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development in Africa**

**The African Statistical Development Indicators
(revised version)**

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INTRODUCTION

Context and justification

In response to the challenges posed to African countries by the increased demand for quality statistics, stakeholders have taken several initiatives; among these is the Marrakech Action Plan for Statistics (MAPS). It consists of a global agenda aimed at improving the availability and use of quality statistics in support of poverty reduction strategies, according to a well-defined budget, covering a specific period of time.

In line with this international initiative and building on the lessons learned from past experiences, African stakeholders and partners developed a regional implementation version to the MAPS: the ***Reference Regional Strategic Framework for Statistical Capacity Building in Africa (RRSF)***. This framework is expected to strengthen the capacity of countries' national statistical systems to respond to the information needs in support of their development efforts.

In order to support the monitoring and evaluation of progress--or lack thereof-- made in the implementation of the RRSF, the Economic Commission for Africa (ECA) has developed the African Statistical Development Index (ASDI). It is a composite index that is expected to help not only African countries but also partners and other stakeholders in their quest to support African countries develop their statistical systems.

Based on the consensual framework that is the RRSF, the index has the following objectives: (i) support the monitoring and evaluation of the implementation of the RRSF; (ii) identify for each African country weaknesses and strengths in order to support interventions, and; (iii) provide a general idea of the performance of African countries' statistical systems.

During the third session of StatCom-Africa, 18-23 January 2012, in Cape Town, South Africa, ECA presented a report on ongoing efforts to develop the African Statistical Development Index (ASDI). In the ensuing discussion, support was expressed for the idea of creating an index on statistical development. However, the participants pointed out that the reviews could be done on a biennial basis, rather than annually. Questions were also raised about the methodology and lack of information on reliability analysis. It was therefore suggested that a technical meeting should be held to discuss the methodology. Some delegates also expressed concern that countries had not been given prior notice of the exercise before being ranked.

Other reasons justify the renovation of the methodology and/or the architecture initially proposed by UNECA for the construction of the ASDI. In fact, the international development environment has drastically changed since 2012, with the entry into force of the Sustainable Development Goals. The Resolution A/RES/70/, adopted by the United Nations General Assembly on 25 September 2015, clearly mentioned that these Sustainable Development Goals and their targets are integrated and indivisible, global in nature and universally applicable, taking into account different national realities, capacities and levels of development and respecting national policies and priorities. Governments have the primary responsibility for follow-up and

review, at the national, regional and global levels, in relation to the progress made in implementing the Goals and targets over the coming 15 years.

Regarding progress in statistical development, Goal 17 of the SDGs sets two further targets that directly tackle issues of data, monitoring and accountability. Target 18 of Goal 17 is envisaged by 2020 “to enhance capacity-building support to developing countries, including for least developed countries and small island developing States, to increase significantly the availability of high-quality, timely and reliable data, disaggregated by income, gender, age, race, ethnicity, migratory status, disability, geographic location and other characteristics relevant in national contexts”.

Associated indicators are proposed to measure progress made by National Statistical Systems on production of indicators and adequate funding of statistical plans and national statistical legislations that compile with the Fundamental Principles of Official Statistics.

Within the context of these new developments in the international arena and in line with the suggestions made during the third session of the StatCom-Africa meeting, ECA decided to work on a revised version of the ASDI. The present report has been prepared in this regard.

Organization of the report

The report is structured into two parts: (1) Presentation and analysis of the existing ASDI;
(2) Potential areas for renovating the ASDI.

1. PRESENTATION AND ANALYSIS OF THE EXISTING ASDI

1.1. Index Structure: Components and Variables

One of the most important and controversial steps of developing a composite index is the choice of components and variables. At this stage, a number of decisions have to be taken related to the determination of the components and selection of relevant variables. The determination of the components and selection of the variables is generally based on theory, empirical analysis, pragmatism, intuitive appeal or a combination of these. The number and nature of the components of the ASDI, initially developed by UNECA, emanate directly from the 12 strategies and 79 recommendations of the RRSF¹. In addition, the following criteria were used in variable selection: validity, comparability, simplicity, and data availability.

Validity requires that the variables measure the component they are intended to measure. Thus, all the ASDI variables do indeed measure the components or sub-components they are representing². This is not a surprise as the RRSF and the related recommendations have been prepared following a thorough consultative process with all stakeholders including specialists in different areas. Therefore, the resulting recommendations have been selected to meet the challenges facing African countries in enhancing their capacity to produce and use reliable statistical information. As a result, the 79 recommendations (potential variables) are closely related to the 12 strategies (potential components/sub-components) and the four specific objectives. The potential variables (recommendations) have been designed to measure the components (strategies) they are supposed to represent. Moreover, improvement in each of the retained variables implies an enhancement in statistical development. This is an alternative way to test for validity.

Comparability deals with ensuring meaningful comparisons of indices through the standardization of concepts and methodologies employed in data collection. This was ensured by the design of a standard questionnaire³ that is used to collect the information from all African countries.

The choice of the variables took also into account a good balance between the complexity of the phenomenon and **simplicity** of the index. The complexity of the phenomenon at stake is reflected in the number of recommendations made in order to enhance statistical capacity- building efforts in African countries. Among the 79 recommended actions, some are not really suitable for index construction. This is the case of recommendations such as “ensuring that the framework is endorsed by countries and other stakeholders and by relevant governance bodies” and “ensuring that stakeholders understand their roles in the framework and mobilize them to support it”. A careful look at the 79 potential variables using this criterion brought the number of relevant quantifiable variables to 42. This process simplified the construction of the index and ensured parsimony.

Data availability is of paramount importance in the development of an index. This question needs to be assessed in terms of timeliness and coverage. As far as timeliness is concerned, there is a need to ensure

¹ Details on the strategies and recommendations can be found in AfDB, PARIS21, UNECA and The World Bank. (2006). The Reference Regional Strategic Framework for statistical Capacity Building in Africa: Better Statistics for Improved Development Outcomes. *UNECA Documents Publishing and Distribution Unit*, Addis Ababa.

² Sanga, D., Bakary Dosso, B. and Gui-Diby, S. “Tracking Progress towards Statistical Capacity Building Efforts: The African Statistical Development Index” <http://onlinelibrary.wiley.com/doi/10.1111/j.1751-5823.2011.00151.x/full>

³ A copy of the questionnaire can be found on the RRSF Website at: <http://ecastats.uneca.org/acsweb/rrsf>.

that data required for index computation are recent and available on a regular basis following the agreed upon periodicity. By virtue of the proximity of the African Centre for Statistics (ACS) to African countries, it is likely that data on the variables will be obtained on a regular (annual) basis and will be up to date. The coverage of the index refers to samples being large enough to ensure statistically valid results. In this regard, the index computation is expected to cover all African countries. Nevertheless, it is well known that not all countries respond to questionnaires from international organizations and ACS is not an exception. But recent experience shows that the response rate to the ASDI questionnaire is quite high: in 2010, the ACS received 37 responses out of 53 African countries for a notable 70 per cent response rate. It is likely that this rate will increase once African countries recognize the importance and usefulness of the index.

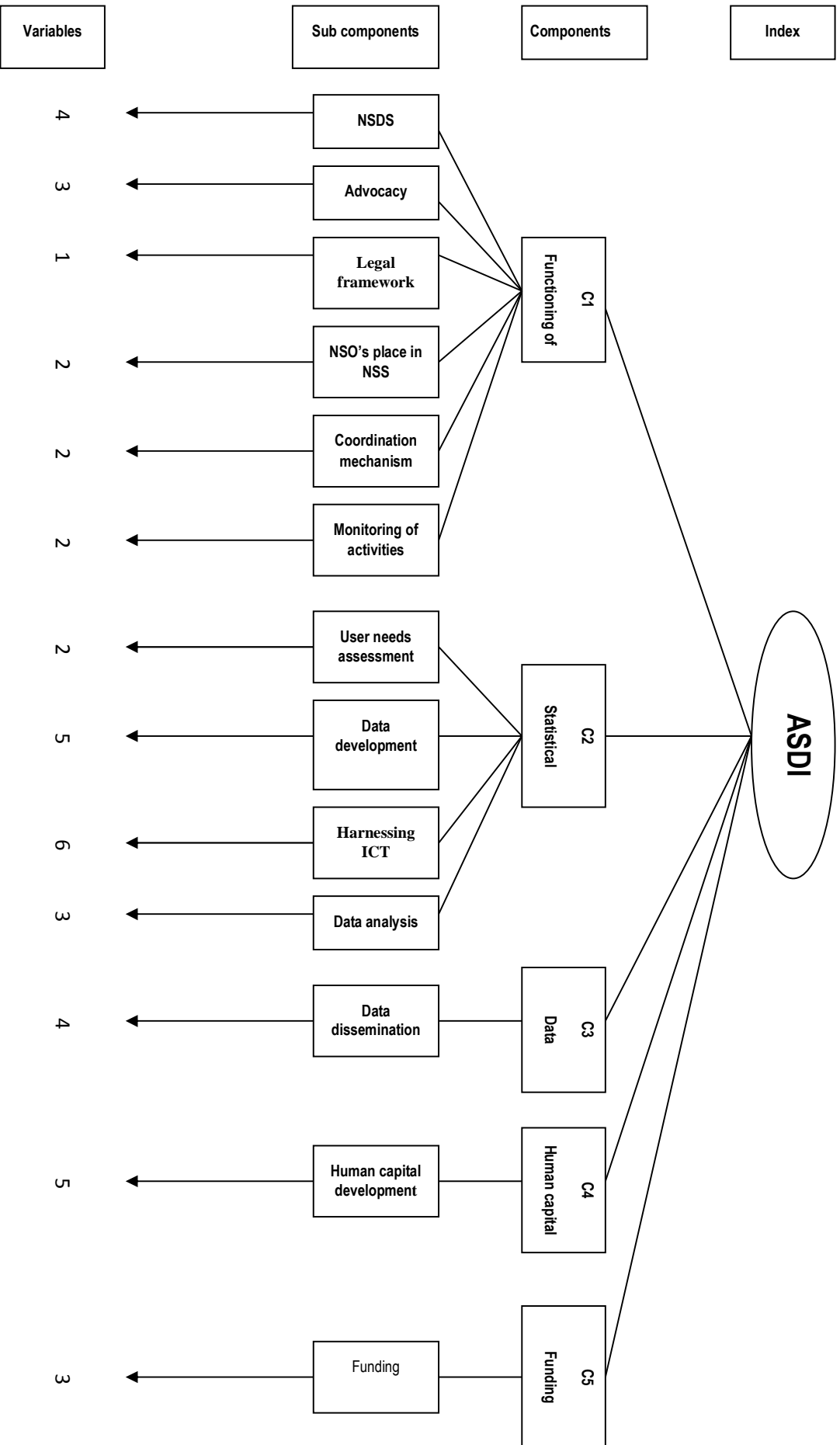
Following the above procedure, the ASDI structure has been developed by UNECA as depicted in figure 1. It comprises the following five components:

- Functioning of the national statistical system: organization and coordination of the statistical system;
- Status of statistical infrastructure;
- Data dissemination;
- Human capital development; and
- Funding.

