Nigeria (CBN), Development Bank of Nigeria (DBN), Bank of Agriculture (BOA), Bank of Industry (BOI), Commercial Banks etc.
6	Ministries Departments and Agencies (MDAs)	Ministries: Federal Ministry of Science and Technology (FMST), Federal Ministry of Industry Trade and Investments (FMITI), Federal Ministry of Finance, Budget and National Planning (FMFBN), Federal Ministry of Education (FME)etc. Agencies: National Agency for Science and Engineering Infrastructure (NASENI), National Office for Technology Promotion and Acquisition (NOTAP), National University Commission (NUC), National Board for Technical Education (NBTE), National Bureau of Statistics (NBS) etc.

The stakeholders were further classified based on their power of influence and interest on the STI web-based scoreboard. The result is as presented in Table 2.

Table 2: Level of Power and Interest of Stakeholders

High Power, Low Interest	High Power, High Interest
State Governments, National Assembly, Development Bank of Nigeria (DBN), Bank of Agriculture (BOA), Bank of Industry (BOI)	NACETEM, Federal Government, FMST, Central Bank of Nigeria (CBN), NBS
Low Power, Low Interest	Low Power, High Interest
Organised Private Sectors, Commercial Banks, FME, FMITI	NUC, NBTE, FIIRO, NASENI, NOTAP, UNESCO Nigeria Office, AU-STRC Nigeria Office

The analysis/result assisted the Consultant in the selection of key stakeholders; decide the mode of interaction and on key logistical issues regarding hosting the meeting.

3.1.2 Definition of Terms and Concepts

It was considered pertinent to ensure that all the participants have a clear and common understanding of relevant terms and concepts relating to the subject matter. This was necessary to ensure productive conversations and agree on suitable indicators.

In order to come up with the list of acceptable indicators, the meeting agreed to come up with a working definition of the activities that make up science, technology and innovation (STI). These are science and technology activities, business Innovation, innovation activities, and indicators as adopted from the OECD Frascati and Oslo manuals as well as other reliable sources. These documents are standard guides for measuring R&D and Innovation performance around the world which ensures indicators international comparability, benchmarking and competitiveness. The adopted definitions from the latest editions of the manuals are as follow:

   i. **Science and Technology Activities** can be defined as all systematic activities which are closely concerned with the generation, advancement, dissemination and application of scientific and technical knowledge in all fields of science and technology.
   ii. **A business innovation** is a new or improved product or business process (or combination thereof) that differs significantly from the firm's previous products or business processes and that has been introduced on the market or brought into use by the firm.
   iii. **Innovation activities** include all developmental, financial and commercial activities undertaken by a firm that are intended to result in an innovation for the firm.
   iv. **Indicators:** An indicator is defined as "a statistic, such as GDP, or population, or a combination of statistics, such as GDP per capita, which tells the public and the policy maker about the state of the economy and the society" (NEPAD, 2005). Adopted definitions of indicator types are provided in table 6.

The definitions provide the boundaries around which STI is situated; hence, guiding the selection or otherwise of the indicators.

Table 6: Definitions and types of indicators

SN	Log Frame Component	Definitions
1	Input Indicators	Indicators of program inputs measure the specific resources that go into carrying out a project or program, for example, amount of funds allocated to the health sector annually, Gross Expenditure on R&D (GERD).
2	Output Indicators	Indicators of outputs measure the immediate results obtained by the program, for example, number of publications or number of staff trained, GDP.
3	Outcome indicators	Indicators of outcomes measure whether the outcome changed in the desired direction and whether this change signifies program "success" or "failure", for example, number of Spin-off or spin-out companies, number of technology transfer to the industry, number of graduates with thriving /surviving businesses.
4	Impact Indicators	Impact indicators measure the long-term effect of programme interventions (e.g., the prevalence of violence against women and girls in community x.)
5	Enablers	An enabler is indicator capable of identifying and instigating opportunities for key business improvement.
6	Linkages	A Linkage is a cause/effect relationship between two indicators. Actually, the link is between the systems that the indicators measure -- but the indicators are windows into the systems. A Linkage can be parallel or inverse, direct or indirect.

