

KENYA NATIONAL BUREAU OF STATISTICS

CENSUS OF KENYA 2009

QUALITY ASSURANCE FRAMEWORK

March 31, 2009

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1. PREFACE

The Kenya National Bureau of Statistics has asked for assistance in establishing a framework for assuring that the 2009 Census of Population and Housing is carefully planned, organized, and executed to produce high quality estimates of the demographic and socio-economic state of the country. This document outlines the steps that the KNBS Census Staff will need to consider in establishing a quality framework to provide staff and stakeholders with a detailed roadmap for demonstrating the quality of the upcoming Census.

This framework begins with a discussion of quality and then applies quality considerations to each component of the Census. Where applicable, there is a listing of the tasks that need to be performed for the successful conduct of that census component. This is followed by recommendations.

The framework concludes with an appendix (Appendix 2) which is a paper by Bernard Baffour and Paolo Valente which describes how a census is evaluated for quality. It was included as a counterpoint. The Framework describes how to carry out a quality Census. The paper shows one way that the quality of a completed census can be assessed.

2. INTRODUCTION

KNBS needs to start with five principal ingredients if it is to have any chance of conducting a quality census:

- a detailed, well-designed project plan;
- an adequate number of capable, well-motivated staff, willing to work as a team;
- adequate resourcing;
- sufficient time to carry out all the steps in the project plan; and
- careful monitoring to identify issues that threaten to throw the plan off schedule and allow management to make adjustments that minimize adverse impacts on quality in the effort to maintain the critical path schedule .

A Census is the largest, most complex, endeavour that any country undertakes in peacetime. Its staff must be able to enumerate everyone in the country, without omission or duplication, in a relatively short period of time.

Since Kenya does not have a reliable population register, the only alternative means of ensuring complete, unduplicated coverage is to develop an area frame. This requires the division of the entire country into small, non-overlapping, units each of which can be covered by an enumerator (hence usually referred to as an Enumeration Area (EA)) in the time allotted. The boundaries of each of these units must be clear enough to an enumerator that (s)he will neither miss any part nor stray beyond into another's area. The boundaries must also respect the boundaries of all political, administrative and socio-economic units for which the KNBS will be expected to provide statistical aggregations.

For the next census, there will be thousands of Enumeration Areas. This requires the hiring and training of thousands of enumerators; providing them with identification, writing tools, questionnaires and other materials necessary for the completion of their tasks. The Census will also need to introduce mechanisms to supervise, assist, review and forward the thousands of completed sets of questionnaires to (a) processing centre(s) without loss or damage.

What content the Census is to collect needs to be determined. Once the topics have been chosen, the specific question wording needs to be developed so that the correct information is gathered. Since there is more than one language commonly spoken within the country, questionnaires may need to be developed for (at least) each (major regional) language. Question wording and coding structures need to be designed to:

1. minimize the risk of enumerator or respondent error;
2. minimize response and recording time;
3. facilitate accurate data capture;
4. minimize data capture time and costs.

Once the questionnaires have been set, instructions need to be developed, question by question, to deal with any difficulties that the respondent may have. In addition, more detailed material needs to be developed as input to the content material for enumerator training. This includes not only a clear understanding of what the questions are designed to collect, but also why the questions are being asked and why it is important to provide a response.

The development of a sound operational and content training programme is vital for a quality census because:

1. training is usually delivered in pyramidal fashion, with the headquarters staff training regional staff; (who train sub-regional staff); who train supervisors (there may be more than one level); who, finally, train the enumerators. There is likely to be some loss of information/understanding at each transmission point. The better the training, the lower the impact of that transmission loss on data quality;
2. during enumeration, it will not be easy for an enumerator to get help when an unexpected event occurs. The better the training, the more likely the enumerator will be able to come up with the correct response.

Hiring, training, distributing, equipping and supervising a large number of temporary staff (very large relative to the total number of permanent Census staff) is a logistical challenge that requires careful planning to establish which employment resource pool to tap to obtain enumerators with the correct skills and motivation; government procedures and regulations also add constraints

Census staff needs Having a quality Census is only possible with meticulous planning, adequate resources, committed staff, careful monitoring, good communications and teamwork. The quality of the Census is a summation of the quality of each of its component activities. This means that getting every phase of the Census right is important, if the objective is to produce a high quality Census.

Quality cannot be considered in isolation from cost and timeliness since there are trade-offs between them. The quality of the 2009 Census of Kenya plan will be affected by how well the Census staff can detail the work that needs to be done, the resources (budget, staff, materiel) needed, and the time allowed to accomplish all the tasks.

The Census is only half over once the fieldwork is completed. The information from each questionnaire needs to be captured into an electric form. These data then need to be edited and validated.

Once validated, the statistics need to be organized for dissemination and made available to users.

The final step in the Census process is Analysis. It is during the analysis stage of the Census when shortcomings, if any, in census content, concepts and variable structure and coding come to light.

The Census Quality Assurance Framework is a structure which assesses the design and execution of each step in the census process the sum of which is the quality of the Census.

The sections which follow include a discussion of the items that need to be considered in the conduct of a quality census. Each section will conclude with one or more recommendations which summarize what actions should be considered

2.1 RECOMMENDATIONS

The Census should generate a hierarchical list of census component tasks and designate managers, for each component and project leaders for component parts who are responsible for the successful execution of their component.

Each component and sub-component manager should outline what (s)he intends to deliver/develop/produce; the resources (human, budgetary, materiel) needed to achieve the objective(s); the time constraints and the resource/time trade-off implications.

The sum of these component plans constitute the preliminary Census Plan. From this Census Management can develop the requirements for the Census including budget and the time needed to prepare. It is likely that the first iteration of this plan will have costs greater than the KNBS can hope to obtain budgetary approval for and a time line longer than the preferred Census Date (since component managers are likely to be generous in the estimate requirements to cover unknown contingencies). Census Management needs to review these requirements with each component manager to come up with realistic estimates. This may take several iterations.

This Census Plan should then serve as the basis for a budget request for the Census and the setting of a Census Date contingent on approval of the sums requested within an allotted timeframe.

A census project management, reporting, and monitoring system needs to be set up to provide Census Management with timely information on how well the plan is progressing so that management can make whatever changes are necessary to keep the census on schedule while maintaining quality.

3. DEFINING QUALITY

The quality of a Census or Survey is defined as the degree to which its data is fit to be used for the purpose to which it is put. A Census is used for many purposes but the main categories are for socio-economic concerns particularly at the local or small area level or for comparison among different areas or sub-populations within the country. Having high quality data is therefore important for planning purposes; to assess the state of the population, or a part thereof; to identify vulnerable populations for service delivery purposes; among many others.

In a National Statistical Office environment, quality can be achieved by following generally accepted statistical practices; consulting users to determine what kind of information is needed; developing instruments (censuses, surveys, administrative data) to obtain estimates that fulfill these information needs; developing procedures to collect, capture, validate, tabulate and disseminate the data collected; and have processes to ensure that each of these steps are executed carefully and that problems that are encountered are dealt with expeditiously, in a professional manner.

This document details the steps necessary to do this.

3.1 Dimensions of Quality

According to Brackstone (2002), the key dimensions of quality are:

Relevance: providing the data that users need.

Accuracy: the degree to which the information correctly describes the phenomenon it was designed to measure.

Timeliness: refers to the delay between the reference point to which the data pertains and the date the information becomes available..

Access: making it easy for users to get the information they need in a form that is easy for them to use and, if there is a cost, at a price that they can afford.

Coherence/Interpretability: providing users with information about the underlying concepts so that they understand the data they are using and the way it was produced so that it may validly be compared with similar or related data sets (e.g Census education data and Department of Education data).

4. DEVELOPING A QUALITY CULTURE

4.1 Credibility of the KNBS

In 1996, Ivan Fellegi wrote that “credibility plays a basic role in determining the value to users of the special commodity called statistical information. Indeed, few users can validate directly the data released by statistical offices. They must rely on the reputation of the provider of the information. Since information that is not believed is useless, it follows that the intrinsic value and usability of information depends on the credibility of the statistical system. That credibility could be challenged at any time on two primary grounds: because the statistics are based on inappropriate methodology; or because the office is suspected of political biases.”¹

The Government of Kenya passed a Statistics Act in 2006 which changed the status of the Central Bureau of Statistics from a government department to the Kenya National Bureau of Statistics (KNBS), an arms-length agency whose sole function is the production of quality statistics, and managed by a Board of Directors with representation from government, business, academia and non-governmental organizations. This provides KNBS with the means to satisfy Fellegi’s quality prerequisites. It must follow it up by building trust among its user community that its management takes its quality responsibilities seriously.

Within KNBS

A quality culture is not built by just having posters or placards with mission statements stressing professionalism and quality. While these are useful, management must follow it up with actions that demonstrate that professionalism and quality are really important. This is shown by monitoring performance, providing adequate time and resources to support quality production, and recognition of those who strive for excellence.

Among the User Community

The clients of the Census are more likely to accept KNBS’s assessment of its quality, if their interactions with KNBS tend to be positive. They need to be consulted regarding their information needs before the questionnaire content (which questions; how many classes; how aggregated) is finalized. The consultation should also include how, in what format, and in which media, they would like the results to be made available. Since a Census cannot satisfy all information needs, the report outlining the content decisions should also include an explanation of why that content and not other content that was under consideration. The report should also include discussion of alternate information sources and/or follow-up surveys (post-censal surveys of specific sub-populations) that KNBS is planning or would like to undertake to satisfy other legitimate needs.

Among Respondents

Without the co-operation of respondents, quality statistics would be impossible. Respondents need to believe that their participation is valuable and that it will not adversely affect them.

They obtain the former through the advocacy programme instituted prior to the Census date. Endorsement by persons they respect and explanation of what the information will be used for, and the benefits of, Census data are important as is the stressing that their responses will be held in confidence and only released as aggregate statistics.

They must also understand the questions they are being asked and be in a position to provide an accurate response.