Some components are further divided into sub-components and the sub-components into variables. It is worth noting that the below sub-components and related variables emanate directly from the strategies and recommendations of the RRSF. These were agreed upon during the consultation process leading to the preparation of the RRSF.

They meet the criteria of validity, comparability, simplicity and availability of data. The total number of variables of the existing ASDI is 42 (see figure 1 below).

Figure 1: Structure of the existing ASDI



1.2. Calculation of the existing ASDI

The variables are measured according to different scales: 38 are reported according to an ordinal scale ranging from 1 to a maximum value. Two variables are reported as a percentage (the proportion of statistically implemented and the proportion of Statistics budget financed by the government) and two are absolute numbers (number of computers per person in the National Statistics Office and number of computers by professional staff in the national statistical office).

A linear scale from 1 to 100 has been defined to ensure a clean aggregation. Minimum and maximum as possible are set for the variable and the index values are obtained by subtracting the assigned minimum from the observed value and dividing by the difference between the maximum and minimum. For African countries, the minimum is selected 1 and the index is calculated by dividing the observed value by the maximum value, when the range is quite wide.

As regards the aggregation, weighting was first calculated by the score method. A score is calculated for the variables and for the components and aggregation is continued. The score variables is selected based on the category of said variable. For categorical variables, the score is calculated as follows:

$$S_j = \frac{1}{n_j} \sum_{k=1}^{n_j} V_k$$

Where S_j is the score of the j-th categorical variable, n_j the total number of sub-items in the variable j, and V_k the value of the score correspond to the kth sub-item of the variable. If the value of the sub-category is 'Yes', then its score is n_j while if the value of the sub-item is "No", the score is 1. As regards the absolute numbers, they are treated according the phenomenon involved. To illustrate, the number of computers belonging to the National statistics Office was represented on the scale by dividing by the total number of people (as with a maximum of one computer per person) and the staff number by category and gender proportions was converted, using the total number of the national statistical office staff as a base.

The score of the components is obtained in two different ways: By simple arithmetic average or weighted as ASDI is calculated with or without weights. When ASDI is calculated without weighting, the score of the i-th component of ASDI is as follows:

$$SC_i = \frac{1}{n_i} \sum_{j=1}^{n_i} S_{ij}$$

Where SC_i is the score of the i-th component, S_{ij} is the score of j-th variable in the i-th component and n_i is the total number of variables in the i component.

As for the weighted score for the i-th component, the score is as follows:

$$SC_i = \sum_{j=1}^{n_i} w_{ij} S_{ij}$$

Where SC_i as before is the score of the i-th component, S_{ij} score of j-th variable in the i-th component, w_{ij} is the weight (obtained by principal component analysis (PCA)) and n_i is the total number of variables in component i-th.

Once the scores are calculated, proceed to aggregation. If ASDI is weighted, the weighted index

is a weighted arithmetic or geometric average of different components scores as follows :

$$ASDI = \sum_{i=1}^n w_i SC_i ; \quad ASDI = \prod_{i=1}^n SC_i^{w_i}$$

With weights provided by PCA.

However, if the index is not weighted, it is a simple arithmetic or geometric mean of different components scores as follows:

$$ASDI = \frac{1}{n} \sum_{i=1}^n SC_i ; \quad ASDI = \sqrt[n]{\prod_{i=1}^n SC_i}$$

1.3. Strengths and weaknesses of the existing ASDI

In this section, we present the strengths and weaknesses of the ASDI index as initially developed by UNECA. For this, we rely on a set of criteria: Measurement of statistical development, aggregation strategy, synthesis ability, analytical ability, originality and innovativeness, transparency, reproducibility, robustness, maturity, reliability of data used, communicability, ability to be an instrument for public action, recognition and legitimacy and finally comparability in space and time.

The following table summarizes the strengths and weaknesses identified to the existing ASDI.

Table 1: Strengths and weaknesses of the existing ASDI

Criteria	Strengths	weaknesses
1.Measurement of statistical development	Based on a strategic regional consensual reference framework for statistical capacity building in Africa	Do not include very explicitly the dimension relating to data quality
	Covers many fields of statistical development	
2.Strategy aggregation	Pre-standardization of variables before aggregation	For the simple means scenarios Equi-weightings assigned to the chosen dimensions implies that the 5 dimensions are equal in statistical development
	Simple calculation (functional form used: arithmetic average of the sub-dimensions)	The additive form of ASDI implies perfect substitutability between sub-categories (for additive scenarios)
	ASDI has satisfied those three axioms that favor geometric formulas over arithmetic expressions. ⁴	The normalization used for each variable issues that maximum may vary from year to year, making it interpretations difficult from one year to another
	Capture the influence of each under dimension on the overall index	ASDI does not check all the axioms on good properties of an index defined by

⁴ Carmen Herrero Blanco and al (2008), "Improving the measurement in Human Development". Those axioms are Scale, neutrality and ratio consistency.

(See "http://econ.univie.ac.at/fileadmin/user_upload/proj_econ/SeminarPapers/WS_2010/herrero.pdf)

Criteria	Strengths	weaknesses
		Carmen Herrero Blanco et al (2008) ⁵
3. Synthesis Capacity	Summarized in a single value 42 variables grouped into five dimensions	General cons of composite indicators
	Summarizes 12 strategic axes and 79 recommendations of a continental consultation process	
4. Analytical skills	Each component is linked to a common problem of statistical development of African countries and may be subject to individual and detailed analysis	Synthesizing does not promote a well detailed analysis
	The fact that all the information is synthesized into a single indicator provides greater ease in the analysis	
5. Originality and innovative nature	ASDI is original in its ability to take into account both operational issues, regulation, dissemination, development of human capital and funding	
	Calculating a composite indicator	
6. Transparency	The methodology and assumptions are transparent. The index is focused on the African level by the ECA.	The only document available on the index is the report which presents the first test of its calculation.
7. reproducibility		No update of ASDI available
8. Robustness	The calculation methodology is based on a rigorous mathematical approach	
9. Maturity		Low maturity of the index as very few used operationally
10. Reliability of data	Good quality of data from a survey harmonized across the continent	
11. communicability		Very little press and absent in the national statistical systems and devices
		No visualization available
12. Instruments for political action	Can help more easily and quickly judge the level of statistical development	Lack of dissemination of results of ASDI
		Low visibility ASDI
		The global nature of the indicator does not show the strategic areas of intervention

⁵ Carmen Herrero Blanco et al (2008), "A Multiplicative Human Development Index", Fundacion BBVA, Documentos de Trabajo, 1, 2008. Those properties include: i) minimal lower boundedness that requires that the index shall be minimal when any component is at its minimum level in all sample countries; ii) independence which stipulates that the ranking of two countries or a country at different points in time that have the same value on one variable does not vary if we change this value by the same amount; and iii) monotonicity which suggests that the index is an increasing function of its arguments. (see http://www.fbbva.es/TLFU/dat/DT_2008_01.pdf).

Criteria	Strengths	weaknesses
13. Recognition and legitimacy	Recognized and accepted indicator	
14. Comparability in space and time	Calculated for 42 African countries, so comparability in space	Calculated only once, so comparison is impossible in time

In addition to the analysis of strengths and weaknesses identified based on axioms, one can add the OECD recommendations relating to deficiencies in the construction of an indicator;

Table 2: Checklist for building a composite indicator (OECD): 10 steps:

Step	Objectives of the step and Comments whether or not the step satisfied the requirements of OECD guidelines
Theoretical framework: well defined	<p>Yes:</p> <p>ASDI</p> <ul style="list-style-type: none"> - has structured the various sub-groups of the phenomenon; - Has clear understanding and definition of the multidimensional phenomenon to be measured. - compile a list of selection criteria for the underlying variables <p>ASDI's criteria of variables selection is: validity, comparability, simplicity, and data availability</p>
Data selection	<p>Yes/No:</p> <ul style="list-style-type: none"> a- <i>To check the quality of the available components, sub-components and variables;</i> b- <i>To discuss the strengths and weaknesses of each selected variables; (ASDI suggesting that via the scores of the components)</i> c- <i>To create a summary table on data characteristics, e.g., availability (across country, time), source, type (hard, soft or input, output, process).</i> <p>Revisited ASDI made a detailed description table of the variables of the Index, but without availability and source</p>
Imputation of missing data	<p>No:</p> <ul style="list-style-type: none"> a- <i>To estimate missing values;</i> b- <i>To provide a measure of the reliability of each imputed value, so as to assess the impact of the imputation on the composite indicator results;</i> c- <i>To discuss the presence of outliers in the dataset.</i> <p>Revisited ASDI did not perform this exercise, although outliers will affect the sensitivity of the index</p>
Multivariate analysis: (a) to study the overall structure of the dataset, (b) assess its suitability, and guide subsequent methodological choices (e.g., weighting, aggregation)	<p>No</p> <ul style="list-style-type: none"> a- <i>To check the underlying structure of the data along the two main dimensions, namely individual components and countries (by means of suitable multivariate methods, e.g., principal components analysis, cluster analysis);</i> b- <i>To identify groups of components or groups of countries that are statistically "similar" and provide an interpretation of the results;</i> c- <i>To compare the statistically determined structure of the data set to the theoretical framework and discuss possible differences.</i> <p>Not explicitly shown in the study except the use of the PCA to obtain weights for the components and the index</p>
Normalisation:	Yes/No:

Step	Objectives of the step and Comments whether or not the step satisfied the requirements of OECD guidelines
To render the variables comparable.	<p>a. To select suitable normalization procedure(s) that respects both the theoretical framework and the data properties.</p> <p>b. To discuss the presence of outliers in the dataset as they may become unintended benchmarks;</p> <p>c. To make scale adjustments, if necessary;</p> <p>d. To transform highly skewed indicators, if necessary.</p> <p>Regarding (a), (c) and (d), ASDI is fine with regard to aggregation using simple means. However, no standardization as a version of normalization was mentioned for the weighted formulas, although the authors used PCA to provide the weights.</p>
<p>Weighting and aggregation: Should be done along the lines of the underlying theoretical framework.</p>	<p>Yes/No:</p> <p>a. To select appropriate weighting and aggregation procedure(s) that respect both the theoretical framework and the data properties;</p> <p>b. To discuss whether correlation issues among components indicators should be accounted for;</p> <p>c. To discuss whether compensability among components should be allowed.</p> <p>Revisited ASDI has not considered the concept of compensability among its components</p>
<p>Uncertainty and sensitivity analysis: To assess the robustness of the composite index r in terms of e.g., the mechanism for including or excluding an indicator, the normalisation scheme, the imputation of missing data, the choice of weights, the aggregation method.</p>	<p>No:</p> <p>a. To consider a multi-modelling approach to build the composite component/ index , and if available, alternative conceptual scenarios for the selection of the underlying components/indices;</p> <p>b. To identify all possible sources of uncertainty in the development of the composite index and accompany the composite scores and ranks with uncertainty bounds;</p> <p>c. To conduct sensitivity analysis of the inference (assumptions) and determine what sources of uncertainty are more influential</p> <p>Revisited ASDI lacking (a), b) and (c) above</p>
<p>Back to the data: To reveal the main drivers for an overall good or bad performance. Transparency is primordial to good analysis and Policymaking.</p>	<p>Yes/No:</p> <p>a. To profile country performance at the component/ sub-component level so as to reveal what is driving the composite index results;</p> <p>b. To check for correlation and causality (if possible);</p> <p>c. To identify if the composite index results are overly dominated by few components/ subcomponents and to explain the relative importance of the sub-components of the composite index.</p> <p>Revisited ASDI addressed (a) above, but lacking through examination addressing (b) and (c) above.</p>
<p>Links to other indices: To correlate the composite index (or its dimensions) with existing (simple or composite) indices as well as to identify linkages through regressions.</p>	<p>Yes/No:</p> <p>a. To correlate the composite index with other relevant measures, taking into consideration the results of sensitivity analysis;</p> <p>b. To develop data-driven narratives based on the results.</p> <p>Revisited ASDI conducted the correlation exercise, but without consideration to any sensitivity analysis. Also no narrative was presented based on the results</p>
<p>Visualisation of the results</p>	<p>No:</p> <p>a. To identify a coherent set of presentational tools for the targeted</p>

Step	Objectives of the step and Comments whether or not the step satisfied the requirements of OECD guidelines
The visualisation can influence (or help to enhance) interpretability	audience; <i>b. To select the visualization technique which communicates the most information;</i> <i>c. To present the composite indicator results in a clear and accurate manner.</i> Revisited ASDI need to use a visualization technique.

1.4. Discussion on weights and comments on the 4 formulas of ASDI

On the choice of equal or not equal weighting schemes

The discussion on the weighting scheme is a classical topic in the construction of a composite index. The following table 3 makes a short benchmark of the weighting approaches of some composite indicators used to monitor public action.

Table 3: Weighting approaches of some composite indicators

Indicator	Number of components	Weighting scheme
Human development Index	3	Equal weights
Mo Ibrahim Index of African Governance	14	Equal weights
Synthetic Index of Economic Emergence	3	Different weights derived from multiple factor analysis
African Transformation Index	5	Equal weights
Environmental Performance Index	16	Different weights derived from PCA
THES World University Ranking	6	Different weights
SJTU World University Ranking	6	Different weights
Composite Learning Index	17	Different weights derived from multiple regression analysis

We presented this short benchmark to support the fact that there is no single practice in the weighting schemes for composite indicators.

The weighting scheme should correspond to the global priorities of the resulting indicator and the objectives pursued in assessing the statistical development.

Some practitioners suggest applying different weights when one wish to highlight or minimize the significance and the explanatory power of a component.

As far as the ASDI is concerned the decision of equal or different weights should consider all the aforementioned issues. If there is no strong reason to think that one component is more important than the other in the statistical development of a country, then equal weights shall be given to all components. On the contrary, if there is any reason that sustains the fact that some components should be given more weights than some others, then a strong objective weighting technique should be used to derive the weights of variables/components.

On the functional form

For experimental purposes, four versions of the African Statistical Development Index were calculated. However, the functional form used is one that uses an arithmetic average of the scores of different components.

The 4 formula initially tested are presented below:

Simple arithmetic and geometric means of scores:

$$ASDI = \frac{1}{n} \sum_{i=1}^n SC_i, \quad (1)$$

$$ASDI = \sqrt[n]{\prod_{i=1}^n SC_i}, \quad (2)$$

Weighted arithmetic and geometric mean of scores:

$$ASDI = \sum_{i=1}^n w_i SC_i, \quad (3)$$

$$ASDI = \prod_{i=1}^n SC_i^{w_i}, \quad (4)$$

Formulas (1) and (3) are linear (additive) aggregation rules, while formulas (2) and (4) are geometric aggregation rules.

We make some critical review of the formulas as regard to the general critics in the literature.

Linear aggregation rules (Formula 1 and 3 above)

The linear aggregation (weighted or not) is the most commonly additive approach used in building composite index⁶. Two of the four scenarios of the ASDI use a linear aggregation rule, namely the arithmetic mean.

⁶ In fact there is also power-arithmetic mean

Pros

One great advantage of the linear aggregation rules is their simplicity and transparency. This may be one of the reason those rules are frequently used in literature. Moreover, they adapt to all weighting methods (Nardo and Saisana, 2008)⁷.

Cons

One of the first issues raised by linear aggregation rules is the issue of compensation. Munda and Nardo (2003)⁸ refer to compensability as “the existence of trade-offs, i.e. the possibility of offsetting a disadvantage on some variables by a sufficiently large advantage on another variable”.

In the case of the arithmetic averaging, the elasticity of substitution between the components indices is infinite, thus making the ASDI components (when using these scenarios) perfect substitutes. This means that for two countries, different scores in component indices may lead to the same level of statistical development, because changes in component scores can compensate each other. This issue may lead to inconsistent and questionable rankings using these rules.

A second issue related to linear aggregation rules is the requirement that before using an additive aggregation rule, one might be sure that the components of the indicator are mutually preferentially independent (see Munda and Nardo, 2005)⁹. In other words, for a set of n components, this rule suggests that the trade-off ratio between two components is independent of the values of the $n-2$ other component.

The issue is that this requirement cannot be easily tested in practice as it is extremely time consuming. Generally, indicators using linear rules do not test preference independence.

Another major issue raised by linear aggregation rules is related to the weights (when using weighted scenarios). The OECD¹⁰ suggests using weights to give symmetrical importance to the component (meaning that when a component has a greater weight, this component shall be more important in explaining the final phenomenon). However, Munda and Nardo (2005) argue that, weights do not mean systematic importance in linear rules. According to them, weights can only have the meaning of tradeoff ratio. They notice that in the case of linear rules, weights are dependent on the range of variables scores and then cannot reflect the importance of the components.

Another undesirable issue raised by the linear aggregation rule is that, multiplying any of the components by a scalar would result in a change of the relative weight of that component.

⁷ Nardo M, Saisana M (2008) OCDE/ JRC Handbook on constructing composite indicator. Putting theory into practice

⁸ Munda G. and Nardo M. (2003) «On the methodological foundations of composite indicators used for ranking countries», OCDE/JRC Workshop on composite indicators of country performance, Ispra, Italy

⁹ Munda G. and Nardo M. (2005) « Constructing consistent composite indicators : the Issue of weights », report 21834, Joint research Centre, Italy

¹⁰ OCDE/ JRC (2008) Handbook on constructing composite indicator. Methodology and user guide; OCDE publisher, Paris

In the process of building the composite indicator, one should proceed of normalizing variables before combining them through a functional form. In the case of linear aggregation forms, changing the upper or lower bound may lead to significant changes in the final rankings, which is not a desirable feature one want for the resulting indicator.

Geometric aggregation rules (formula 2 and 4 above)

Geometric aggregation rules have gained interest in the process of building composite indicators. There are some arguments in favor of geometric aggregation rules:

Pros

Also known as deprivational aggregation rule, the geometric aggregation rules are considered as an alternative to the major issue of perfect compensability posed by linear rules. The immediate implication of aggregating components using geometric aggregation rules is that poor performance in any component is directly reflected in the resulting indicator, which is viewed as a good property of an index.

Another key advantage of geometric aggregation is that the rankings produced by geometric mean are invariant to the scale of the variables. This feature guaranties that the relative weights of component would not be affected by a scalar factor multiplication.

In Geometric aggregation rules changing in the maxima used to scale variables do not affect the final rank, but changes in minima still affects the final rankings.

Cons

One issue of the geometric aggregation is that these functional forms are affected by the choice of minima. This requires a careful choice in the minima when scaling variables. Moreover, it is not suitable when the weighting based on benefit on debt or unobserved component model.