Source: Adapted from MEASURE Evaluation Manual, 2003

Current sets of STI indicators consist of five accepted dimensions: research and development (R&D), human resources, patents, innovation and technology balance of payments (TBP) (UNCTAD, 2010). These dimensions, their collection and interpretation were discussed and explained during the meeting.

4   THE PROCESS AND PROCEDURE

4.1   Facilitating the Stakeholders' Engagement

The objectives stated in the contract terms of reference guided the course of actions before, during and after the stakeholders' engagement.

In moderating the stakeholders' engagement, a major input i.e., the general indicators' list provided by ACTS in an MSExcel Workbook was necessarily adopted as the working document. The workbook contains a total of 175 indicators, sufficiently comprehensive and detailing name/ description of indicators, the sources, values, ranking, logical framework component, actors, STI main activity type and quality ranking. However, based on the logical framework components and for the sake of convenience, the indicators were grouped or categorised into five; namely, enablers, impact, input, linkages and output. Please see table 7 for details.

Table 7: General Indicators by Type

SN	Log Frame Component	Number of Indicators
1	Enabler	107
2	Impact	30
3	Input	13
4	Linkages	13
5	Output	12
	Total	175

Prior to the meeting, an abridged Indicator's list was produced for use by the stakeholders based on the categorisation in Table 7. Due cognisance was given to other details provided in the original indicator workbook especially, the actors, the sources, and STI main activity type. The indicators' list by type, a one-page brief/concept note and a formal letter of invitation (see appendix) were shared with the participants, at least 48 hours before the meetings. This gave the participants ample time to study and digest the documents prior to the engagements. It also aided their understanding of the project objectives and ensured optimal participation and contributions during the meetings.

Given the consultant's experience and based on the output of the stakeholder's analysis, NACETEM's role as the National Focal Point (NFP) for ASTII Initiative was accorded special attention. NACETEM, an agency under the aegis of FMST collects and documents STI indicators through national R&D and innovation surveys on behalf of Nigerian government. The agency also works closely with NBS to disseminate data/information from the national surveys. To that extent, the stakeholder's engagement was therefore conducted at two meetings:

i.   At the level of NFP, NACETEM in Ile-Ife; and
ii. At the level of other key stakeholders in Abuja, FCT.

That approach turned out to be a useful one in that it assisted the Consultant to gather broad-based views, opinions and buy-ins from the participating stakeholders.

NACETEM being in close proximity with the Consultant was the first point of call. The meeting at NACETEM involved the NACETEM STI Indicators group and two (2) technology management experts from the African Institute for Science Policy and Innovation (AISPI-OAU). The meeting was held at the NACETEM headquarters on Wednesday 7th April, 2021. The meeting was attended by eight (8) participants (see appendix table A1 for list of participants).

The Abuja meeting involved experts and actors drawn from various institutions based on stakeholders' mapping exercise earlier stated in section 3.1. A total of 12 participants were invited for the meeting, however, only eight (8) were in attendance (see appendix table A2). The meeting held on Tuesday 13th April, 2021 from 09.00 am to 3.30 pm at the Rock View Hotels (Classic), CAD Zone, Plot 194, A8, Adetokunbo Ademola Crescent, Wuse II, Abuja.

4.1.1 Opening Session

The programme commenced around 10am with a welcome speech by the consultant followed by self-introduction by the participants with each providing a brief about themselves and the organization they work with and/or represents.

Thereafter, a general overview of the project was presented (in ppt) by the facilitators to the participants including historical perspective of the STI indicator in Nigeria, socio-economic relevance of indicators, key concepts and definition of terms, past and present experiences in STI indicators, why web-based scoreboard, and types of indicators to consider; namely, enablers, impact, input, output and linkage indicators. The presentation adopted working definitions of key terms including science and technology activities, business Innovation, innovation activities, and indicators. The presentation was highly interactive as the participants were at liberty to interject at intervals to pass comments and/or ask questions in the course of the presentation. The presentation set the agenda for a rewarding engagement with the stakeholders.