Among Stakeholders

The sponsoring stakeholders of the Census (government, donors, other supporters) will need a professional assessment of the quality of the Census as a whole and that of its component parts. This is made available in a quality evaluation report summarizing the debriefing of staff experiences and the results of the PES. This is used to make improvements for the next Census cycle.

4.2 Maintaining Relevance

Statisticians sometimes feel that a Census is so obviously important to the information needs of a country that they need not demonstrate its relevance. This is not so. The relatively high cost and effort needed to conduct a Census requires persuasive evidence to demonstrate that it is worth doing. Fortunately, this is not difficult in countries where there are no alternative sources of consistent, detailed socio-economic data at national, regional and local levels. In association with the results from previous censuses, it provides indications of change by geography, population/sub-populations and topic. It is vital for economic and social planning purposes and demonstrating progress towards national goals and commitments (e.g. MDG and PRSP).

4.3 Professional Execution

A quality culture requires that the Census is carefully planned, adequately resourced, and with clear delineation of responsibilities so that everyone on the Census Team knows what (s)he is supposed to have ready, by which date; from whom they can expect to receive inputs, by which date; and to whom they will turn over their outputs.

While everyone can be expected to do everything possible to carry out her/his duties, unexpected difficulties do arise. As soon as a person realizes that (s)he will have problems in meeting a responsibility that fact needs to be communicated so that

contingency plans can be put in place to minimize the adverse effects of that problem and keep the Census programme ahead of, or on, schedule.

4.4 Motivated Staff

KNBS cannot deliver a quality Census unless its staff believes it is possible to do so; that their contribution is important; that they are capable of carrying out their assignments; and that they have the support of their superiors in meeting their responsibilities.

Good work needs to be recognized and rewarded. Financial rewards are an obvious way of rewarding exceptional performance. However, there are means of recognition that cost very little: plaques or certificates for doing something beyond the call of duty; for making suggestions that improved performance; employees of the week, month and/or year. The recognition of over-achievers needs to be accompanied by supervisors recognizing and helping those employees, who would like to, but whose efforts do not shine as bright, with the means to polish their skills.

4.5 RECOMMENDATIONS

KNBS should review its quality strategy to determine how well it has positioned itself to deliver a quality census programme and how well it is viewed by its stakeholders as to its ability to deliver a quality census programme.

5. CENSUS COMPONENT ACTIVITIES

5.1 PLANNING

Planning a census starts years before Census Day with the development of systems and procedures to support strategic and operational planning as well as coordination and control of the census. The main steps in taking a census include the content consultation process; enumeration area delineation; questionnaire design and production; collection; processing; validation; and dissemination. Each of these processes are inter-dependent. The output of one feeds to another and one's requirements create constraints for others. Structures need to be developed to ensure that constraints are respected and that output flow of each component reaches the next component when needed.

5.1.1 Organizational Structure

An organizational structure is the way the work is divided among personnel to permit delegation of responsibility and authority, and specialization of effort, and to ensure that stated objectives are met. Three widely used organization structures are:

Functional organization structure is a simple hierarchy with each person reporting to a single manager; activities are grouped according to functions performed or type of skills for the purpose of greater efficiency in the use and development of resources.

This structure is usually very effective if the tasks to be performed are repetitive with routine rules and procedures, planning and control methods.

Pure project organization structure is any undertaking which meets a stated objective, consumes significant resources, results in an end product, is a reasonable unit of work to plan and control, and ends at a specific point in time.

This structure puts all resources under the sole direction and authority of the Project Manager. It facilitates coordination and quick reaction among specialists to efficiently achieve on-time and on-budget targets.

Matrix organization structure may be appropriate when many interactions between the functions are necessary or desirable and when time delays or budgetary overruns are undesirable or unacceptable.

This structure overlays a project-based structure (typically a project team) with a functional structure in an attempt to receive the benefits of both designs. In a matrix structure, employees are temporarily assigned to specific project teams, usually no longer than a couple of years. They also have a permanent functional unit, typically known as a “home” division, in which they reside during the project’s life cycle. The result is that employees have two or more bosses—the Project Manager and the Functional Manager, within the matrix structure. The relative degree of supervisory authority of these two managers depends on the specific matrix configuration and their duties. The relationship between the census project teams and the functional organizations, often-called matrix management, is illustrated in Appendix 1 (Census Matrix Organization chart). (It should be noted that this chart illustrates the concept of matrix management and does not show all projects or all participating divisions.) It does not replace a functional organization because all managers still report to their respective functional superiors.

Many National Statistical Offices have chosen to use a matrix organization structure in an attempt to obtain the benefits of both functional and pure project organizations while minimizing costs and weaknesses of each.

It is suggested that KNBS use a matrix organization structure to accomplish its objectives. This type of organization is particularly well-suited for the 2009 Census, a large, complex and multidisciplinary undertaking, which must be accomplished within a well-defined budget in a specific period of time.

Appendix 1 provides a simplified diagram of the 2006 Census of Canada matrix structure. The 2009 Census of Kenya structure may be different in detail but should be similar.

The following is one possible structure:

5.1.1.1 Census Management Committee (CMC)

The strategic planning and monitoring activity for the Census is vested in the CMC which is chaired by the Director General and should consist of senior managers of KNBS who provide technical, operational and administrative support to the Census. It establishes the parameters for the Census; selects the senior Census operational staff; sets targets; monitors performance; and determines courses of action when major difficulties arise.

5.1.1.2 Census Advisory Committee (CAC)

Many national census organizations have found it useful to have a CAC for advocacy purposes. It should be chaired by someone outside KNBS, preferably a nationally respected Census user plus representatives of major Census user communities.

The CAC can help KNBS make difficult choices regarding trade-offs among content, budget and timeliness, and can act as a go-between between KNBS and government/donors; KNBS and the public; and KNBS and respondents.

In some countries, e.g. South Africa, the CAC is given responsibility for quality assurance and the PES to demonstrate the independence of the QA process.

5.1.1.3 Census Manager (CM)

The CM is responsible for the operational success of the Census. (S)he develops the detailed operational plan for the Census; divides the Census operation into phases, projects, tasks, sub-tasks, etc. and delegates responsibility for each of these to staff who accept responsibility for the successful completion of her/his component.

(S)he monitors progress directly and/or through operational committees which are created to expedite inter-divisional co-operation.

5.1.1.4 Project Teams

Project Teams are established for each major component of the Census. Big components may be further subdivided into sub-projects, tasks and sub-tasks so that each bit is small enough for one person, or a group of two or more people, to be given, and accept responsibility for completion with specific resources, within a given period of time.

5.1.1.5 Monitoring

An important part of planning is monitoring to ensure that the objectives of the planning process are being met. The charting of the plan and its sub-plans are critical to ensure that Census Management can be kept aware of how well tasks are going and be able to

appreciate the implications of deviations from the plan for tasks that still remain. This is usually done using software such as Microsoft Project but it can also be done using spreadsheets such as Excel.

5.1.1.6 Planning Tasks and Responsibility Assignments

- get Census approval
- develop Census plan
- estimate budget by component
- get budget approval
- develop advocacy programme
- establish senior Census committees
- establish planning process review and monitoring protocols
- establish monitoring unit and reporting protocols

5.1.1.7 RECOMMENDATIONS

It is recommended that KNBS review its Planning process and strategy to assure itself that the 2009 Census execution will be well structured, managed and controlled.

5.2 ADVOCACY

Given the immensity of the Census task, KNBS needs external support from many quarters to obtain the assistance and co-operation that it needs to produce quality results. A strong Advocacy Programme is needed to facilitate the release of the funds necessary to carry out the Census and to obtain the co-operation of the national government as well as lower government levels; international donors; NGOs; academia; the private sector; and the ordinary citizens of Kenya.

Advocacy is much more than a publicity programme. It is the co-opting of the fore-going to the status of Census boosters.

The easiest community to swing into the support column is the one that consists of existing and future users of Census data. Users know why the Census is necessary and are waiting for the results. They can be co-opted by convincing them of KNBS's determination to improve quality and facilitate access to data.

The user part of the national government (government researchers, policy analysts, programme planners) need Census data, the only source of time series, small area, demo-socio-economic series, to improve programme delivery, carry out detailed research, and demonstrate progress toward goals such as the Millennium Development Goals, etc. Lower levels of government use Census data for internal planning and to demonstrate how things have changed over time and between their area and other, similar, areas in the country.

International donors are likely to appreciate the need for the Census but may need convincing that support for the Census continues to be as important as other national competitors for scarce international aid.

NGOs want Census data to identify vulnerable communities, to which they can direct their assistance, and to demonstrate how their assistance has changed conditions in the decades they have been providing support.

Academia and the education sector is where many Census users are found. To them the Census is a resource to expand their understanding of Kenya and to demonstrate how the education industry is, or is not, fulfilling its mandate.

The Private Sector can use Census data for a better understanding of its internal market and to enhance business opportunities.

The ordinary citizens of Kenya are the main beneficiaries of a successful Census, if the data are used to improve government, NGO, and business, service delivery. Their support is crucial for Census success since they constitute the respondent base. Co-operative respondents, improve data quality and reduce collection time and, therefore, cost.

Everyone expects KNBS to extol the need for, and benefits of, a Census. It is therefore more difficult for them to convince others. However, if the same arguments are made by a third party (someone outside who is a Census supporter), the importance of the Census is much easier to sell, especially if the supporter is someone who is known and respected.

[In Canada, where the Census is conducted every five years, Statistics Canada relies on external advocates to persuade the government to provide the \$300+ million for each Census].

5.2.1 Advocacy Tasks

- Set up an Advocacy Committee;
- Develop Advocacy Strategy;
- Identify real and potential supporters and support groups;
- Gain their support;
- Use supporters to promote the need for the Census;
- Use supporters to convince the sceptics
- Use the Advocacy Committee to independently assess the quality of the Census.

5.2.2 RECOMMENDATIONS

It is recommended that KNBS develop an Advocacy Strategy that harnesses the support of Census advocates to buttress the activities of the Census programme and demonstrate its efforts in the production of a quality census.

5.3 CONTENT DETERMINATION

5.3.1 Content Continuity

The Content Project Team begins by reviewing the concepts, questions and response classes of the previous census(es) to determine which are still relevant and, for those that are, whether changes in Kenya over the decade(s) justify modification.