1.5. Comparison of ASDI with other statistical capacity indicators

The existing ASDI can be compared to the indicators developed by PARIS 21 and the World Bank to monitor statistical development. The comparison can be made at three levels: at the selection of variables, in terms of data collection and methodology of calculation, and finally on monitoring and evaluation.

Regarding the selection of variables, a fundamental force of ASDI is that it covers the fundamental aspects of statistical development that are the organization and coordination of the statistical system, statistical infrastructure, data dissemination, development and management of human capital, and the funding of the statistical system.

Unlike the existing ASDI, the indicator of the World Bank (which covers three dimensions, see box 1 below) is very limited because it does not cover all aspects related to the organization of the statistical system, the human capital management and the financing of the system. The other components are partially covered. In an effort to improve of the coverage of some of the components, the World Bank is currently revisiting the set of indicators and has used some of the inputs from the development of the ASDI.

As for the PARIS21 indicators (see box 2 below), they only partially cover the major components of statistical development.

From the standpoint of methodology, initially, the data used to calculate the existing ASDI are supposed to better reflect the realities of the country than the data used to calculate the index of the World Bank. Indeed, data collected to calculate this come from various sources (World Bank, the IMF, the United Nations, UNESCO and WHO) And thus suffer from deficiencies related to the diversity of sources, the collection period, the methodology for data processing from these sources. In the contrary, ASDI data come from an instant survey at the country level and the information provided will reflect more reality. Second, the weighting in the calculation of the index SCI is left to the resource persons and thus risk that the weights are not always adequate.

The methods of calculation also differ. The World Bank SCI index has the advantage of a simple calculation (simple average) and is easy to understand and interpret unlike ASDI whose method of calculation is more complex. But the latter method is more rigorous. However, obtaining an overall result, as searched by ASDI and World Bank – SCI, does not allow to have a detailed idea in all areas, because of the risk of information loss. Which is not the case for the PARIS21 indicators.

Finally, on monitoring and evaluation, the index SCI receives regular follow-up, in an annual base, in contrast of the existing ASDI.

Box 1:

The Statistical Capacity Building Indicators (SCBI) of Paris21

● Presentation

Statistical Capacity Building Indicators (SCBI) were set up by PARIS21. They form part of the growing demand for statistics to meet the needs of an evidence-based analysis adopted by the objectives of development for poverty reduction. Added to this is the need for improved statistics now recognized by all.

It is a set of indicators for all countries (whatever their statistical development level) with a view to assessing their statistical capacity and these capabilities evolution over time. In other words, these are part (variables) selected so as to be measurable whatever the country and likely to reflect the country's level of development. Are specifically targeted countries with large deficits in terms of availability of statistics and those who cannot increase their statistical capacity without outside help.

● Methodology

⇒ Variables selection

Variables have been selected according to certain criteria: brevity and the facility to be built. These variables should provide an overview and a sufficiently representative picture of the statistical conditions in the country. Moreover, they must also account for temporal trends. Finally, at the level of international comparability, they must be the same for all countries and power be shared with the entire international community.

Using these criteria, a set of 16 quantitative variables and 18 qualitative was chosen. Quantitative indicators are: the public funding of operating and capital expenditures; the funding from donors in terms of funds and days of expertise for technical assistance; donors involved; the downsizing and the loss of staff; the equipment of the technologies of information and communication (ICT) (mainframe, PC, network and Internet access); surveys and administrative registers that are used as sources of data. the types of data, including the reference years and the names of the agencies producing statistics; the frequency of data dissemination and; modes of data dissemination. As for qualitative indicators, they focus on the institutional prerequisites; integrity, methodological rigor, accuracy; the reliability, usefulness and accessibility.

This is particularly:

- The legal and institutional environment and resources necessary to carry out statistical operations obtain the cooperation of respondents and administrative authorities and manage statistical operations;
- Professional and cultural framework in which the statistical operations are conducted;
- The methodological expertise to establish data sources and their links with the statistical products;
- The population to be covered and surveys, survey questionnaires and administrative data sources;
- The skills and techniques needed to transform data sources into statistical products ;
- Evaluation and validation of data sources, the use of statistical techniques, assessment and validation of intermediate data and statistical outputs;
- The relevance of the statistics in economic and social problems, including the analytical capacity to confirm the existence of certain problems and identify those that need to be studied;
- Periodicity, dissemination and internal and cross coherent statistics;
- The methods and channels used to ensure wide and relevant dissemination of statistical products.

➤ *SCBI calculation*

The indicators are the result of a questionnaire to the attention of data producers. This questionnaire consists of a table where the indicators are listed and instructions on the information to be provided.

Each indicator is evaluated against a scale at four levels level 4 applies to highly developed statistical activities, level 3 moderately developed activities, level 2 for developing activities but which are still many deficiencies and level 1 characterizing the activities underdeveloped. This ranking has been established on the assumption that levels 3 and 4 relate to statistical activities not requiring outside help.

To allow international comparisons, three levels of assessment were selected for all countries. The first level is about indicators related to the whole system, it is to identify the statistics produced in the country, with the used reference year and the body producing them. The second level indicators relating to agencies, quantitative indicators are applied to each organization establishing the GDP statistics, of the population as well as income and household spending. At the third level, that of indicators related to the data, it applies qualitative indicators to data on GDP, population and income and household spending.

Finally, the SCBI were not secured by a formula that summarizes all of the variables. This implies the absence of a strategy of aggregation. Each indicator is analyzed according to its purpose.

Box 2:

The statistical capacity indicator of the World Bank

● **Presentation**

The statistical capacity indicator (SCI) is the World Bank work. It provides an overview of the statistical capacity for over 140 developing countries. It aims to assess the capacity of national statistical systems and to monitor progress in strengthening statistical capacity over time.

● **Methodology**

The SCI is a composite indicator that is based on three dimensions: i) statistical methodology; (ii) the data source; and (iii) the periodicity and timeliness.

Statistical methodology measures the ability to conform to the standards and practices internationally. It is represented by 10 indicators. This aspect is captured by the assessment guidelines and procedures used to compile macroeconomic statistics and social data reporting and estimation practices. Countries are assessed against a set of criteria.

The data source indicates if the country carries out activities of data collection in line with the recommended periodicity internationally, and if data from the administrative systems are available and reliable for purposes of statistical estimate. It is represented by five indicators. More specifically, the criteria used are: the periodicity of the censuses of population and agriculture, the frequency of poverty surveys and investigations related to health, and the completeness of the coverage of the system of civil status.

The periodicity and timeliness dimension examines the availability and frequency of the key socio-economic indicators, of which nine are indicators of the MDGs (Millennium Development). It is notably identified through 10 indicators on income poverty, child, and maternal health HIV / AIDS, the completion of primary school, gender equality, access to water and GDP growth.

⇒ ***SCI calculation***

For each dimension, the country is evaluated against specific criteria, using available information from the World Bank, the IMF, the United Nations, UNESCO and who. A composite score on a scale of 1 to 100 is obtained for each dimension based on weighting fixed by expert opinion. Finally the SCI is calculated by simple arithmetic average of the scores obtained for each dimension of the considered level. For example, a score of 100 indicates that the country meets all the criteria.

2. POTENTIAL AREAS FOR RENOVATING THE ASDI

As regard to the previous comments on the African Statistical Development Index (ASDI), a set of recommendations were made for purpose of improvements.

2.1. Monitoring and evaluation of statistical development in Africa: a composite index or not

A composite indicator is the compilation (using an underlying model) of several individual indicators into a single index. Generally, composite indicators are constructed to measure complex phenomenon that cannot be captured individual indicators.

Composite indicators are subject of many debates regarding their relevance as tools to sustain policy decision making.

Consistent with OECD (2008)¹¹, the pros and cons of composite indicators were documented.

Table 4: The pros and cons of composite indicators

Pros	Cons
<ul style="list-style-type: none"> • Can summarize complex, multi-dimensional realities with a view to supporting decision-makers. 	<ul style="list-style-type: none"> • May send misleading policy messages if poorly constructed or misinterpreted.
<ul style="list-style-type: none"> • Are easier to interpret than a battery of many separate indicators. 	<ul style="list-style-type: none"> • May invite simplistic policy conclusions.
<ul style="list-style-type: none"> • Can assess progress of countries over time. 	<ul style="list-style-type: none"> • May be misused, e.g. to support a desired policy, if the construction process is not transparent and/or lacks sound statistical or conceptual principles.
<ul style="list-style-type: none"> • Reduce the visible size of a set of indicators without dropping the underlying information base 	<ul style="list-style-type: none"> • The selection of indicators and weights could be the subject of political dispute
<ul style="list-style-type: none"> • Thus make it possible to include more information within the existing size limit. 	<ul style="list-style-type: none"> • May disguise serious failings in some dimensions and increase the difficulty of identifying proper remedial action, if the construction process is not transparent.
<ul style="list-style-type: none"> • Place issues of country performance and progress at the center of the policy arena 	<ul style="list-style-type: none"> • May lead to inappropriate policies if dimensions of performance that are difficult to measure are ignored.
<ul style="list-style-type: none"> • Facilitate communication with general public (i.e. citizens, media, etc.) and promote accountability. 	
<ul style="list-style-type: none"> • Help to construct/underpin narratives for lay and literate audiences. 	
<ul style="list-style-type: none"> • Enable users to compare complex dimensions effectively. 	

¹¹ OECD (2008), "A Handbook on constructing composite indicators, Methodology and User guide".

The debate on composite indicators concerns many other aspects not mentioned in these pros and cons. One may, notably, refer to Saltelli (2006)¹² for a full review of the main terms of controversy surrounding the use of composite indicators.

Based on the various feedbacks, from experts in the statistical development in Africa, and relying on the literature on the use of composite indicators, one may consider that for the case of statistical development in Africa, the construction of a composite indicator should not be a primary concern; the aim being to identify in detail the main constraints that limit the effectiveness of African statistical systems.