During the presentation, the participants were asked to ponder on some relevant questions to help focus their attention on the project objectives. This was essentially to enhance their curiosity, generate broad-based views and opinions on the specific indicators to be included on the scoreboard. Some of the questions posed by the Consultant during the presentation include the following;

i.   What is the socio-economic relevance of STI indicators to Nigeria?
ii.   Why are stakeholders important in selecting relevant indicators for the web-based dashboards?
iii. What are business Innovation, innovation activities, and their relevance to STI indicators?
iv.   How suitable (to Nigeria) are the definitions and indicators adopted from the OECD Frascati and Oslo manuals?
v.   What are the justifications for retaining, modifying and/or deleting some of the indicators?
vi.   What are the implications of expanding some of the input indicators on the output indicators?
vii. How best should the outputs indicators from the informal sector be adequately captured?

Each participant was given opportunity to contribute to the discussion and consensus building was engendered in ensuring the meeting produced the set of indicators that truly reflect the current realties within the NIS in Nigeria.

4.1.2   Interactive Session

Following the presentation, the facilitator and the participants went through the list of indicators, picking each of log frame component one after the other as well as the indicators in a similar manner, asking for views, opinions and decisions as to whether to retain, delete, modify and/or expand any particular indicator. The views, opinions, decisions and justifications were recorded appropriately. It is instructive to mention here that the meeting held at NACETEM, Ile-Ife and the outputs and lessons learnt helped to streamline activities during the Abuja meeting.

After the list had been exhausted and all the views, opinions, decisions and justification recorded, the rapporteur presented an abridged report including key decisions and justifications on each of the indicators to the participants. All participants appreciated the effort with few comments and reactions which were adequately captured and documented. The views, opinions and decisions from both meetings (i.e. Ile-Ife and Abuja) were harmonized and the outcomes are presented in the sections that follow.

5   OUTCOMES OF THE ENGAGEMENT

5.1   General observations

After fruitful deliberations the following general observations were made:

i.   The general list of indicators shared in the MS Excel workbook is considered extremely useful and hence was adopted to facilitate the stakeholder's engagement.
ii.   A number of the indicators are considered inadequate, not giving due considerations to gender perspective.
iii.   Some of the indicators are too general, not reflecting activities in core STI; for example STEM education.
iv.   Most of the indicators collected by NACETEM from the National R&D and Innovation Surveys under the ASTII initiatives are not listed.
v.   ICT related indicators are seen as important but not adequately represented.
vi.   Manufacturing indicators were well represented, however those of service subsector were grossly inadequate, etc.

5.2   Selection of Indicators for the Web-based Scoreboard: Key Decisions by Stakeholders

After due considerations of all the indicators based on conformity, relevance, quality, completeness and appropriateness with the adopted definitions and terms of references, the followings decisions were made:

i.   One hundred and thirteen (113) of the 175 indicators are found to be of good quality, complete, and appropriate, therefore retained as conceived.

ii. Some of the indicators (42) are ambiguous or repeated, and/or have no little or no implications or relevance to the adopted definitions, they are therefore recommended for deletion.

iii. Two (2) of the indicators though have direct relevance/implication for science, technology activities but appear too general, they are therefore recommended for modifications. The modification included linking the indicators to STEM, collecting and interpreting them accordingly.

iv. Some indicators (18) are non-inclusive, covering activities in only manufacturing subsector. They are recommended for expansion to cover activities in the service subsector.

v. Most key indicators from the National R&D and Innovation Surveys previously undertaken and even, on-going by NACETEM (See Table 8) are not listed, therefore should be included.

vi. Consideration of more ICT related indicators for inclusion (some suggestions are listed in Table 9)

vii. New set of indicators with special biases for gender inclusiveness are also suggested for consideration (see Table 10)

Table 8: Indicators from National R&D and Innovation Surveys Recommended for Inclusion