This is followed up by a review of UN Statistical Division recommendations for questions and question wording for the 2010 round of Censuses to determine whether to add questions or to consider modifying existing questions.

5.3.2 Content Consultation

This information is used as preparatory material for consultation with users. If a Census Advisory Committee exists, it should be consulted first. Its assistance will be useful in consultation with other users.

The output of this team should be a report outlining what was considered; what was decided upon; why some items were not accepted for this Census, and, if possible, alternative ways that such information could be obtained.

5.3.3 Content Testing

Before a final decision is made to include new questions and/or significantly modifying questions from earlier censuses, each of these will need to be thoroughly tested to satisfy the Team that it is possible to collect valid information for that concept from the Kenyan population.

A secondary outcome of testing is to obtain cost estimates for asking each question (and differential costs of alternative wording/coding strategies).

5.3.4 Content Implementation

There should be significant overlap between the composition of the Content Project Team and the Questionnaire Design Project Team and the Edit and Imputation Project Team to ensure that there is continuity of purpose in the development, implementation and validation of Census concepts.

5.3.5 Content Tasks

- assign project manager;
- establish team;
- review previous Census content debriefing and recommendations for improvement;
- develop a consultation strategy;
- consult the user community;

- prepare a report outlining the results of the consultation process and recommend Census content;
- Census Management Committee approves recommendations, or requests clarification or revision (if the latter, the Content Committee decides how to revise its report and resubmits, until CMC accepts);
- other higher approvals, if necessary;
- advise users and other stakeholders of content plans.

5.3.6 RECOMMENDATIONS

The content provides the dividends for census investment. It is recommended that content considerations be given its full weight in KNBS's census strategy. It is an important factor in advocacy.

5.4 COVERAGE

The principal quality objective of the 2009 Census is to cover every resident of Kenya without any omissions and without any duplication. Since there is no frame which lists every Kenyan resident, the only practical alternative is to create an area frame for the country. The area frame consists of a large number of units, usually referred to as Enumeration Areas (EA), which a single enumerator can completely cover in a fixed period of time (enumeration period). EA respect all political and administrative boundaries for which the Census of Kenya is expected to produce estimates.

5.4.1 Quality Control Procedures

There are two main quality control (QC) coverage issues:

(a) Coverage: *Do the EA cover all of Kenya without overlap?*

This can be tested using GIS to generate a map of Kenya from the EA frame file. As a corollary, it can also test if the EA respect all the political and administrative boundaries.

(b) Workload: *Is each EA of a size that a single enumerator can complete her/his assignment within the enumeration period?*

This is a more difficult quality issue to control. EA demarcation errors can be in either direction – too small, so that the enumerator has too little work to do and completes the assignment well before expected; and too large, so that the enumerator cannot complete his assigned responsibilities properly, in the time allotted, without cutting corners.

An enumerators workload is established by the equation $W = n*(H+d)$ (Workload equals the number of household(n) multiplied by the sum of the average household enumeration time (H) plus the average time it takes to get from one household to the next (d). An enumerator in an urban area can cover more households than one in a rural area because of the increased distance between households. At the other extreme, enumeration of densely populated urban slums requires more attention to

ensure complete coverage of households and individuals surviving in ad hoc living arrangements.

If there are too many under-size EA, Census collection costs are too high; if there are too many over-size EA, quality (timeliness or response) will suffer.

The previous Census provides an EA baseline for demarcation QC. Satellite imagery, where it exists for the two Census intervals can help pinpoint areas of growth, and re-listing of high growth areas will permit better demarcation.

Despite the best efforts and experience of staff, under- and over-size EA are inevitable. The goal is to keep the total number small; to recognize over-size EA quickly; and have procedures to support enumerators in over-size EA so that the temptation to reduce workload by cutting corners, is not acted upon.

If a decision is made to split an EA workload into two or more smaller EA units (by adding enumerators), it is important to be able to identify each of these “new” EA by code; to map the new boundaries of each; to transmit these changes to the staff maintaining the EA frame; and for them to ensure that the EA frame is updated to reflect these changes.

5.4.2 Quality Assurance Procedures

When the EA frame is created, it should include a preliminary estimate of population, number of households and number of questionnaires. (The assumptions used when creating the original EA). As the EA bundles arrive for processing and/or as Preliminary Estimates are developed, the observed population, number of households and number of questionnaires are compared to the expected values on the frame. Where there is a significant deviation (e.g 10%) between the two, the EA is flagged for sample QA evaluation.

5.4.3 Coverage Tasks

- Establish an EA demarcation strategy;
- Set up an EA delineation programme;
- Delineate EA;
- Perform QA of EA delineation;
- Establish 2009 Census EA Frame;
- Reconcile 2009 EA Frame with earlier Census Frame(s)

5.4.4 RECOMMENDATIONS

It is recommended that EA delineation be completed with care using the previous census frame as a starting point. Automation of the process using GIS and satellite imagery simplify the quality assessment process.

5.5 QUESTIONNAIRE DESIGN

Questionnaire Design is the operationalization of the Content Development process. Content Development is getting the right census output while questionnaire design is to ensure that that out is collected, coded and data captured correctly.

A quality questionnaire needs to satisfy four conditions:

- (a) It must permit easy and accurate data capture. Since scanning is the chosen data capture methodology, the questionnaire must satisfy the requirements of the hardware manufacturer.
- (b) The questions asked must be adequate to generate the information expected and, as a corollary, the questionnaire must allow the enumerator to enter/code all responses provided.
- (c) A respondent must be able to understand what is being requested and be able to provide an accurate response.
- (d) The questionnaire must be structured in such a way that an enumerator can efficiently ask, and accurately code, all pertinent questions without omission.
- (e) New, complicated, or controversial, questions need to be accompanied by instructions for enumerators and to receive special attention in the Enumerator Training Manual and the Enumerator Training syllabus.

A fifth objective (rather than a condition), that the questionnaire design team should strive for, is to ask questions in a manner that the respondent will accept as important or useful to her/his family/community/region/nation. The longer the questionnaire and/or the more sensitive questions are, the more important it is to meet this objective in order to maintain respondent cooperation and, thereby, response quality.

5.5.1 Quality Control Procedures

All questions, especially new questions (including old questions with new wording and/or categories) should be tested on as diverse a population as possible to ensure that the question that the Census is asking is the same as the question that the respondent thinks (s)he is answering.

One area that does not receive adequate attention in countries whose population includes many linguistic groups, is that of translation. Training is usually done in the official language(s). In areas where a significant proportion of the population speak a local language, enumerators who speak that language are usually hired. However, few statistical offices provide the enumerator with a translation of the questionnaire so that enumerators actually ask the same question, in the same way, within a language area and

across the country. If enumerators interpret questions differently, or were inadequately trained, response bias can affect the quality of those questions.

Ideally questionnaires should be printed in each major language. However, this may affect printing costs and will undoubtedly complicate distribution logistics, especially if linguistic groups are interspersed within a region. At a minimum each enumerator should have a translated set of questions for each of the languages that (s)he is expected to encounter.

Once questionnaire wording is finalized, a data dictionary, which includes every question and every valid response (and its numeric code), needs to be developed. Where there are few valid responses (e.g. Gender, Marital Status), they are all likely to be pre-coded on the questionnaire. Where there are many, (e.g. Place of Birth, Occupation) strategies need to be developed to allow for most answers to be coded without write-in. This reduces write-in coding time, reduces processing costs, and is likely to be more accurate.

Finally, once the questionnaire is designed, dummy questionnaires need to be processed through the scanning hardware to ensure that the information on the questionnaire is captured accurately.

5.5.2 Quality Assurance Procedures

It is important to de-brief enumerators after each Census Test in order to identify weaknesses in questionnaire content and design and/or in enumerator training.

A sample of respondents should be approached to determine:

- their ability to understand the questions being asked;
- their ability to provide an accurate response;
- their comfort level in providing a response (where discomfort is high, query to determine reasons for discomfort and possible means of obtaining the required information by means that are more acceptable).

After the fact Questionnaire Design QA is determined through the PES content quality evaluation and analytical feedback from researchers.

5.5.3 Questionnaire Design Tasks

- Study scanning hardware and software requirements;
- Convert content recommendations into questionnaire format to maximize concept accuracy; minimize respondent resistance; minimize enumerator workload; and minimize data capture operator coding intervention;
- Test alternate question wording and questionnaire design;
- Finalize questionnaire
- Create data dictionary and question codebooks;
- Translate questionnaire into major languages found in Kenya;

- Verify translations;
- Develop enumeration instructions and training manuals to reflect questionnaire content and design;
- Initiate the questionnaire printing and delivery process.

5.5.4 RECOMMENDATIONS

Within the constraints of data capture requirements, it is recommended that questionnaire design be as simple and straight-forward as possible to minimize the likelihood of enumerator bias and response error. This includes using strategies to maximize the use of pre-coded entries rather than having to look up codes and enter them on the questionnaire.

5.6 LOGISTICS AND FIELD OPERATIONS

Logistics is the process by which raw materials (pencils, questionnaires, EA maps, manuals, etc.) are distributed so that each enumerator/supervisor is able to begin work on Census Day and the completed EA questionnaire batch is transmitted to the Processing Centre (plus the tracking system to ensure that everything is working as planned). By extension, it also includes the process of ensuring that every enumerator gets to the appropriate EA.

In some cases (e.g Nigeria), the Census uses existing infrastructure for its logistical process (there is a statistical office in each Local Government Area). This makes planning the logistics easier. In most countries the NSO does not have this depth so the Census has to build the logistical infrastructure from scratch or borrow the structure from other government agencies.

Co-operation ranges from provision of office space, to including the secondment of personnel to use of transportation equipment. While there is usually good-will in working together for a common national goal, difficulties can arise when Census needs conflict with co-operating agency priorities and ambiguities such as who will cover expenses such as fuel, repair and over-time. Such disputes can play havoc with schedules.