Thus, for the purpose of monitoring and evaluation of statistical development in Africa, instead of focusing on the construction of a single final to measure of statistical development, a set of indicators, namely African Statistical Development Indicators (ASDIs), could be constructed. These indicators would be the measures of core dimensions of statistical development in Africa.

This approach will enable each African country to examine its achievements in all the fundamental dimensions of statistical development. Thus, each African country will have the opportunity to conduct a multidimensional review of its statistical development, to identify its main strengths, as well as the main challenges and limitations it faces in its statistical development process.

Nevertheless, the idea of constructing a composite indicator may remain an option, since composite indicators also have advantages, as shown in Table 4. In particular, a composite indicator could be very useful in synthesizing (in terms of visualization, communication and dissemination) a large amount of information that would be transmitted by the ASDIs. In the end, the suggested approach is to focus initially on the construction of the African Statistical Development Indicators (ASDIs), urging countries to actively engage in converging their statistical systems towards best practices, for each of the dimensions measured through these indicators.

The idea of designing a composite measurement of statistical development in Africa could be seen as an objective to be achieved by 2020. In the meantime, African countries would have made sufficient progress in the various indicators and an integrated measure of statistical development will thus be defensible.

2.2. Selection of the ASDIs components and variables

The variables for the new version of the ASDI have been selected on the basis not only of the Strategic Reference Framework for Statistical capacity building in Africa, but also on the African Charter on Statistics and on the internationally recommended standards of quality. Efforts were also made to align the framework to the national strategies for statistical development that many African countries have put in place in the recent years.

Four indicators have then been identified to measure statistical development in Africa. These indicators are related to: (i) A functional institutional and organizational framework; (ii) Good capacities for an efficient statistical system; (iii) The production of relevant statistics that meet international quality standards; and (iv) A good dissemination policy and effective use of the produced statistics for analysis and research.

Each of these four indicators (dimensions) is divided into sub-components and the sub-components into variables. The following table gives details on the sub-components and variables for each indicator.

¹² Saltelli (2006), COMPOSITE INDICATORS BETWEEN ANALYSIS AND ADVOCACY (see <http://www.andreasaltelli.eu/file/repository/SIR2007.pdf>)

Table 5: Dimensions, sub-dimensions and variables of Statistical development

DIMENSION 1: AN INSTITUTIONAL AND ORGANIZATIONAL FRAMEWORK FUNCTIONAL

SUB-DIMENSIONS	VARIABLES
<i>Existence of a functional framework organizing and coordinating the National Statistical System (NSS)</i>	A <i>National Council of Statistics</i> or coordination organ setting up
	The National Statistics Council meeting periodicity
	An autonomous <i>National Institute of Statistics</i> (INS) setting up and functionality
	The statistical office management
<i>Existence of a specific legislative and regulatory framework for Statistics and regularly updated</i>	<i>Regions</i> in the country covered by a local dismemberment of the Statistical Office
	Formal adoption of the United Nations <i>official statistics fundamental principles</i>
	Ratification of the <i>African Charter on Statistics</i>
	Existence of a national <i>Statistics law</i> voted in Parliament and published in the Country's Official Journal, in line with the official statistics fundamental principles and the African Charter on Statistics principles, including the principles of independence, quality, mandate for data collection, dissemination, protection of personal data, information sources and respondents, coordination and cooperation
	Adoption and implementation of the <i>decrees</i> of the National Statistics Act

DIMENSION 2: GOOD CAPACITIES FOR AN EFFICIENT STATISTICAL SYSTEM

SUB-DIMENSIONS	VARIABLES
<i>Statistics funding</i>	<i>Share</i> (in %) <i>of the overall budget</i> of the State (operation and investment) allocated to the Statistical Office
	% of the lines of actions of the Statistical Master Plan included in the National Budget for the year
	Share over the last 5 years of the global NSO budget supported by the state
	NSO external funding and the main partners
	Share of the investment budget share in the global budget
	Creation and operationalization of a <i>Development Fund for Statistics</i> with stable resources
<i>Good Governance of the Statistical Office</i>	Adoption and implementation of a <i>multiannual Corporate Plan</i> by the NSO
	Managers and the department heads of the NSO appointment method
	Monitoring and evaluation of NSO and its personnel
	NSO strategic plan designing
	Existence of an <i>annual Work Program</i> within the NSO
	<i>Annual publication of a Report on progress made in the implementation of the statistical programs</i>
	proportion of ministries having a functional statistical production structure
	<i>% of achievements in the statistical activities</i> planned for the year
	Existence of a framework for assessing the quality of the statistical data
	Existence of a functional <i>Manual of Procedures</i>
	Effective implementation of a <i>Technical Committee of statistical programs (TCSP)</i> , coordinated by the statistical Office, responsible for ensuring the consistency and comparability of the information collected through various sources within the National Statistical System
	Existence of the TCSP <i>subcommittees</i> that are operational
Existence of a Users-Producers of official statistics Committee, without any discrimination, to ensure the adequacy of the statistical information published to their needs.	
<i>Annual certification of the NSO accounts</i> by an external control body	

Human capital	Existence of a human resources development and management plan in the NSS
	Professional staff or not dedicated to the production and dissemination of statistics at national level
	Proportion (in %) of professional staff in the NSO regional agencies who have advanced degree in statistics or related field.
	Number of non-statisticians and non-demographers staff
	% of professional staff who have signed a confidentiality agreement at the time of entry into function
	Number of students enrolled in the training structures in statistics at national and regional level and in the universities of the country, per 100 000 inhabitants
	Percentage of students enrolled in the training structures in statistics at national and regional level and in the universities of the country with scholarship
	Existence of initial or/and continuous training center for the NSS statisticians
	Existence of continuous training sessions (of different types) organized by the Statistical Office in the area of statistics and the modules
Physical and material infrastructure	Existence of a building owned by the National Statistical Office
	Estimation of the quality of the building housing the Statistical Office headquarters (on a scale of 1 to 5)
	Transport infrastructures for surveys
	quality of the NSO transport infrastructures for surveys on a scale of 1 to 5
statistical infrastructure	Existence of a Unit dedicated solely to Standards and statistical classifications within the Statistical Office
	Existence of a Unit dedicated to Statistical Directories
	Existence of a Unit dedicated to Statistical Methodologies
	Statistical softwares acquired and used by the Statistical Office in the production of statistics
	Existence of a unit dedicated to sampling within the Statistical Office
	Existence of a geographical information system within the Statistical Office
	Use of PDAs or other electronic tools for censuses and large surveys
ICT Equipment	Existence of an IT master plan
	Existence of an IT Unit within the Statistical Office
	Existence of an Intranet and a server owned by the Statistical Office
	Number of computers per professional statistical staff
	Estimation of the quality of the speed of the Internet network used by the Statistical Office
	Management of a centralized databank
	Estimation of the overall quality of computer systems and equipments used in the Statistical Office
Active promotion of bilateral and multilateral cooperation for statistical capacity building	Number of countries with which the Statistical Office maintains cooperative relationships (data exchange, methodologies, technical assistance, etc.)
	Proportion of the partnership agreements concluded by the Statistical Offices with regional and global statistical bodies
	Proportion of the NSO officials who benefited in the year from a training program delivered by global and regional statistical bodies

DIMENSION 3: PRODUCTION OF RELEVANT STATISTICS THAT MEET THE INTERNATIONAL QUALITY STANDARDS

SUB-DIMENSIONS	VARIABLES
<i>Proper evaluation of data requirements</i>	Effective evaluation <i>of data needs</i> arising from the National Development Plan
	Effective evaluation of data needs generated by the Sustainable Development Goals and the Agenda 2063 of the African Union
	Annual data needs collection from the various Ministries
	Existence of a mechanism (eg survey) to assess specific data needs for other users (private sector, civil society etc.)
<i>statistical programming</i>	Formal adoption of a <i>multiannual program of censuses and statistical surveys</i> by the National Statistics Council, ensuring its adaptation to the needs of the NSS and of the different users
	Having of a national Statistics Development Strategy or other similar plan by the country
<i>Comprehensiveness, periodicity and timeliness of data collected</i>	Respect of the population and housing censuses periodicity
	Respect of the agriculture and livestock censuses periodicity
	Respect of the poverty-related surveys periodicity
	Designing of the surveys or modules related to demographics, health, education, gender , childhood, violence and environment periodicity
	Respect of the economic statistical indices periodicity
	Respect of the employment statistics periodicity
	Respect of the national accounts statistics periodicity
	Coverage level (in%) of the Civil Registration System (births)
	Coverage level (in%) of the Civil Registration System (deaths)
	Existence of an organizational framework of the current statistical production that permit to continuously improve the thematic and geographical coverage
	Number of SDG indicators that the NSS can inform
Number of the African Union Agenda 2063 indicators that the NSS can inform	
<i>Data collection and validation</i>	Availability of a clear legal mandate authorizing the collection of data
	Existence of a clear policy choice of data sources, taking into account to the quality of data they can provide, their timeliness, particularly the costs on respondents and costs on donors of data
	Existence of a set of guidelines and internal guidelines for the conduct of collection operations
	Existence of a systematic testing device, before collection, of the questionnaires used in statistical surveys
	Estimation of the quality of the overall device of survey design, samples selection and estimation methods
	Systematic review and revisions as necessary of data during their collection
	Systematic review and revision as necessary of data during their codification and data entry
	Existence of appropriate methods for imputation, clearance and recovery of data, regular evaluation, and if necessary their correction or update
	Existence of standardized procedures, timely and transparent for the revisions
	Estimation of the overall quality of the device of statistical and computer processing of data collected
	Involvement of the Statistical authorities in the design of administrative data, in order to make them better adapted to the statistical use
	Conclusion of agreement with administrative data holders who express a shared commitment to use these data for statistical purposes