SN	Indicators
1	GERD million PPP$
2	GERD per capita PPP$
3	GERD as a % of GDP
4	Business sector (BERD) million PPP$
5	Government sector (GOVERD) million PPP$
6	Higher education (HERD) million PPP$
7	Private non-profit organisations (PERD) million PPP$
8	GERD by sector of performance (percentage)_HERD
9	GERD by sector of performance (percentage)_GOVERD
10	GERD by sector of performance (percentage)_BERD
11	GERD by sector of performance (percentage)_PERD
12	GERD by source of funding (percentage)_Business
13	GERD by source of funding (percentage)_Goverment
14	GERD by source of funding (percentage)_HEI
15	GERD by source of funding (percentage)_PNP
16	GERD by source of funding (percentage)_Foreign Sources
17	GERD by type of R&D (percentage)_Basic Research
18	GERD by type of R&D (percentage)_Applied Research
19	GERD by type of R&D (percentage)_Experimental Research
20	R&D personnel (headcount)
21	Researchers (headcount)
22	Researchers as a % of R&D personnel
23	Researchers population in million
24	Research personnel per million inhabitants
25	Researchers per million inhabitants
26	Female R&D personnel
27	Female researchers
28	Female share of total research personnel
29	Female share of total researchers
30	Researchers by sector of employment (headcount) percentage shares_Business
31	Researchers by sector of employment (headcount) percentage shares_Government
32	Researchers by sector of employment (headcount) percentage shares_HEI
33	Researchers by sector of employment (headcount) percentage shares_PNP
34	R&D personnel by level of education (headcount)_PhD
35	R&D personnel by level of education (headcount)_Theoretically based university studies
36	R&D personnel by level of education (headcount)_Others
37	R&D personnel by level of education (headcount) Percentage shares_PhD
38	R&D personnel by level of education (headcount) Percentage shares_Theoretically based university studies
39	R&D personnel by level of education (headcount) Percentage shares_Others
40	R&D personnel and researchers (FTE) (total and females)_R&D personnel total
41	R&D personnel and researchers (FTE) (total and females)_R&D personnel females
42	R&D personnel and researchers (FTE) (total and females)_Researchers total

SN	Indicators
43	R&D personnel and researchers (FTE) (total and females)_Researchers female
44	R&D personnel and researchers (FTE) (total and females)_R&D personnel total
45	R&D personnel and researchers (FTE) (total and females)_R&D personnel females
46	R&D personnel and researchers (FTE) (total and females)_Researchers total
47	R&D personnel and researchers (FTE) (total and females)_Researchers female
48	Researchers by field of science (headcount) percentage shares_Natural sciences
49	Researchers by field of science (headcount) percentage shares_Engineering and technology
50	Researchers by field of science (headcount) percentage shares_Medicine and health
51	Researchers by field of science (headcount) percentage shares_Agricultural sciences
52	Researchers by field of science (headcount) percentage shares_Social sciences
53	Researchers by field of science (headcount) percentage shares_Humanities
54	Scientific output_1990–1994
55	Scientific output_1995–1999
56	Scientific output_2000–2004
57	Scientific output_2005–2009
58	Innovation rate (number of innovation-active firms as a percentage of the total number of firms with responses)
59	Number of firms with abandoned or ongoing innovation activities as a percentage of the total number of firms
60	Number of firms whose product innovations originated inside the country as a percentage of all product innovation-active firms versus the number of innovative firms whose product innovations originated outside the country
61	Number of firms whose process innovations originated inside the country as a percentage of all process innovation-active firms versus the number of firms whose process innovations originated outside the country
62	Proportion of total expenditure by type of innovation: Intramural R&D
63	Proportion of total expenditure by type of innovation: Extramural R&D
64	Proportion of total expenditure by type of innovation: acquisition of machinery
65	Proportion of total expenditure by type of innovation: Acquisition of external knowledge
66	Number of firms which rated each of the various types of information sources for innovation as highly important, expressed as percentage of all innovation-active firms. These include internal sources, suppliers of equipment, clients or customers, competitors, consultants and universities.
67	Number of firms which collaborated on innovations with various types of collaborative partners, expressed as a percentage of all innovation-active firms. These include other enterprises within own enterprise group, suppliers of equipment, clients or customers, competitors, consultants and universities.
68	Number firms which rated various outcomes of product and process innovation as highly important, expressed as a percentage of innovation-active firms
69	Number of innovation-active and non-innovation-active firms that rated various barriers of innovation as highly important, expressed as a percentage of all innovation-active and non-innovation-active firms respectively
70	Number of innovation-active firms which used the various methods of claiming their intellectual property (IP) rights for the innovations they developed, expressed as a percentage of all innovation active firms.