To minimize difficulties, it is important that co-operation protocols are clearly spelled out well in advance with the service provider accepting that, for the Census Period, Census needs will be given priority with resolution of unanticipated issues being deferred to a mutually accepted higher authority.

5.6.1 Quality Control Procedures

QC can be assured if there is a detailed Logistics MIS that tracks each logistical component as it passes through each logistical node with real-time transmission of the passage communicated back to the Monitoring Centre. This was done in South Africa in 2001 using bar codes and bar code readers.

Early identification of problems permits rapid response and minimizes the adverse affects of delays locally, and to the Census as a whole.

5.6.2 Quality Assurance Procedures

An evaluation of the impact of the logistical operational problems that occurred, how they were resolved, and their downstream impact on the remainder of the Census operation will provide users with a better understanding of the short-comings, if any, of the data they wish to use.

5.6.3 Logistics and Field Operations Tasks

- Design the Field Organization and Distribution System (HQ, Region, etc.)
- Make accommodation and staffing arrangements;
- Establish distribution nodes and flow arrangements (how information and material are transported from the centre to the periphery via points (nodes) where material is accumulated and re-packaged for further distribution and vice versa for completed questionnaires and returned material);
- Arrange transportation equipment for movement of goods and staff;
- Monitor flows;
- Develop contingency plans for errors in packaging;
- Develop contingency plans for transport breakdowns;
- Hire logistics staff, supervisory staff, and enumerators;
- Organize training of staff including facilities, training material, and trainers;
- Establish re-numeration rates;
- Develop distributed payment procedures;
- Develop payment verification and control procedures;
- Develop security procedures for completed questionnaires, staff and pay.

5.6.4 RECOMMENDATIONS

It is recommended that the Logistics strategy be tested as rigorously as the other components of the Census and that contingency plans be developed for each difficulty that is likely to occur so that the adverse consequences of such difficulties are minimized.

5.7 COLLECTION

Enumeration of a typical EA usually takes one to two weeks and should be uneventful if the enumerator is capable, motivated, well trained, and supplied with all the material needed to carry out the assignment.

Respondents should have been advised by local leaders of the impending Census and encouraged to co-operate (Part of the Advocacy Programme). The enumerator should have

proof of his Census affiliation, be well-groomed, courteous and conscientious in the execution of Census duties.

Enumeration of the EA should start at one corner and be covered systematically, using the EA map provided, to avoid missing dwellings, households, and/or individuals.

Questionnaires should be handled carefully; responses to questions clearly coded; and completed questionnaires closely guarded.

When an EA is complete, the enumerator should review each questionnaire to ensure that the structure codes (geographical codes, dwelling code/household code) and question responses are complete and clearly marked using the pencil/pen provided.

The EA summary sheet should be completed.

The complete package should then be returned to the supervisor.

The Supervisor verifies each EA submitted to her/him is complete.

When all EA are in and verified, a Supervisory Area summary sheet is completed and all the EA packages are forwarded to the next higher collection point.

The Summary Sheets constitute the source material for the production of the Preliminary Estimates.

5.7.1 Quality Control Procedures

Enumerator

As each dwelling is enumerated have some method to record that it has been completed.

Before leaving a dwelling ask if there is anyone living in the dwelling (on a full or part-time basis) who was not listed because the respondent was not sure that (s)he should be included.

Before leaving, quickly scan the questionnaire to ensure that no question, that should have been asked, was omitted.

Before turning in the completed EA, review each questionnaire for completeness, neatness, and legibility.

Prepare the EA Summary Sheet and if the totals were significantly different from what was expected, provide an explanation, if known.

5.7.2 Quality Assurance Procedures

The Supervisor should review each enumerator's returned EA bundle for completeness, neatness, and legibility.

The Supervisor should verify the accuracy of each enumerator's summary sheet.

Each EA bundle collection point should check-off receipt of each EA as it comes in

5.7.3 RECOMMENDATIONS

Adequate training of Supervisors and Enumerators is crucial for a quality collection process.

5.8 DATA CAPTURE

The 2009 Census, like its predecessor, will use scanning as its method of data capture. This is a more accurate form of data capture since it eliminates the human error prone key-entry process. Scanning also dramatically reduces the time it takes for the data capture process.

If the majority of the scanning is OMR (Optical Mark Recognition) the data capture quality should be very high. OCR (Optical Character Recognition) and ICR (Intelligent Character Recognition) can be used to assist in the coding of write-ins for the "Other – specify" classes of some questions and more complex multiple class questions such as Occupation and Industry. Coders look at the capture screen instead of the questionnaire thereby eliminating the manual coding capture step. This process can also include electronic coding manuals or look-up tables further speeding up the coding process and increasing the coding quality potential.

Modern Data capture software permits the specification of logic and consistency edits as part of the data capture process so that many inconsistencies can be identified at the data capture stage and resolved using the information on the scanned questionnaire. This permits imputation using the information on the questionnaire, itself, rather than the less accurate strategies used in earlier censuses.

5.8.1 Quality Control Procedures

Scanning software includes many statistics that can be used for quality control purposes. These can be compiled by page, questionnaire, household, and/or EA.

If edit specifications are included as part of these statistics, very detailed quality control procedures can be specified and elaborate QC statistics generated.

5.8.2 Quality Assurance Procedures

Assuming that the 2009 Census takes advantage of the reporting and editing functions of the data capture process, the Quality Assurance Team will have a great deal of detailed information on the magnitude and type of errors identified and the processes developed to deal with them. This information can be at the EA (and higher aggregations) level, the household level, the person level, the question level, and even by code within a question.

5.8.3 Data Capture Tasks

- Develop data capture technology tender requirements;
- Invite vendors to tender;
- Choose successful vendor;
- Acquire hardware and software;
- Train staff to use equipment for scanning operation;
- Train staff to optimize the quality control capabilities of the scanning software;
- Train staff to optimize the quality assurance capabilities of the scanning software;
- Develop interface between data capture and data processing systems;
- Monitor questionnaire in-flow and out-flow

5.8.4 RECOMMENDATIONS

It is recommended that the data capture team become familiar with the data capture software diagnostic capability to make the best use of its ability to identify (potential) errors at a point in the process where accurate correction is still possible with minimal negative impact on timeliness.

5.9 EDITING AND VALIDATION

The editing and imputation process is traditionally carried out after data capture using inter-person, intra-household information or, if this is not possible, using information from “similar” respondents and questionnaires. This is not ideal but was the only practical way to remove inconsistencies without going back to original questionnaires or respondents for clarification (a time-consuming process that is deemed to be counter-productive on the quality/cost/timeliness trade-off triangle).

With editing moving to become part of the data capture process, it becomes more practical to revisit the assumption that it is impractical to refer back to the questionnaire. All edit failures are flagged as part of EA capture. An operator can review and correct failures of the scanning process to capture available information (most common reasons: mark not dark enough or multiple marks read).

More importantly, the system retains the original data capture situation as well as the correction(s) so that “imputations” are reversible if, for any reason, a determination is made that another course of action is warranted.

5.9.1 Quality Control Procedures

Specify the validity and logic edits, question by question;
Specify the within person and inter-person, intra-household consistency edits;
Monitor edit failures as part of the data capture process;
Establish correction procedures and conditions where no corrective action is to be taken at the data capture stage;
Maintain edit failure statistics
Maintain error correction statistics at the data capture stage;
Maintain edit failure statistics on the post data capture file;
Run the imputation module;
Re-run the edit module and the imputation module until the edit module finds no failed records.

5.9.2 Quality Assurance Procedures

Review the edit failure statistics from the data capture stage and the edit and imputation stage.

Select a sample of questionnaires with edit failures from the raw data capture file and, using analytical staff, re-edit the questionnaires and evaluate the difference between the resulting records and those on the “clean” file. This should provide an edit and imputation quality indicator.

Another method would be to compare the proportion of records (by question, person, households, questionnaire) passed through the edit process in 2009 with the proportion passed through in 1999. [This assumes that error correction during data capture is more accurate and that only difficult edit situations are passed to the edit and imputation phase.

5.9.3 Edit and Imputation Tasks

- Develop structural edits, validity edits and consistency edits;
- Develop programmes to identify failures in structural edits, validity edits and consistency edits;
- Investigate, and make use of, the edit potential of the data capture software;
- Run the data capture file(s) through the edit programme and flag failures;
- Prepare edit failure logs for QA analysis;
- Analyze edit failures and develop imputation strategy;
- Impute edit failures using the imputation strategy;
- Prepare imputation logs for QA analysis;
- Run the data capture file(s) through the edit programme and flag failures again, if any;
- Repeat until there are no edit failures;

5.9.4 RECOMMENDATIONS

It is recommended that the edit diaries maintain separate records of those “corrections” made as part of the data capture edit and imputation process where the correction is determined to be due to an operational failure (mark to faint, more than one mark due to erasure/dirt etc) but that corrective action could be taken with a very high probability of being correct and those which use the traditional edit and imputation approaches which generate statistically acceptable responses.

5.10 DATA DISSEMINATION

Making information available for use is the sole reason justifying the undertaking of a Census. Thus the quality of the Data Dissemination process is just as important for quality assurance as any of the preceding phases. Yet, because it is near the end of the process and money has become scarce, it is the phase that, in the past, has frequently dragged down the quality assessment of many Censuses.

Dissemination requires the same attention to detail as the other Census components. It begins with the user consultation at the beginning of the Census process. Census analysts should understand what information is needed; how it is going to be used; and the best means of providing that information so that it may be used as input for decision making or into the formulation of policies, action plans and assessments.

This consultation process fed the questionnaire content process which was the source of the data on the clean data file.

The consultation process should have demonstrated, to Census data producers, that “users” are not a homogeneous entity who can be satisfied with a single product line or approach.

Most users are not sophisticated data manipulators. They are interested in getting a “picture” or understanding of a specific issue, population or area. They either are unable, or unwilling, to extract nuggets of information from detailed tables. Such users need processed information in the form of graphics and indicators with narrative summaries of results for topics, populations and geographies of interest.

Paper products should be small and focussed as to topic and audience with many small- run publications rather than large multi-faceted tabular publications.