Quality assurance of the data produced	A Quality policy is defined
	The Quality policy is disseminated to the public
	Number of guides published by the Statistical Office for the NSS actors, about the concepts, methods, classifications and standards, defined independently and in compliance with the rules of ethics and professional deontology
	Organization by the Statistical Office, at least once a year, of a training session for the NSS statistical agents about the concepts, methods, classifications and standards
	Business Directory and frame household surveys / individuals regularly reviewed, revised if necessary and updated
	Existence of a quality certification system for all data generated by the NSS, if necessary by calling on outside experts, while ensuring strict compliance with the quality principles enshrined in the African Charter on Statistics: relevance, sustainability, data source, accuracy and reliability, continuity, coherence and comparability, timeliness, integration of African specificities, awareness of data providers on the importance of statistics.
Archival, storage and security of data	Estimation of the quality of the infrastructure for archiving and storage of data in digital media
	Estimation of the quality of the material device put in place to ensure the security and integrity of the statistical databases
Data management	Data management as a dedicated activity in the NSO
	Background of the people in charge have a in the field of study
	Data management dependence on what the software provides or on what the NSOs strategic direction dictates
	Proportion of the financial resources devoted to data management
	Data currently stored format (text file, CSV etc.)
	Geo-referenced data accessed by users
	Metadata storing for all data
	Data validation mechanisms currently being used by NSOs
	The different versions of the same data set stored and tracked
	Person who is allowed to extract data from the NSO server
	A clear guideline on how to access the data by the general public
The data secured	

DIMENSION 4: GOOD DISSEMINATION POLICY AND EFFECTIVE USE OF THE STATISTICS PRODUCED FOR ANALYSIS AND RESEARCH

SUB-DIMENSIONS	INDICATORS
Communication on the Statistical Office and on the NSS activities to strengthen statistical culture within the society and to give a good image of the official Statistics	Existence of a Communication Plan on the NSO and the NSS activities, prepared by a specialized structure in this domain
	Existence of an internal unit to the NSO responsible for communication on the statistics produced, animated by professionals in corporate communication
	NSO work closely with the media in their training and communication programs
	Celebration of the African Statistics Day (ASD)
	Government member represented at the last celebration of ASD
Subscription to international data dissemination systems	Sessions organized in the year by the NSO, to publicize and / or strengthen the capacity of the Public in the interpretation of statistical data
	Subscription to the IMF General Data Dissemination System (GDSS)
	Subscription to the IMF Special Data Dissemination Standard (NSDD)

<i>Existence of data dissemination strategy in clear form, understandable, practical and appropriate</i>	Effective average time between the end of the reference period and the date of publication for the flagship publications of the Statistical Office, during the last year (a monthly publication, a quarterly publication, a semestrial publication)
	Setting up of a website dedicated to the NSO, easily usable by the public
	Establishment by the NSO of harmonized databases for statistics from various sources,
	Establishment of a billing policy
	Ability for users to access to metadata on request
	Ability for users to access to data disaggregated by geographic area, sex, region, revenue, etc., at their request
	Existence of a rectification political of Publications results marred by significant errors using statistical standard practices, or, in the most severe cases, suspending the broadcast and clearly marked to the attention of users the reasons for these corrections or suspensions of these results
	Strict protocols apply to external users accessing statistical microdata for research purposes
Regular evaluation of the satisfaction and confidence of data users	
<i>Promoting research and thorough analysis of statistical data produced</i>	<i>Existence of analytic content in the NSS current publications</i>
	<i>Existence of a Research Unit within the NSO</i>
	<i>Establishment of a formal framework for cooperation between the NSO and the research institutions to promote comprehensive data analysis and applied research</i>

2.3. Methodology for the calculation of the ASDIs

Each of the four indicators is the final measure of a process of calculation based on the 10 steps for building a composite indicator developed by the OECD:

The Theoretical framework

ASDIs are consistent with a strong theoretical framework that is discussed in Section 2.3 below.

Data collection

A harmonized survey has been designed to collect the different data from countries. Once the data are collected, a summary table on data characteristic will be provided. This summary will be on;

- Availability of data across countries and time;
- Source of data;
- Type of variables.

Imputation of missing data

Missing values will be estimated through a robust approach. To handle the presence of various types of variables, the framework of the multiple imputations will be developed.

The multiple imputation framework suggested is built around three (3) steps:

➤ Deciding to impute

At the stage of deciding to impute, the main question that arises is whether to impute data or to perform analysis on complete cases only. This question is important to answer since imputation processes are very demanding in implementation time. Another issue to solve at this stage is the theoretical foundation of the retained approach.

It is also important to consider the power issue. In fact the choice of imputing is guided by the fact one wishes to avoid losing observations since they contain missing values. Then the approach adopted shall lead us to use the information available in those observations that contain missing values, and this can lead to smaller confidence.

At this stage of deciding to impute or not, the type of missings should also be considered. In imputation literature, data may be "missing completely at random" (MCAR). In the case of MCAR data, the probability of a particular value being missing is completely independent of both the observed data and the unobserved data. In other words, the complete cases are a random sample. Generally in the case of MCAR data, both complete cases analysis and multiple imputations give unbiased estimates.

When the probability of a particular missing value depends only on the observed data, then the data is said to be "missing at random" (MAR) and the complete cases are not a random sample. In the case of MAR data, complete cases analysis gives biased results but multiple imputations does not.

Data may also be "missing not at random" (MNAR). In this case, the probability of a particular value being missing depends on the observed and unobserved data.

So tests should be run at this stage to discover which types of data are missings are the data.

➤ Creating imputation models

Once we decided to perform imputation, it becomes important to create the models that would sustain the process.

Generally in theory, an imputation model estimates the joint distribution of all the variables it contains. But there are some approaches (multiple imputation using chained equations for instance) break this problem into a series of estimations of one variable on all the other variables in the model. But the issue with these techniques is that a series of models of the distributions of individual variables does not necessarily add up to a consistent model of the joint distribution.

In the process of selecting imputation models, one should give focus to the choice of variables as well as the choice of the methods (continuous but non-normal variables, transformations, bounded variables, inclusion of non-linear terms and interaction terms, etc.). However ideally, it is better to work on getting the real data than relying on imputation methods.

➤ Imputing

This stage consists simply in implementing the imputation models defined previously.

At this stage, treatment of outliers will be made.

Multivariate analysis

At this step, we the overall structure of the dataset will be studied by means of factor analysis, correlation analysis and cluster analysis.

Normalization

A linear scale from 1 to 100 has been defined to ensure a clean aggregation. Minimum and maximum as possible are set for the variable and the index values are obtained by subtracting the assigned minimum from the observed value and dividing by the difference between the maximum and minimum.

Symbolically, let X_{min} , and X_{max} denote the minimum and maximum possible are set for the variable, while denote the observed value and the index value by X_{obs} , $I(X_{obs})$ respectively. Then according to the above described scaling:

$$I(X_{obs}) = \frac{(X_{obs} - X_{min})}{(X_{max} - X_{min})}, \quad (1)$$

Which ensure that the transformed variables will have (0, 1) as a common scale.

Once the variables are normalized, scores will be computed for the variables. For the different indicators, we deal with three main categories of variables: absolute numbers, percentages, and categorical variables.

Categorical variables are mainly questions with sub-items. The score of such variables is computed as:

$$S_j = \frac{1}{n_j} \sum_{k=1}^{n_j} V_k, \quad (2)$$

Where S_j is the score of the j^{th} categorical variable, n_j the total number of sub-items in the j^{th} variable, and V_k the value of the score corresponding to the k^{th} sub-item of the variable. If the value of the sub-item is “Yes”, then its score is n_j while if the value of the sub-item is “No”, its score is 1.

The treatment of absolute numbers depends on the phenomenon at stake.

Weighting and aggregation

- Weighing

Consistent with the various comments made in the review of the ASDI, a weighted scheme will be built for each of the indicators. This suggestion is based on the fact that the different variables/sub-components should not entry identically in the measure of statistical development dimensions in Africa. However a multi-modelling framework could also strengthen this position.

The weights will derive from factor analysis but will be strengthen by expert opinion.

- Aggregation

After reviewing the ASDI, the suggested aggregation scheme for the ASDIs is the weighted geometric form:

$$ASDI_s = \prod_{i=1}^n SC_i^{w_i}$$

With weights w_i defined in the weighing sub-section.

However, a multi-modelling approach (applied to each indicator) will be conducted for purpose of robustness checks. In this multi-modelling framework, may consider additionally a non-compensatory multi-criteria approach as suggested by the OECD to better and practically assess the robustness of the geometric rule.

Uncertainty and sensitivity analysis

When building the ASDIs to measure statistical development in Africa, it is necessary to consider existing methodologies so as to avoid misleading policy messages. By doing so, we are able to determine the changes in the results when the core assumptions are varied within a set of possibilities.

For each indicator, the suggested uncertainty analysis consists of assessing the impact of alternative models on the country ranks. Each model is a different indicator in which the choice of weights and aggregation method will be varied within a plausible range. The uncertainty analysis is performed through the process of multi-modelling approach.

The multi-modelling approach would consist of exploring a number of combinations of three main assumptions needed to build an index:

- *The weight given to each sub-component/variables*

Regarding the weighting scheme, we suggested a weighted approach based on factor analysis and reinforced with expert opinion. The paper performs both equal weighting and PCA derived weighting approaches. In practice, these are not the unique frameworks. In addition to this weighting scheme, we may test two more alternatives: an equal weight approach and a cross-efficiency DEA.

- *The aggregation technique*

Regarding the aggregation technique, we build first on the suggested aggregation rule that is the weighted geometric rule:

$$ASDI_s = \prod_{i=1}^n SC_i^{w_i} \quad (1)$$

Then we also consider the non-compensatory multi-criteria approach in addition to those approaches in the process of the multi-modelling.

- ***The number of sub-components included in the final measures;***

For the purpose of our multi-modelling approach, we will build the ASDIs either by keeping all the sub-components/variables or by excluding one at a time. This statistical procedure would allow us to test for the robustness of inference. This should not be viewed as a modification of the general framework that would be retained.