Table 9: Suggested ICT Readiness for Inclusion on the Scoreboard

|	INDICATOR NAME	LOGICAL FRAMEWORK COMPONENTS	ACTORS	STI ACTIVITIES MAIN SUBJECT
1	Internet access tariffs (20 hours per month), in US$, and as a percentage of per capita income	Enabler	Users/Consumers	ICT Readiness
2	Mobile cellular tariffs (100 minutes of use per month), in US$, and as a percentage of per capita income	Enabler	Users/Consumers	ICT Readiness
3	ICT goods exports as a percentage of total exports	Enabler	Users/Consumers	ICT Readiness
4	Value added in the ICT sector (as a percentage of total business sector value added)	Enabler	Users/Consumers	ICT Readiness
5	Affordability: 1GB of data must be available for 2% or less of average monthly income	Enabler	Users/Consumers	ICT Readiness

Table 10: Suggested indicators on gender dimensions/inclusiveness

GENDER PERSPECTIVES IN EDUCATION
1. Number of female with PHD
2. Female PHDs within child bearing age
3. First Graduate
4. Percentage of female drop-out due to marriage
5. Female enrolment in STEM from secondary
6. Percentage of women with degrees in Science and Technology
7. Number of women with STI articles and publication
8. Percentage of women tertiary gross enrolment
9. Graduation rate in tertiary education
ASSET OWNERSHIP AND GENDER
1. Percentage of women that have access/right of asset ownership
2. Percentage of women with right
3. Percentage of women that Intellectual Property Rights (IPR)
4. Percentage of women patent applicant
5. Percentage of women with design rights
6. Percentage of women with Model Utility
7. Percentage of women with Trade Mark
SOCIO ECONOMIC
1. Percentage of women with right to decision making over their personal lives, family,

	society
2.	Percentage of women with freedom to adopt/reject technologies e.g Agricultural Technology
3.	Number of women working in STI sector
4.	Percentage of female graduates in manufacturing and construction
5.	Literacy percentage of women 15-24
6.	Percentage of women employed in the technical informal sector
7.	Percentage of women entrepreneurs and employers
8.	Percentage of women inactivity rate
9.	Percentage of women living below one dollar
INSTITUTIONAL	
1.	Percentage of women with access to credit
2.	Percentage of women overburdened with childbearing /early marriage
Decision Making	
1.	Percentage of women in decision making positions (Legislators, ambassadors, ministers etc)
2.	Percentage of women who head research institutes
3.	Percentage of female VCs

A total of 175 indicators were filtered to 131 cogent indicators as depicted in figure 2. Although, there may still be a need to carry out empirical assessments on these indicators to ascertain its adaptabilities to developing countries like countries of Africa, because of our heterogeneities as it relates to diversities of culture, socio-economic variabilities, business environments, political terrain, policy diversities, among others. In total, putting all the processed modules of indicators together, a total of 131 emerged and are recommended for inclusion into the proposed STI scoreboard for Africa.

The figure 2 below summarised the outcomes of the engagement considered.