Tabular data should be published in database/DVD/CD format and made available on the internet. This is not only cost effective but also a benefit to analysts since it is in digital form. Data analysts require flexible electronic access to user-specified electronic data. The technology preparation required to provide such services is now well developed and referred to as Data Warehouse software.

5.10.1 Time Series and Trend Data

There is a misconception among staff in some NSO that preceding census data become obsolete upon the release of the latest Census. Nothing can be further from the truth [assuming that the preceding Census(es) were well executed (if not, then they were not very useful even when just released).]. Preceding Census data gain a new lease on life when a new Census is released. They provide the means to assess how things have changed (comparison between two points in time) and what trends are developing (direction of change indicated by several time points). The ability to produce tabulation for a topic using several Censuses adds time as a variable and enriches the data immensely.

Time series requires that the information collected in each Census be comparable (uses same concepts and classes) or be made comparable through re-conciliation.

5.10.2 Quality Control Procedures

Log all request for data and maintain turn-around time information on response to requests;

Record how many requests are:

- (a) Fully satisfied
- (b) Partially satisfied
- (c) Could not be satisfied

5.10.3 Quality Assurance Procedures

Conduct user satisfaction surveys;

Record number of hits on 2009 Census internet pages;

Feedback results of these surveys to the data dissemination operation.

5.10-4 Dissemination Tasks

- Analyze user consultation documentation as input to dissemination strategy;
- Investigate best dissemination practices as input to dissemination strategy;
- Develop dissemination strategy;
- Review Internet design as part of; dissemination strategy;
- Discuss feasibility of implementing data warehousing capability as part of Census dissemination with Information Technology staff;
- Ensure that the Dissemination Office is prepared to handle information requests with rapid turn-around, when results begin to be released;
- Prepare Preliminary Release data from Field feedback process;
- Develop dissemination publicity process;
- Provide data via graphics and indicators so that more Kenyans can appreciate what the results mean;
- Release data in stages so that Census stays in the news;

- Be prepared to offer clients the information they request in the medium and format most suitable for their needs (e.g. paper tables; graphs; electronic tables in ASCII format, EXCEL spreadsheets; via the Internet or on CD or DVD or via FTP, etc.).

5.10.5 RECOMMENDATIONS

It is recommended that KNBS look at the 2001 Census of South Africa as a good model for best data dissemination practices in Africa.

5.11 ANALYSIS

Operational analysis is conducted on the edited census data file to determine if there are any surprising (i.e. unexpected) results from the Census. It is important to do this before the census data is certified as clean and ready to be used for data tabulations and information release. Data surprises can be the result of unexpected trends but may equally be the result of an unanticipated systematic procedural failure in one of the preceding Census operations. The most common reasons are computer programming error(s). Others include enumerator bias (possibly due to a misinterpretation of instructions due to a lack of training or poor training) or respondent bias (possibly due to a misunderstanding of what is being requested or unwillingness to provide the correct answer). Programming errors can be corrected and the tables re-run with no long term ill-effect. Enumerator and/or respondent biases are more difficult to resolve. If the variable quality and/or the quality in a geographic area is seriously compromised, the decision has to be made whether to hold back that information (because it is unreliable/incorrect) or to release it with caveats.

Once the data are released, they are available to the user community for analysis. Where there is a known absence of analytical depth within Kenya, KNBS may be asked, or decide on its own, to produce analytical products to fill the gap. If it does, it should arrange for the output to be refereed by external experts who would assess them for professional competency and objectivity. This is important to maintain KNBS's image of statistical independence and neutrality.

5.11.1 Analysis Tasks

- Establish analysis teams to review tables by subject matter (e.g. Demography, Ethnicity, Migration, Education, Health, Disability, Socio-Economic variables, etc.);
- Encourage Kenya's analytical community to mine the Census data to produce insightful analyses of the demo-socio-economic situation.

5.12 POST ENUMERATION SURVEY (PES)

The PES is the most significant quality assurance programme of the Census. It provides a measure of how well the Census met its objective of complete coverage, as well as measures of the quality of each question.

The PES is a re-interview of a stratified random sample of the Census using the most qualified enumerators and supervisors. The PES may be a repeat of the Census questionnaire, or a subset of the whole questionnaire and is usually conducted within a few months of the Census Period.

The resulting PES questionnaires are then matched, and compared with the same questionnaire from the Census.

The assumption is that PES quality is superior to Census quality because it is a smaller, better controlled, process using better qualified staff.

To be credible, the PES needs to be properly planned, resourced and executed (in order to justify the assumption in the previous paragraph);

It needs to be seen as independent of the regular Census management (because Census management may not wish to have its shortcomings exposed, or even if this is not so, critics may accuse them of such actions);

The results of the PES should be widely disseminated and relevant observations should be included when releasing data to users;

There is no consensus over whether Census data should be adjusted to reflect the findings of the PES (i.e. if there is a 5% undercount, the released final figures are adjusted by that amount). Most national censuses do not publish PES adjusted data. They leave it to the analyst to determine whether it may be a significant factor in her/his study and, if so, what sort of adjustment to make.

An analysis of the results of the PES are an important input into the planning of the next Census.

5.12.1 PES Tasks

- Identify an independent (of the 2009 Census operation) PES Manager;
- Establish the parameters for Project Team selection;
- Select the PES sample (the EA in the sample should not be known to Census staff until after collection is complete);
- Select staff;
- Train staff;
- Conduct the Survey;
- Capture the data;
- Match the raw PES results with the raw Census data, EA by EA, and within each EA, household by household, and person by person;

- Maintain records of discrepancies at the EA, Household, Person, and question level;
- Derive quality coverage indicators at national and regional levels;
- Derive quality indicators at the variable, or variable set level, at national and regional levels;
- Publish the results.

5.12.2 RECOMMENDATIONS

It is strongly recommended that KNBS give serious consideration to the conduct of a quality PES if it wishes to clearly demonstrate the quality of its census effort. To do so it will have to ensure that the funds and staff are available to execute the activity as indicated in 5.12.1.

5.13 DEBRIEFING, DOCUMENTATION AND RECOMMENDATIONS FOR 2019

Since the next Census is not for another decade, it is important to document what went well and where the 2009 Census difficulties were, including suggestions on how to avoid them in the future. This information is fresh in the minds of the Census staff and therefore easy to access. Many of the current Census staff may no longer be involved with the Census, or even KNBS, by the time the planning for the next Census begins. If this information is not documented for posterity, KNBS is likely to repeat at least some of the errors of 2009.

5.13.1 Debriefing and Documentation Tasks

- At the end of every task component (e.g. training, testing, enumeration, assembly, processing, etc.), staff should be asked to comment on the process, particularly on what could have been done better, and how; what was not well explained, problems that arose and how they were overcome;
- Supervisors, as part of their responsibilities, should be expected to prepare a report on what went well, and what didn't; how things could have been done better to improve data quality, and/or to improve timeliness, and/or to reduce costs. This report should be based on their observations plus the comments from the debriefing of their staff;
- A Census Evaluation Team should be established to prepare a Census Evaluation Report from an analysis of the staff debriefings and the PES results. This report should form part of the final Census Administrative Report so that it is readily available for use by the next Census team.

5.13.2 RECOMMENDATIONS

It is recommended that each Manager and Project Leader conduct a debriefing of his team before disbanding it. After de-briefing (s)he should prepare a report of what went well and what didn't, including recommendations on how the task could be better performed in 2019.

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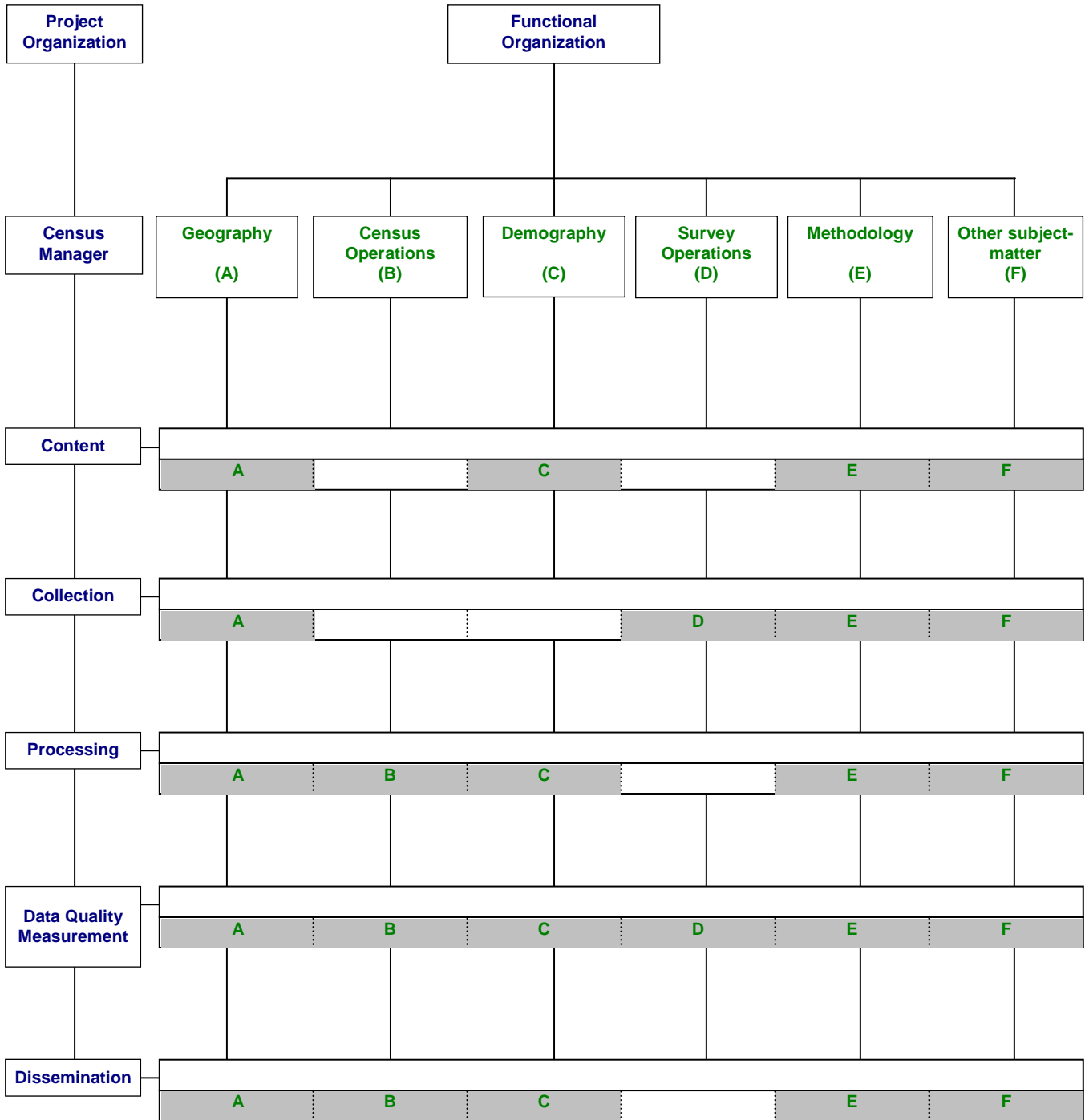
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APPENDIX 1 CENSUS MATRIX ORGANIZATION