Finally, this multi-modelling approach will allow us to perform uncertainty analysis. Now, complementary to uncertainty, we suggest performing a sensitivity analysis, using the different scenarios that would derive from precedent multi-modelling design. For instance, we suggest calculating, for each country, the absolute rank shift between the original index rank and the rank provided by the scenarios, and use Root mean square error (RMSE), Spearman rank correlation coefficient and percentiles to report the shifts for all the countries.

Decomposition into the underlying indicators

At this stage, a country performance profile is built to highlight strengths and limitations in the different indicators.

Visualization of the results

At this stage, a suitable presentation tool will be developed to disseminate the results of the indicators.

2.4 Limitation of the study

The major limitations of this study include:

- Use of composite function for aggregation:* The proposed aggregating scheme is based on a composite function which has undesirable properties as outlined in table 4. However this weakness is common to all composite functions and addressing these cons is in the field of theoretical and mathematical field of statistics that still an open unsolved problems;
- The choice of the components, sub-components and indicators:* there is no global and standard approach to guide the selection of the input of the indicators (indices). As we have shown in Section (1.1), one need to adopt a controversial steps of developing a composite index in the choice of components and variables. And that the determination of the components and selection of the variables is generally based on theory, empirical analysis, pragmatism, intuitive appeal or a combination of all of these. Whatever choice is therefore will carry with it an element of arbitrariness.

3. THE WAY FORWARD

- The Statistical Commission for Africa is requested to endorse this methodology which has been subjected to an extensive discussion of an EGM (October 2016). This in turn, will allow each member states to have an efficient, comparable and effective tool for measuring their progress in statistical development through time in the short term.
- The Commission may want to guide ECA on the subsequent steps needed to implement this methodology, including for instance the development of software for data collection, compilation and computation of the proposed indicators.

APPENDICE: QUESTIONNAIRE



African Centre for Statistics

AFRICAN STATISTICAL DEVELOPMENT INDICATORS

Survey

This questionnaire is important as it collects information to measure national and continental progress in statistical development. It is composed of four sub questionnaires that collect data which will help to calculate indicators in the areas addressed by the questionnaire.

The African Centre for Statistics wishes to thank you for the time you will devote to complete this questionnaire.

IDENTIFICATION

Country: _____

Year: _____

Name of Respondent's Institution:

First Names and Surname **of Respondent** _____

Title _____

Phone Number _____

E-mail address _____

Questionnaire A: A FUNCTIONAL INSTITUTIONAL AND ORGANIZATIONAL FRAMEWORK

NB: Only select one option unless otherwise specified.

A. Existence of a functional framework organizing and coordinating the national statistical office

1. Is there a coordination organ or similar organization in the country?
 Yes No

2. If so, how often does the Board meet?
 Monthly Quarterly Semiannual Other (explain, list) _____

3. Does the country have a National Statistics Office or Institute?
 Yes No

4. If so, does the institute/office satisfy the following conditions? (*You can make multiple choices*)
 It is functional
 It is autonomous
 It has sufficient authority to force the implementation of international and national standards

5. How is the head of the National Statistics Office appointed?
 Call for application
 By Discretionary choice or recommendations of the national authorities
 Other (explain, list,) _____

6. What is the NSO Head or Chief Executive Officer level in the hierarchy of public service of the country? (*Level 1 is the Minister*)
 1 2 3 4 5

7. Does the National Statistical Office (NSO) have regional offices or Sub-national branches?
 Yes No

8. If so, indicate the number of offices per region / zone

B. Existence of specific legislative and regulatory framework for statistics, regularly updated

9. Has the country formally adopted the official statistics fundamental principles of the United Nations?

Yes No

10. Has the country ratified the African Charter on Statistics

Yes No

11. Does the country have a statistical law?

Yes No

12. If so, does this law satisfy the following conditions? (*You can select multiple options*)

It is voted in Parliament

It was published in the official newspaper of the country

It applies the official statistics fundamental principles of the United Nations

It incorporates the principles of the African Charter on Statistics

It is already implemented

It provides the central role that the NSO should play within the National Statistics System.

Questionnaire B: CAPACITY FOR AN EFFICIENT STATISTICAL SYSTEM

A. Funding

1. Give the Share (in %) of the state budget (operation and investment) allocated to the NSO

Share _____

2. Give the Share (in %) of the last General Census of Population budget funded by the Government

Share _____

3. Give the Share (in %) of the overall NSO budget supported by the state

Share _____

4. Delays between commitment of funds by the Government and their actual payments are :

No delay

Acceptable

Crippling for the successful implementation of the NSO activities

5. Give the share over the last 5 years of the global NSO budget supported by the state

Year 1 _____

Year 2 _____

Year3 _____

Year4 _____

Year5 _____

6. Does the country have a statistical development fund?

Yes No

7. If yes, is it (*You can make multiple choices*)

Operational?

With reliable resources?

8. What is the annual amount available within the fund in dollars? _____

9. Does the NSO receive external funding?

Yes No

10. If yes, give the main partners (and the support received in the last year) _____

Partners	Type of support given	Value in dollars	Share in the NSO budget

11. What is the Investment budget by professional officer of the NSO (in local currency)?

B. Good governance of the Statistical Office

12. How are the managers and the department heads of the NSO appointed?

Call for application on the basis of professional skills (including internal level)

By own choice of the NSO general manager

By Discretionary choice or recommendations of the national authorities

Other (explain, list,) _____

13. Is there a process established for personnel evaluation at all levels

Yes No

14. Is there a process of monitoring and evaluation in the NSO?

Yes No

15. Is there a Strategic Plan for the National Statistics Office

Yes No

16. Is an annual Work plan prepared by the National Statistics Office?

Yes No

17. Is a progress report on the implementation of the annual statistical programs published at the end of the year?

Yes No

18. Is there a framework for assessing the quality of statistical data produced?

Yes No

19. If yes, does the framework have a functional operation manuals?

Yes No

20. Are the financial statements audited and annually certified by an external control body?

Yes No

21. Give the proportion of ministries having a functional statistical production structure / unit _____

22. Give the proportion of ministries for which statistics are produced by the NSO.

23. Indicate whether the country has the following organs?

- Technical Committee of statistical programs (CTPS) functional, coordinated by the Statistical Office, responsible for ensuring the consistency and comparability of the information collected through various sources within the National statistic system : Yes No

- Sectoral committees involving sectoral statistics producers : Yes
 No

- Users - producers of official statistics Committee functioning without discrimination, to ensure the adequacy of statistical information published their needs. : Yes
 No

c. Human capital

24. Is there a human resources development and management plan in the National Statistics System of the country?

Yes No

25. Give the number of Professional staff (staff with qualification in statistic or demography or related field) dedicated to the production and dissemination of statistics at NSO

Total (in number) _____ Proportion of the total _____

26. Give the number of non-statisticians and non-demographers staff _____

27. Give the proportion (in %) of professional staff in the NSO regional agencies who have advanced degree in statistics or related field. _____

28. Share (in %) of professional staff who have signed a confidentiality agreement at the time of their employment.

Share (in %) _____

29. Share (in %) of professional staff who left the NSO in the year

30. Give the number of students enrolled in the training institutes specializing in statistics in the country's universities

Total (in number) _____ Total per 100 000 inhabitants (in %) _____

31. Give the number of students enrolled with scholarship Total (in number) _____

32. Is there an initial training center and / or continuous training program for the NSO statisticians?
 Yes No
33. Are continuous training sessions organized for the National Statistics System by the Office of Statistics or training centre in Statistics?
 Yes No
34. If so, specify the statistics training modules _____
35. What is the modules frequency _____

D. Physical and material infrastructure

36. Does the NSO have its own building?
 Yes No
37. Please rate the quality of the building housing the NSO on a scale of 1 to 5

38. Does all staff have his own bureau?
 Yes No
39. Does the NSO have enough transport infrastructures for surveys?
 Yes No
40. Please rate the quality of the NSO transport infrastructures for surveys on a scale of 1 to 5

E. Statistical infrastructure

41. Is there a Standards and autonomous statistical classifications unit within the Statistical Office?
 Yes No
42. Is there a statistical unit register within the Statistical Office?
 Yes No
43. Is there a Unit dedicated to Statistical Methodologies within the Statistical Office?
 Yes No
44. Is there a Unit dedicated to sampling within the Statistical Office?
 Yes No
45. List the statistical software packages are acquired and used by the NSO for its work?

46. Does the NSO use PDAs or other electronic tools for data collection during censuses and large surveys?
 Yes No
47. Is there a geographical information system within the Statistical Office?
 Yes No

F. ICT Equipment

48. Is there an ICT department in the Statistical Office?
 Yes No
49. If so, is the department? (*You can make multiple choices*)
 Sufficiently equipped?
 Functional?
 Has sufficient human resources?
50. Does the NSO have its own website?
 Yes No
51. If so, how often is it updated?
 No annual twice a year quarterly monthly other
specify _____
52. Is there an Intranet and a server within the NSO
 Yes No
53. Give the percentage of NSO professional staff that have their own computer for work?