Figure 2: NIGERIA STI SCOREBOARD
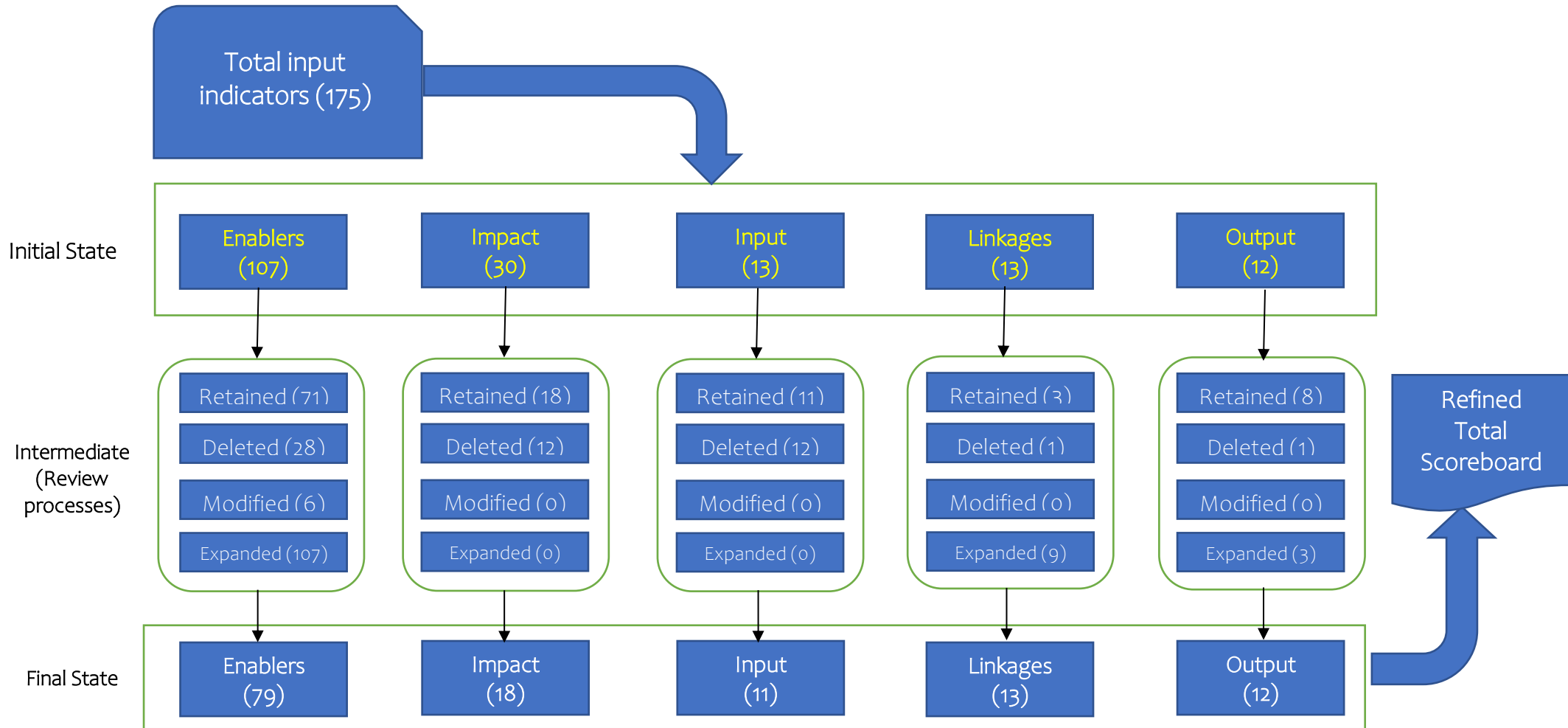
6 Summary and Conclusion

The stakeholder's meeting/engagement was considered a success. Utmost attention was paid to the project objectives and terms of reference. Due cognisance was also given to indicators' selection criteria including quality, completeness and appropriateness. The Frascati and Oslo manuals were consulted to providing guiding definitions for STA, business innovations, innovation activities and indicators. All participants' views and decisions on each of the listed indicators were adequately documented (see attached).

By and large, one hundred and eleven (111) of the given sets of indicators were recommended for retention as conceived, forty-four (44) were considered inadequate or inappropriate and therefore recommended for deletion. Furthermore, two (2) indicators; enablers 7 and 9, were recommended for modification i.e., properly linked to STEM education. And to complete the set, eighteen (18) of the indicators were non-inclusive, with focus only on manufacturing subsector, and hence recommended for expansion to cover service subsector of the industrial sector. Besides those, the participants also recommended the listing of some ICT readiness indicators.

Finally, the stakeholders expressed the opinion that the content of the scoreboard should leverage on the national R&D and Innovation Surveys; to that extent recommended those set of indicators should be included in the emerging STI scoreboard for Nigeria. And as much as feasible, the stakeholders concluded that all indicators must reflect the gender dimension and inclusiveness.

7 RECOMMENDATIONS

The overall objective of the exercise is to explore the metrics used by different initiatives that measure science, technology and innovation in Africa and provide country-level assessment of the quality, completeness and appropriateness of the approved set of indicators. The main deliverable of this pre-pilot study is essentially to come up with a collection of indicators to be considered to form part of the web-based dashboard/scoreboard for Nigeria. The initiative is envisaged to provide many benefits including accessing and utilizing the indices in performance monitoring and evaluation; making policy and business decisions; informing intervention programmes and benchmarking across sectors and countries, amongst others. However, to fully realize the project objectives and harness the full potential of an STI web-based scoreboard the following points are strongly recommended:

Gender inclusiveness: Simply put, gender inclusion is the notion that all services, opportunities, and establishments are open to all people irrespective of their gender. It is indispensable for economic prosperity of nations. By and large, person's gender should not limit or define their roles in the society and stereotyping should be totally avoided. Regrettably, stereotyping is still a very big challenge across African nations, including Nigeria. For instance, Nigeria still struggles to consistently meet the UN recommendation on gender inclusion which advocates that at least 30% of political offices be occupied by female. There are strong evidences that Nigerian women are still stereotyped to particular occupations and professions and notably also, the girl child is still denied access to quality education. Therefore, having adequate indicators with special biases for gender

inclusiveness will assist to monitor and measure progress in terms of efforts and initiatives of actors in combating gender inequality in Nigeria as well as enabling benchmarking with other nations. Gender inclusion indicators including: number of female with PhD; Female PhDs within child bearing age; female enrolment in STEM from secondary; and percentage of women with degrees in STEM among others may be considered.

Maintain focus on STI and STEM: Since the project primary objective is focusing on science, technology and innovation metrics, attention on STI and STEM content of the dashboard should be maintained. It may be inappropriate to start generalizing by including other indicators which may not necessarily add any related value. Therefore, all indicators that appear somewhat general in nature should be expunged to avoid data redundancy.

Clarity, completeness and relevance: Indicators should provide monitoring and evaluation information crucial for decision-making at every level and stage in the development process. A key benefit of the web-based scoreboard is to make available indicators backed by empirical evidence that will assist stakeholders in making policies that can enhance the capacity of firms to implement new products and services as well as improved delivery of public goods. Important features of a good indicator include non-ambiguity, reproducibility, completeness, relevance among others. Selecting indicators with these characteristics becomes extremely important to achieving the intended objectives of the dashboard. Consequently, all indicators (about 42) found to be ambiguous or repeated, nor have relevance to the purpose of the dashboard, have been recommended for deletion and should not be included in the dashboard.

Retain ASTII initiative at the core of activities: The ASTII initiative birthed the measurement of STI indicators in most African countries. Hence, future efforts at supplying the content of the scoreboard should leverage on the success of the ASTII initiative. For instance, NACETEM remains the national focal point of the ASTII initiative in Nigeria; the Agency periodically collects STI indicators including innovation indicators and R&D indicators on behalf of the Federal Government; the Agency would be ready to collaborate on this new initiative. It should be noted, however that while some of these indicators are published regularly by some international databases, many of them have not gained traction in terms of usage in the public policy space in the country. To that extent, the STI scoreboard must be seen as a good opportunity to bring the indicators into the public policy domain for uptake by the key stakeholders. Building the STI scoreboard around the ASTII initiative has other benefits including regular data supply, consistency and uniformity of indices/metrics and finally, ease of benchmarking among nations.

Comprehensiveness of Innovation indicators: Innovation is a key driver of economic progress. It brings benefits to consumers, businesses and the economy as a whole. Under the ASTII initiative, business innovation is measured in two sectors including the manufacturing and services. This is to provide for comparability of measured progress between the sectors. The provided list of indicators is focused largely on the manufacturing sector and deficient in corresponding indicators on the service sector. This in some aspects has defeated the purpose of the dashboard. Therefore, it is recommended that innovation indicators should be all-encompassing and complete, covering both the manufacturing and the service sectors.

Expand the enablers under ICT: ICT remains a major driver of socioeconomic development. It is an enabler of innovation among business enterprises. ICT has made the world borderless and boundless within a very short period. Indeed, today, information exchange is the lifeblood of product development which spurs experimentation, innovation, feedback and their iteration into the product development process (HBR, 2001). Furthermore, the proliferation of Fintechs, mobile banking, point of sales (POS) terminals and the evolution of digital economy all powered by ICTs now have great import and impact on economic growth and development, the world over. Therefore, it is very necessary to provide adequate number/quality and reliable set of indicators to monitor and evaluate progress in the development, deployment, diffusion, transfer and adaptation of ICTs in the national economies. It was noted that the original list of ICT enablers is largely insufficient; hence, five additional ones including: Internet access tariffs (20 hours per month) USD; and Internet access tariffs (20 hours per month) as a percentage of per capita income among others have been suggested.