(This chart does not show all participating projects or all participating divisions)



Source: Statistics Canada *Census Management Guide*, 2006

APPENDIX 2

ECONOMIC COMMISSION FOR EUROPE CONFERENCE OF EUROPEAN STATISTICIANS

Joint UNECE/Eurostat Meeting on Population and Housing Censuses

Eleventh Meeting

Geneva, 13-15 May 2008

Item 2 of the provisional agenda

CENSUS QUALITY ASSURANCE AND EVALUATION

Census Quality Evaluation: Considerations from an international perspective

The paper was prepared by Bernard Baffour and Paolo Valente (UNECE). The views expressed in this paper are those of the authors and do not necessarily reflect the views of the United Nations.

ECE/CES/AC.6/2008/SP/4

9 May 2008

Original: ENGLISH

Note by UNECE Secretariat

Summary

Regardless of the methodology used and of the measures that can be taken to assure the best quality, the population census cannot be a perfect operation and there will always be some errors affecting the quality of the census results in terms of coverage and content. For this reason, the agencies responsible for the census should always conduct an evaluation of the quality of the census and provide an assessment of the census coverage and content errors. This is particularly important considering the huge resources invested in the census and the key role played by the census results for the national statistical systems and as primary source of statistical data for the countries. Measuring the census quality, however, is not an easy task, in particular when non-traditional census methods are adopted, for which established census evaluation techniques like the Post Enumeration Survey cannot be applied. In this paper, some issues concerning census quality evaluation are discussed for each of the most common census methodologies, considering the implications on the different dimensions of quality. Some considerations are also presented on census quality evaluation from an international perspective, and on the role that International Organisations can play in this field.

I. INTRODUCTION

1. The population census cannot be a perfect operation, and there will always be some errors, regardless of the methodology adopted and of all the measures that can be taken (and should be taken) to assure the best quality in all phases of the census.
2. Different types of errors can affect the census at various extents and at various stages, depending on the methodology. In a traditional census with field operations, for instance, errors can be introduced during data collection by the enumerators/interviewers or by the respondents (voluntarily or involuntarily). When data are processed, errors can be introduced, for instance,

during data coding, entering, and editing. For censuses based on registers, on the other hand, there could be errors in the registers used as data source, or errors could be introduced for instance when data from different registers are linked, or when data are estimated for variables that are not available in registers.

3. In order to deal with these errors, an important component of each census is an appropriate quality assurance and improvement system. This system should be planned as an integral part of the census programme with the primary objective "to ensure that quality is appropriately considered in all phases of the census work"¹. A well developed system should allow identifying on time and addressing most of the problems and errors that can affect the census data. However, there will always be some errors that will not be corrected, and that would eventually affect the quality of the census results, in terms of coverage and content.

4. It is, therefore, very important that the agencies responsible for the census are able to evaluate the quality of the census and provide an assessment of the census coverage and, as far as possible, also of the content errors. A comprehensive census evaluation program, however, should not be limited to estimate coverage and content errors, but should include an assessment of all phases of census operations, in order to provide the users with a complete picture of the quality of the census.

5. The next section of this paper is dedicated to what is generally intended by census quality, and what are the different dimensions of quality that are commonly considered. Section 3 is dedicated to the discussion in general terms of the main measurement issues for each of these quality dimensions. In section 4, the most common census methodologies will be reviewed and the implications on quality evaluation will be discussed. Finally, some general results about census evaluation activities carried out by ECE countries in the 2000 census round will be presented, together with some considerations on census evaluation from an international perspective.

II. WHAT IS QUALITY? WHAT IS CENSUS QUALITY?

6. The realization that *information* lies at the helm of any census it is the end product and the main purpose for which a census is undertaken is pivotal to the formulation of any census quality evaluative exercise. Thus, an assessment of census quality translates into an assessment of the information that is produced by the census. The definition of quality, on the other hand, is fraught with a lot of difficulties. However, the most widely used definition focuses on the fitness for use of the information. In a census context, quality can be characterized in terms of six dimensions, namely: *relevance, accuracy, timeliness, accessibility, interpretability, and coherence*².

¹Conference of European Statisticians Recommendations for the 2010 Censuses of Population and Housing (United Nations, 2006) para. 72.

²These are the six dimensions of quality considered in the Conference of European Statisticians Recommendations for the 2010 Censuses of Population and Housing (United Nations, 2006), para. 76 and Appendix IV. There is likely to be agreement between international statistical agencies on a standard set of quality dimensions later in 2008. The differences between the standard set and the set used here are expected to be minor.

- a) The *relevance* of information reflects the degree to which census data meet the needs of the population, users and stakeholders. As it is impossible to measure every phenomenon, this dimension looks at whether the country's pertinent informational needs are satisfied by the census. The relevance dimension, hence, looks at achieving a balance between meeting the (sometimes conflicting) user requirements and satisfying the most important needs within the confines of constrained resources, which is admittedly not a straightforward task. A particular category of users of census data is represented by international and supra-national organisations. In the ECE region, for instance, for the 2010 census round countries will be requested to provide census data to UNSD and Eurostat. These data, to be provided in the form of tabulations or hypercubes (multidimensional matrices) will allow presenting comparable country-specific census data that could be used for analysis, policy formulation or other purposes.
- b) The *accuracy* of census results is the degree to which the data describe the phenomenon of interest. It concerns the reliability and precision of the population estimates, and is usually characterized in terms of errors. The precise measurement of most phenomena, although ideal, is unattainable due to the fact that no measuring instrument is perfect; thus there is the distinct likelihood of error. However, a concerted effort to quantify the coverage and other errors leads to the production of data of a reasonable quality within the resources available to the national statistical institute. The accuracy achieved will depend on the explicit methods put in place to identify and control for any errors that occur throughout the entire census, from the inception to its fruition. More so, to achieve the most accurate results in a census there needs to be an extensive effort put into the census design, collection procedures and processing. This dimension is linked to the degree of *coherence* and *timeliness* of the information, and oftentimes key decisions taken to improve accuracy will impact on the delivery timescales, and how coherent the outputs are to users.
- c) The *timeliness* dimension refers to the time frame of the census process, and in particular to the interval between the census reference date and the time when the results become available. Evidently most censuses do take a long time even as the results are being disseminated, there is planning under way for the subsequent census but the longer it takes for the national statistical office to release the results the less of a 'snapshot' it is, and questions start to arise as regards the data validity and *relevance*. Even so, it must be reiterated that time must be taken in the post-censal processes so as to ensure that the quality of the outputs are of the best standard (there is a trade-off with the *accuracy* dimension).
- d) The *accessibility* of census data refers to the availability and ease with which they are disseminated to the stakeholders and public at large. Census information is usually disseminated through a mix of free and tailor-made products and services by the national statistical institute. The strategy adopted including the costs of the services and products will influence the degree to which the data is accessible. The census is conducted to meet the needs of various categories of users, including the

central government (that use the data for instance for the formulation of policies and the distribution of resources), researchers, businesses, non-governmental organizations and the general public. As a result, care needs to be taken to ensure that the census data, albeit widely accessible, is also *coherent* and easily *interpretable* so as to facilitate its effective and appropriate use.

e) *Interpretability* refers to the degree to which the information is easy to understand and any salient census results are easily found by the user; in essence this dimension focuses on how the data 'makes sense' to the users. The interpretability dimension of quality, therefore, measures how the data input and the data output relate, particularly whether the responses given answer the question being asked. A detailed pre-testing programme should ameliorate this aspect of interpretability. The other aspect concerns how available supplementary information is that would make the census output easier to understand (i.e. metadata provision). This metadata should explain the underlying concepts, terms, definitions and classifications. Additionally links to papers and publications that detail the methodology and assumptions behind the data collection and adjustment processes should be made available.

- e) The *coherence* of census information reflects the degree to which the census data can be brought together with other existing statistical information. It also concerns the conceptual integrity of the information, which can be assessed by comparing to existing information either through older censuses, or surveys or administrative data. A detailed coherence strategy will consequently have a programme of certification and validation of the data so that it investigates and explains any deviances from the expected trends.

7. These six elements, although suitably distinct may not be mutually exclusive, and actions taken to address one element of quality may have an effect on the others. Accordingly any actions to improve a dimension need to be weighed against any possible detrimental effect this might have on the other dimensions realistically an optimum balance may be achieved by careful appraisal of the effect of each of the six attributes.

III. MEASURING CENSUS QUALITY

8. The evaluation of the quality of the census is a very important exercise for a number of reasons. From the organisational point of view, the evaluation should allow verifying whether the very large effort and investments of resources required by the census was worthwhile. Moreover, the evaluation exercise can help in identifying any aspects of the census organisation that could be improved. This could be particularly useful for planning the next censuses, and improving their efficiency and effectiveness.