54. Does the NSO own big machines?
 Yes No
55. Estimate the quality of the Internet speed used by the NSO
 Very Good
 Good
 Fair
 Poor
56. Estimate the overall quality of IT systems and equipment used in the NSO _____
 Very Good
 Good
 Fair
 Poor
57. Is there an IT master plan?
 Yes No
58. Does the NSO manage a Centralized databank?
 Yes No
59. Is there an outside back-up system?
 Yes No

G. Active promotion of bilateral and multilateral cooperation for statistical capacity building

60. Have the country entered an NSO exchange program?
 Yes No
61. Give the number of the partnership agreements concluded by the NSO with regional or global statistical agencies _____

62. What proportion of NSO officials benefited from a training program delivered by global and regional statistical agencies during the year? _____
63. What is the proportion of professional staff that are part of professional bodies or networks _____
64. Does the NSO works towards having chartered statisticians in Africa?
 Yes No

Questionnaire C: PRODUCTION OF RELEVANT STATISTICS THAT MEETS INTERNATIONAL QUALITY STANDARDS

A. Proper evaluation of data requirements

1. Does the NSO conduct systematic evaluation of data needs arising from the National Development Plan?
 Yes, fully Yes, Partially No Other, specify _____
2. Does the NSO conduct systematic evaluation of data needs according to the Sustainable Development Goals?
 Yes, fully Yes, Partially No Other, specify _____
3. Does the NSO conduct systematic evaluation of data needs according to Agenda 2063 of the African Union?
 Yes, fully Yes, Partially No Other, specify _____
4. Does the NSO conduct systematic evaluation of data needs from different departments?
 Yes, fully Yes, Partially No Other, specify _____
5. Is there a mechanism (e.g. survey) to assess the specific data need for other users (private sector, civil society, etc)
 Yes, fully Yes, Partially No Other, specify _____
6. If yes, explain the mechanism _____

B. Statistical programming

7. Does the country have a national Statistics Development Strategy or other similar plan?
 Yes No
8. If so, check the following boxes (*You can make multiple choices*)
- The strategy (or plan) design was participatory and unrestricted (*consultations have involved multiple stakeholders: government ministries and departments, private sector, civil society, academia, researchers, etc.*).
 - The design process was in line with international recommendations
 - The strategy (or plan) is complete and consistent (it *covers the entire National Statistical System (NSS) and sectors*).
 - The strategy (or plan) was officially adopted by the government.
 - The strategy (or plan) is aligned to the SDGs
 - The strategy (or plan) is aligned to the Agenda 2030
 - The strategy (or plan) is aligned to the Agenda 2063

9. Give the sectors (education, health, agriculture, etc.) eventually with statistics development plan

10. Has the government adopted a multi-year program of censuses and surveys?

Yes No

11. If so, does it meet the following requirements?

- Adapted the NSS needs? Absolutely Moderately Not really
- Adapted to the needs of different users? Absolutely Moderately Not really

C. Comprehensiveness, periodicity and timeliness of data collected through census and surveys

12. How many population and housing censuses were conducted over the last 10 years?

One or more
 Zero (0)

13. How many Agriculture Censuses were carried out over the last 10 years?

One or more
 Zero (0)

14. How many Livestock Censuses were carried out over the last 10 years?

One or more
 Zero (0)

15. Did the country conducted poverty surveys with specific module (both Income and Expenditure) over the last 10 years?

Yes No

16. Did the country conducted surveys with specific module in demography over the last 10 years?

Yes No

17. Did the country conducted surveys with specific module in health over the last 10 years?

Yes No

18. Did the country conducted surveys with specific module in education over the last 10 years?

Yes No

19. Did the country conducted surveys with specific module in surveys related gender over the last 10 years?

Yes No

20. Did the country conducted surveys with specific module in children or childhood over the last 10 years?

Yes No

21. Did the country conducted surveys with specific module in surveys related violence against women over the last 10 years?

Yes No

22. Did the country conducted surveys with specific module in surveys related environment over the last 10 years?
 Yes No
23. Did the country conducted surveys with specific module in surveys related employment over the last 10 years?
 Yes No
24. Did the country conducted surveys on business establishment over the last 10 years?
 Yes No
25. What is the level (in %) of birth registrations in the country? _____
26. What is the level (in %) of death registrations in the country? _____
27. Which edition of the balance of payments manual does the country use?
 Sixth edition
 Fifth edition
 Other edition
28. What is the periodicity of national accounts indicators?
 Annual
 Semesterly (Half-yearly)
 Quarterly
 Monthly
 Observed for at least 6 times in 10 years
 Observed for at least 1 time in 10 years
 Are not computed
29. What is the frequency of industrial production indicators?
 Annual
 Semesterly (Half-yearly)
 Monthly
 Quarterly
 Are not computed
30. What is the frequency of price statistics at national level?
 Annual
 Semesterly (Half-yearly)
 Monthly
 Quarterly
 Are not computed
31. What is the frequency of employment indicators?
 Annually
 Observed at least 3 times in 10 years
 Observed at least 2 times in 10 years
 Observed at least once in 10 years
 Are not computed
32. Is there a formal framework for the organization of the current statistical output for continuously improving the thematic and geographical coverage?
 Yes No

D. Data collection

33. Is there a clear legal mandate authorizing the collection?
 Yes No
34. On a scale of 1 to 5 estimate the quality of the overall system of survey design, sample selection and estimation methods of the NSO _____
35. Does the NSO do a Systematic review and revisions of data during their collection, when necessary?
 Yes, always Yes, often Never
36. Does the NSO do a Systematic review and revisions of data during their codification and data entry, when necessary?
 Yes, always Yes, often Never
37. Is there appropriate methods for imputation, clearance and recovery of the data collected by the Statistical Office?
 Yes No
38. Is there standardized procedures, timely and transparent, for the revisions?
 Yes No
39. Does the NSO take part in the design of administrative data systems in order to make the data more suitable for statistical use?
 Yes, always Yes, for some sectors Never
40. Is there an agreement with administrative data holders that express a shared commitment to use the data for statistical purposes?
 Yes, always yes, for some sectors Never

E. Quality assurance of the data produced

41. Is there a defined quality policy?
 Yes, fully Yes, Partially No
42. Is the public informed on the quality policy used by the Statistical Office?
 Yes, fully Yes, Partially No
43. Give the number of user-guides published by the NSO for the NSS stakeholders, about
 Concepts, _____
 Methods, _____
 Classifications and standards, defined independently and in compliance with the rules of ethics and professional deontology

44. Does the NSO organize a training session for staff on the concepts, methods, classifications and standardizations at least once a year?
 Yes No

45. Evaluate the frequency of assessing, correcting and updating of the business register and household surveys/individuals frame

- Rarely
 Often
 Regularly

46. Is there a quality certification system for all data generated by the NSS, while ensuring strict compliance with the quality principles enshrined in the African Charter on Statistics: relevance, sustainability, data source, accuracy and reliability, continuity, coherence and comparability, timeliness, integration of African specificities, awareness of data providers on the importance of statistics?

- Yes No

47. If yes, how? (*multiple choice possible*)

- For external experts
 Call for National experts
 Other (specify) _____

F. Archival, storage and security of data

48. On a scale of 1 to 4, please estimate the quality of archiving and storage infrastructure for data in digital media. _____

49. On a scale of 1 to 4, please estimate the quality of the hardware device(s) in place to ensure the security and integrity of statistical databases. _____

50. On a scale of 1 to 4 please estimate the quality of the technical device(s) in place to ensure the security and integrity of statistical databases. _____

51. On a scale of 1 to 4, please estimate the quality of the organizational device(s) in place to ensure the security and integrity of statistical databases. _____

52. On a scale of 1 to 4, please estimate the quality of the data anonymization system (data secure). _____

G. Data management

53. Is data management a dedicated activity in the NSO?

- Yes No

54. Do the data manager have a background in the field of study?

- Yes No

55. Is data management dependent on what the software provides or on what the NSOs strategic direction dictates?

- Yes No

56. What proportion (%) of the financial resources is devoted to data management?

57. How is the geo-referenced data accessed by users?

- More easily easily acceptable difficult more difficult

58. Is there metadata for all stored data?

Yes No

59. How are the different versions of the same data set stored and tracked?

60. Who is allowed to extract data from the NSO server?

61. Is there a clear guideline on how to access the data by the general public?

Yes No

**Questionnaire D: GOOD DISSEMINATION POLICY AND EFFECTIVE USE OF THE
STATISTICS PRODUCED FOR ANALYSIS AND RESEARCH**

A. Subscription to international standards for data dissemination

1. Does the NSO subscribed to the General Data Dissemination System (GDDS)?
 Yes No
2. Has the NSO subscribed to the Special Data Dissemination Standard (SDDS) of the IMF?
 Yes No

B. Communication on the NSO and the NSS activities to strengthen statistical culture within the Company and to give a good image of official Statistics

3. Is there an internal unit within the NSO responsible for communication on the statistical products?
 Yes No
4. Is there a communication plan for the Agency and the NSS activities?
 Yes No
5. Does the NSO work closely with the media in their training and communication programs?
 Yes No
6. Are there sessions organized during the year by the Statistical Office, to publicize and / or strengthen the capacity of the Public in the interpretation of statistical data?
 Yes No
7. Does the country celebrate the African Statistics Day (ASD)?
 Yes No
8. Was a government member represented at the last celebration of ASD?
 Yes No

C. Existence of data dissemination strategy in clear form, understandable, practical and appropriate

9. Is there an operational plan of distribution of the data produced by the Statistical Office?
 Yes No
10. Is there a simultaneous publication schedule of data produced by the Statistical Office, produced and disseminated in advance (ideally one year), stating, publicly stating clearly the rules that individuals have to follow during the embargo process?
 Yes No
11. Give an estimate of the AVERAGE TIME between the end of the reference period and the publication date for your flagship publications ONLY, during the LAST year:
 Monthly publications
 Quarterly publications
 Half yearly publications
 Annual publications

12. Does the NSO have a user-friendly dedicated website?
 Yes No
13. Does the NSO implement a harmonized database from different sources?
 Yes No
14. Does the NSO have a billing policy?
 Yes No
15. Does the NSO disseminate metadata upon?
 Yes No
16. Does the NSO allow its users to access data disaggregated by region, gender, region, income level, etc., upon request
 Yes No
17. Does the NSO implement a policy of correcting results arising from material errors in publications using standard statistical practices, or, in more serious cases, suspending the publication while clearly stating the reasons for these corrections or suspensions to users?
 Yes No
18. Are there strict protocols applying to external users accessing statistical micro data for research purposes? Yes No
19. Does the NSO regularly assess the satisfaction and confidence of data users?
 Yes No

D. Promoting research through the analysis of data produced

20. Do the current publications of the NSO have an analytical content?
 Yes No
21. Is there a functional Research (statistics, economics and social) and Policy analysis Unit within the Statistical Office?
 Yes No
22. Is there collaboration between NSO and research centers or training centers for further data analysis and applied research?
 Yes No

Thank you for your cooperation