Finally, after careful considerations a total of 131 cogent indicators are recommended for inclusion on the proposed STI scoreboard as against a total of 175 indicators originally suggested. These include 79 enablers, 18 impact indicators, 11 input indicators, 12 output indicators and 13 linkage indicators.

8   References

Gault F (2010) Innovation Strategies for a Global Economy: Development, Implementation Measurement and Management. IDRC.

NEPAD. (2005) African Science, Technology and Innovation Indicators (ASTII), Towards African Indicator Manuals. A Discussion Document. http://www.nepadst.org/doclibrary/pdfs/iastii_jun2006.pdf, accessed March 2009.

NPCA (2014) Cited in Siyanbola et al (2016)

Siyanbola W, Adeyeye A, Olaopa O and Hassan O (2016) Science, technology and innovation indicators in policy-making: the Nigerian experience. Palgrave Communications. 2:16015 doi: 10.1057/palcomms.2016.15.

9 APPENDIX

9.1 List of Participants

Table A1.: List of stakeholders at the first meeting held at NACETEM Headquarters

SN	NAME	DESIGNATION	ORGANIZATION
1	Mr. David Adeyeye	Asst. Director/ **Convener**	NACETEM
2	Dr. Michael Awoleye	Research Fellow	AISPI, OAU
3	Dr. Abiodun Egbetokun	Asst. Director- Research	NACETEM
4	Dr. Caleb Adelowo	Asst. Director- Research	NACETEM
5	Dr. Ololade Adewole	Asst. Chief Planning Officer	NACETEM
6	Mrs. Omolayo Oluwatope	Asst. Chief Research Officer	NACETEM
7	Dr. Sanjo Efunwole	Research Assistant to the Consultant	AISPI, OAU
8	Mr. Olufemi Akindimeji	Asst. Chief Planning Officer/**Secretary**	NACETEM

N.B: *The Consultant had a pre-meeting meeting with David Adeyeye, Assistant Director (Planning)/***convener*** and Olufemi Akindimeji, an Assistant Chief Planning Officer (who also took notes), essentially to layout procedures and expectations from the main stakeholders'meeting.*

Table A2: List of stakeholders at the ABUJA meeting held at Rock View Hotels (Classic), Nigeria, 13th April, 2021

SN	NAME	DESIGNATION	ORGANIZATION
1	Prof. Willie O. Siyanbola	Professor/Facilitator	Centre for Energy Research and Development, CERD, OAU, & Project Consultant
2	Dr (Mrs). Rahilah C. Wakawa	Senior Research Officer	National Centre for Technology Management (NACETEM), North-Central Office, Abuja
3	Dr. M. Kyari	Senior Coordinator	African Union-Science Technology and Research Council (AU-STRC), Abuja Office
4	Mr. Ademola Ajibade	Managing Director	SATCHMO-TECH Limited: Private Sector
5	Dr.(Mrs.) Moma Enang Efiom	National Professional Officer	UNESCO Regional Office, Abuja
6	Mr. N.C Orji	Deputy Director	National Office for Technology Acquisition and Promotion (NOTAP)
7	Mr. Paul Oshokumoboh	Statistician	National Bureau of Statistics NBS
8	Mr. Fatogun M. Temitope	Asst. Director	Federal Ministry of Science and Technology (FMST), Nigeria
9	Dr. Kazeem Abubakar	Asst. Chief Research Officer/ Acted Secretary	National Centre for Technology Management, North-Central Office, Abuja
	Absent with Apologies		
10	Mr. Fatiyi Oluseyi	Deputy Director	Federal Ministry of Budget and National Planning
11	Mr. Afam	Marketing Research Officer	Ministry of Communication and Digital Economy
12	Prof. Rahman Yusuf	Deputy Executive Secretary	National University Commission

9.2   Other Documents Attached to this report

Table A3: Other Documents

SN	DESCRIPTION OF APPENDICES
1	Modified list of STI indicators with remarks (MSExcel Workbook)
2	Relevant documents sent to participants in preparation for the meeting i.e., indictors' list by type
4	Letter of invite to participants and a brief concept note
6	Photographs of event
7	Agenda of the engagement
8	Power point presentation by the Consultant