9. With regard to the use of the census results, the evaluation allows providing the users with some measures of the quality of the data, which would help them to better interpret the results. This is particularly important considering that census results often serve as the benchmark for the national statistical system and as such they are used for a number of other statistical activities and for several years (usually until the next census data are available). The census is often the main (if not the only available) source of information when it comes to

measuring some particular social phenomena, particularly with reference to small population groups or data for small geographical areas. In certain cases and for certain purposes, the results of the evaluation can also be used to produce adjusted estimates of the total population or other census aggregates, taking into account identified errors. In the UK, for instance, the final census results are adjusted on the basis of the results of the coverage assessment³.

10. Census quality evaluation is important also in fostering confidence in the information produced and as such needs to be an integral part of the census. As aforementioned, the best quality assessment undertakes a comprehensive evaluation of the various phases of census operations. In the following paragraphs, some general issues will be discussed on the measurement of the different dimensions of quality.

A. Assessment of Relevance

11. The programmes and outputs of a national statistics office must reflect the country's most important and pertinent informational needs. The relevance requirements have to be managed to ensure that not only is the most pertinent information being collected, but the manner in which the information is collected is also considered, in order to minimise the burden on the public when it comes to collecting the census data. This can be achieved through methods to assess the relevance of previous census content and to identify any new and potential informational gaps that may appropriately be filled through the current census. This assessment should also look at other sources especially with regards to surveys and administrative sources. The census loses its effectiveness if the public fail to engage with it and so due care should be employed to make sure that only the most relevant phenomena are measured via the census so as to reduce the public burden. Seemingly, the best way of assessing the relevance is through feedback from users as they can provide comments on the adequacy and completeness of the data used in their analyses. The consultative exercises, in addition to aiding in the planning, allow the census authorities to provide a forum on which to discuss, and be responsive to, the needs of the stakeholders. It can also serve to encourage a greater understanding of the census plans and activities. As such the assessment of relevance should include:

- i. client and stakeholder feedback mechanisms to facilitate their active participation in the census processes;
- ii. user and public consultations during the planning process;
- iii. consultation with professional bodies as to the most relevant mode of measurement of different phenomena;
- iv. consultation with other agencies collecting data to review and co-ordinate data collection;
- v. market research on the efficiency of different response mechanisms.

³See: "2011 United Kingdom Census Coverage Assessment and Adjustment Methodology", paper prepared for the UNECE-Eurostat Meeting on Population and Housing Censuses, Geneva 13-15 May 2008 (ECE/CES/AC.6/2008/3) <http://www.unece.org/stats/documents/ece/ces/ge.41/2008/3.e.pdf>

B. Assessment of Accuracy

12. In general, errors can be classified into three major categories: coverage errors, content errors and operational errors. The assessment of accuracy seeks to identify and quantify these errors.

13. Coverage errors are those affecting the completeness of the census count. In practical terms, they include census omissions and erroneous enumerations of units that should not have been counted (typically, in case of double counting). There are a number of ways of quantifying the proportion of omissions or erroneous enumerations. The most common is to perform a post-enumeration survey (PES) which consists of a re-enumeration conducted in a sample of areas within the country. The results of the survey are then compared to the census results for the corresponding areas. This permits estimates to be made of the completeness (in other words, coverage) of the census population count, specifically identifying the proportion of people missed in the census. It can also allow estimates to be found of the proportion of people who have been erroneously included in the census due to being counted at the wrong address.

14. Another way to assess the completeness of the population count is through demographic analysis. Population estimates are calculated in most countries using current vital statistics on births and deaths and on in-migration and out-migration movements (or estimates of net migration). This can provide a basis for judging the accuracy of the census information. The validity of this approach clearly depends on the quality of the population estimates, in particular the data or the assumptions used to estimate the migration (since data on births and deaths are sufficiently reliable in most countries). Clearly, it is normal that there will be some differences between the population estimates calculated and the actual census results. However, if the difference is considerable, or if there are glaring divergences in the sex ratios or for specific age cohorts, then they could be due to problems in the quality of the census data. An alternative way to assess the completeness of the census population count relies on comparing the census results to data from other alternative sources, for example administrative registers. The comparison can be conducted at the aggregate or individual level. Also in this case, the validity of the approach clearly depends on the quality of the data used for the comparison, in this case the registers.

15. The second type of errors is content error, which includes the incorrect reporting or recording of the data, and also errors caused by the non-reporting or non-recording of data. The errors may be caused by a variety of factors non-response, enumerator or interviewer effect, recall effect, mode of measurement effects etc. Many of these errors could be avoided by adequate care in the design and implementation of the methodology used to collect the census data. Additionally, national statistics offices normally develop an edit and imputation strategy with the aim of resolving any inconsistencies and providing estimates for the missing data (at least for basic variables) and as part of the data processing phase. The editing process irons out any inconsistencies while the imputation process fills in some or all of the missing information. Doing this has the advantage of producing a set of consistent complete results.

16. The third type of errors is operational error, which result from the day-to-day processes of the census. Operational error can be difficult to quantify, and more often will be less of an issue when compared to the coverage and content errors. Some types of operational error are

data capture error, coding error, tabulation error and classification error. Evidently, the operational error can be minimized if there is a rigorous review of all the processes that make up the census from the initial pre-census activities of consultation, planning, development and testing of the census methodology, to the actual census processes of enumeration and data processing.

17. All these errors coverage, content and operational are interlinked. Clearly, a poorly implemented census will be susceptible to operational error, and will fail to adequately count everyone correctly, leading to coverage error. Further, the impact of a high proportion of coverage error is to lead to a lack of suitable donors with complete data than can be used for the edit and imputation algorithm and this will inadvertently introduce more content error.

C. Assessment of Timeliness

18. The timeliness of the release of census data is an issue of concern to many users. There is often a trade-off between accuracy, coherence and interpretability, but more so in terms of relevance. It goes without saying that the more timely the release of the census, the more realistically pertinent the information is to the phenomena it has been commissioned to measure. Hence, the timeliness can be assessed by various aspects:

- i) the realistic setting of targets relating to the release of the data;
- ii) announcing in advance the release dates so as to manage user expectation;
- iii) setting realistic targets for customized products and ad hoc services provided to users who require non-standard outputs or additional analyses;
- iv) the dissemination schedule should be made clear to users in advance, and they should be made aware of the differences between the planned outputs;
- v) if there are plans for specific census outputs to be released at different time periods (for instance, preliminary and final results, or regular updates of certain variables),

then the time schedule and costs associated with the release of the updates should be detailed.

A. Assessment of Accessibility

19. The benefits of a census are increased exponentially if the results are made widely available. This will also increase awareness of the usefulness of the census, and therefore contribute to improve participation in future censuses. There are a number of issues to be considered with regard to the evaluation of accessibility:

- i) there should be a wide scope of free and priced products and services available;
- ii) the products and services should be in different formats and designs to cater for all the cross-sections of the population, e.g. the blind and partially sighted;
- iii) for chargeable products and services, the prices should be kept at a minimum in particular for general products, that should be affordable to the general public;
- iv) consultancy services and specially commissioned products could be offered to users who want detailed analysis, against payment of the corresponding costs;

- v) sets of census microdata should be available to selected categories of users, taking appropriate measures to ensure data confidentiality;
- vi) the availability of a dedicated website is an important factor for data accessibility;
- vii) the provision of a dedicated customer service is also important to assist the users to find the data they need and to answer any queries, particularly in the period shortly after the release date;
- viii) client feedback on the different products and services should be monitored so as to make improvements and inform future census dissemination.

B. Assessment of Interpretability

20. The assessment of interpretability is closely entwined with coherence, and it can be observed that a meticulous coherence strategy will assist the interpretability of the census information. However, the primary concern of the assessment of the interpretability is the level of provision of additional information (mainly through metadata) to facilitate the understanding and aid usage of the statistical data being disseminated as well as demonstrate transparency. The metadata required for the census is therefore dependent on both the information and the context of its use.

21. Concerning metadata, in accordance with the SDMX Content-Oriented Guidelines⁴ we can consider two main categories: reference and structural metadata. Reference metadata refers to the additional information that provides descriptions of the actual contents (for instance the concepts and methodologies used), the general administration, execution and dissemination of the census (for instance the operations, procedures and other systemic processes). The information provided about the quality assessment activities is also an aspect of reference metadata. The structural metadata meanwhile refers to the additional information that aids the look-up of relevant information, so concerns things like indexes, categorizations and keys that users can consult when looking for particular pieces of census information (bearing in mind that there is often an incredible amount of output disseminated as part of the census).

22. The evaluation of interpretability can be based on:

- i. comprehensive provision of concise and relevant metadata, including information on the methodology used in the data collection and processing, particularly if sampling has been employed clear;
- ii. details of any new elements or changes that may have taken place since the previous census, and that may affect comparability between current and past census results;
- iii. clear and complete explanation of new concepts, in particular if new questions are included in the census for the first time;
- iv. clear statement of any limitations to the released data;

⁴Statistical Data and Metadata Exchange (SDMX) is an initiative by international organizations to facilitate the standardized exchange of statistical information. The SDMX Content-Oriented Guidelines are a key standard for the harmonized dissemination of statistical data. See: http://sdmx.org/wp-content/uploads/2008/02/sdmx_content-oriented-guidelines_draft_february_2008.pdf

- v. summaries of key findings with directions to where to find relevant data, in consideration to the fact that the census contains a wealth of information, which can prove to be daunting to users;
- vi. availability of a glossary describing underlying concepts, methodology, definitions, variables, classifications;
- vii. details of the quality assessment should be made available to users.

F. Assessment of Coherence

23. There are two aspects to the assessment of the coherence dimension of the data quality; namely internal coherence and external coherence. The data is internally coherent if the whole census results are consistent within themselves. In order to have internally coherent data, a number of verification and validation tests should be carried out prior to the dissemination. Particular care should be paid to the possible impact on internal coherence of the data imputation and editing processes, which have a direct impact on changing the data. For these processes, verification tests should be complete, in the sense that they should cover all operations. For other processes that may not impact on the data, sample verifications could be sufficient, especially if a continuous quality assessment programme was implemented. Validation tests are evaluative exercises that analyze planned tabulations of the census data to ensure that there is consistency. This is especially important when there are perturbations added to the final tabular counts due to disclosure control. Validation tests should compare the totals, frequencies and distributions produced. Particular care should also be taken in the aggregation of small areas to make sure that relations between variables or sets of variables and relationships between domains are kept.

24. Furthermore, a number of external checks to the current available data will ensure that there is external coherence in the data. The census information, after imputation and editing has been completed, will have to be checked against prior censuses so as to identify any incongruities. Additional checks of external coherency can be carried out based on comparison of census results against other statistical information either from surveys or administrative sources administered by the national statistical office or other external bodies.

25. The assessment of the coherence could include:

- i. the conduction of verification and validation tests undertaken before dissemination of the data;
- ii. clear indication of definitions, concepts, frameworks and classifications to be used for the census in a consistent way;
- iii. for concepts, definitions, classifications for which international standards exist, these should be adhered to in order to foster international comparability;
- iv. an adherence to standard classification of variables and tabular derivations, with explanative text for any reclassification and retabulation;
- v. the use of common question formats so as to make it easier to compare to other surveys ideally the questions should keep the historical formulation to facilitate longitudinal comparisons;
- vi. details of any unusual trends spotted or inconsistencies in the data.

IV. CENSUS QUALITY EVALUATION FOR DIFFERENT CENSUS METHODOLOGIES

26. The preceding section covered the different dimensions of data quality and presented a general overview of how they can be assessed within a census. However, the methodology adopted to conduct the census clearly influences the assessment of the different dimensions of census quality. This aspect is particularly relevant considering the increasing number of methodological approaches that have been developed in the recent years, particularly in countries in the ECE region. The present section reviews the main methodological approaches to census, and for each of them discusses some issues related to the assessment of the different dimensions of quality.

27. It should be stressed that the methodological approaches considered in this section have been defined in broad terms for the purpose of this paper⁵, and they should not be considered as an exhaustive list of possible census methodologies. Some countries may conduct their census according to variants or combination of these methods, or develop other methods not discussed here.

A. Traditional census - Quality assessment issues

28. The traditional census is intended here as the field enumeration of all individuals at a given moment with exhaustive collection of all characteristics or the collection of selected characteristics on a sample basis (long form/short form). The questionnaire is compiled by the respondents (self-enumeration) or by a census interviewer.

29. The different dimensions of quality and how they come into play in a traditional census are discussed in the next paragraphs.

Relevance

30. In the traditional census, the content and design of the questionnaire plays a central role in determining the relevance of the census. With regard to the selection of topics to be included in the questionnaire, user requirements should be considered taking into account the criteria that census topics should meet, and the limits in terms of costs, number of questions and burden on respondents⁶. Whenever alternative data sources may provide relevant data, their use (instead of the census) should be considered so as to reduce the burden on respondents.

31. With regard to topics that have been included in the questionnaire, the assessment of relevance should take in consideration the following issues:

⁵A more detailed discussion of the methodologies as well as their relative advantages and disadvantages is presented in the CES Recommendations for the 2010 Censuses, in Appendix II.

⁶The criteria for selection of census topics are discussed in the CES Recommendations for the 2010 Censuses, paras. 23-28.

- i. questionnaire responses should reflect accurately the phenomena under investigation;
- ii. post-census consultations with the stakeholders should inform whether the data received meets their needs;

Accuracy

32. In determining the level of accuracy for a traditional census, the following issues should be considered:

- i. the assessment of coverage is usually conducted through post-enumeration surveys (PES) - an essential requirement is that the PES is undertaken by a different group of field staff than those that participate in the initial census field enumeration;
- ii. differential undercount should be assessed through a breakdown of the coverage achieved by geography and key demographic variables;
- iii. the question non-response rates and proportion imputed should be reported;
- iv. for countries that use sampling (long form/short form), the sampling error associated should be included in the operational error -; the sampling design and frame should also be assessed, as census incompleteness could be due to frame deficiencies;
- v. the assessment should cover the management of outsourced activities, including adequate contingency provision against failure;
- vi. the assessment should cover errors inherently introduced through the design, collection or processing and corrected for, so that they could be reported.

Timeliness

33. The timely release of the census output is frequently difficult to achieve in a traditional census due to the size of the operation, which may cause unexpected delays for instance in the data entry or data processing phases. Although all efforts should be made to respect the planned release dates, this should not lead to compromised accuracy, and the over-riding factor should be to disseminate data of the utmost quality.

B. Register-based census - Quality assessment issues

34. In a register-based census, data are taken from a number of registers linked to each other, and there is no collection of data specifically for the census. Census results are produced using the method of register estimation, in which registers are used simultaneously to define for each statistical unit the value of the relevant variables. This approach has a number of advantages, including the reduced costs once the system has been set up, the fact that there is no additional burden on the public, and the possibility to produce census data with high frequency (in Finland, for example, register-based census data are produced annually). On the negative side, a register-based census relies solely on the information currently available in registers, and its quality depends largely by the quality of the registers. The universality of the register-based census

could also be problematic, unless there is a detailed coverage assessment undertaken to ascertain how well the census enumerates the population in its entirety⁷.

35. There are a number of quality assessment issues that need to be borne in mind as they explicitly affect register-based censuses. These are discussed in the next paragraphs, with reference to the various dimension of quality.

Relevance

36. In a register-based census, the relevance dimension is particularly important and critical for the overall quality of the census. In fact, there is no census questionnaire and the census can only provide data on topics that are covered in the registers considered. This may have an impact on the census relevance, for instance if some census variables are not available in the registers, or are available but do not reflect accurately the users' needs, because they may be based on different concepts or definitions.

37. In assessing the relevance of data from a register-based census, the following issues should be considered:

- i. consultation and feedback from users and other stakeholders is important also for register-based censuses, even though the mechanisms may be different from those of a traditional census, since there is no census questionnaire to develop;
- ii. during the consultation with users and public in the planning phase, considerations should be given to how to best meet their information needs using the data from available registers taking into account their characteristics;
- iii. data from registers in most cases are not primarily intended for statistical use, therefore the relevance of the variables should be investigated in detail, in particular when various registers are used for the same variable;
- iv. the interaction and collaboration between the National Statistical Office and other agencies and departments responsible for the various registers to be considered in the census is of primary importance.

Accuracy

38. A properly maintained register can provide very accurate data, but registers in their very nature are susceptible to some errors that need to be taken into account. As such the coverage of the register-based census could be incomplete, and so like the traditional census a coverage assessment should be carried out to ascertain the coverage errors (especially the erroneous enumerations). Moreover, register based statistics obtained from different geographical areas may have varying degrees of accuracy due to the differences in administration, database management and so on.

39. The coverage and quality of the registers used for the census clearly play a fundamental

⁷More information on register-based censuses is available in the publication "Register-based statistics in the Nordic Countries Review of best practices with focus on population and social statistics", prepared by the Nordic Countries and published by UNECE (2007)

role in determining the accuracy of the census results. However, it is also very important to assess the way data from the different registers are integrated. In this context, the analysis of the matching rates (direct matching, statistical matching, and overall matching rates) can provide useful information to assess accuracy. For topics on which information is taken from different registers, accuracy could be assessed also by indicators measuring the consistency of values from different sources⁸.

Timeliness

40. In principle, it could be expected that register-based censuses produce results in a timelier manner compared to traditional censuses because high labour intensive and time consuming operations like field data collection or data entry are not required. However, there are a number of complex procedures that need to be implemented to link the various registers and produce the census data. Moreover, the time needed to produce the census variables may vary from one subject to the other, due to different routines for updating the different registers. This may result in some census results to be released timelier and others to be released less timely compared to traditional censuses.

Interpretability

41. The nature of the metadata is significantly different for register-based censuses, and there could be a considerable amount of supplementary information needed to suitably interpret the data. Additional metadata information could relate to the register(s) used, the creation of units and variables in the register, the different sources that make up the register and any changes to the administrative system. The national statistical office should have access to all the metadata from the various registers, and decide which information should be provided to the users to help them interpret the data.

Coherence

42. Internal coherence of register-based census data should be assured in the phase of data integration. Any inconsistencies or ambiguities that are found at that stage should be resolved, by making sure that there is coherency at a micro-level. At an early stage, there should be a harmonization process aimed at bringing together the different registers under one conceptual and definitional framework. This harmonization could extend to other existing non-administrative sources to facilitate external coherence.

C. Census based on registers combined with sample data - quality assessment issues

43. Some countries have registers that could be used to produce census data, but the registers

⁸See para. 26-28 in "Quality assessment of the register-based Slovenian census 2011", paper prepared for the UNECE-Eurostat Meeting on Population and Housing Censuses, Geneva 13-15 May 2008 (ECE/CES/AC.6/2008/6) <http://www.unece.org/stats/documents/ece/ces/ge.41/2008/6.e.pdf>

do not contain all data required for the census, or their quality is not sufficiently good to rely exclusively on them. An option is to integrate register data with results from sample surveys that are weighted to population totals.

44. The Netherlands developed this approach for the 2001 census (known as the Virtual Census) where register data were integrated with results from existing household surveys, namely the Labour Force Survey. Another approach was developed in Israel, where the population register is used as a basis for the enumeration of the population, and an ad-hoc sample survey is conducted to evaluate the accuracy of the information obtained from registers and to collect the traditional long-form census data.

Relevance

45. Compared to pure register-base censuses, this approach may provide more relevant data given the possibility to rely on data from sample surveys, in addition to data from registers.

However, data from sample surveys because of their nature will provide limited geographic and information detail, and this may affect their relevance.

46. There should be a programme review undertaken to assess the relevance of the registers and the sample surveys. Concerning data from sample surveys, in assessing relevance consideration should be given to the fact that they are normally representative only at the national and perhaps regional level, but clearly not for small areas. The sampling design also could have an impact on the results, and possible implications on relevance should be considered.

Accuracy and Coherence

47. Combining data from administrative sources to surveys has the advantage of the promotion of coherence between the different statistical data collection instruments of the national statistical office. For example in the Dutch census a method called *repeated weighting*⁹ ensures that there are no inconsistencies between the table estimates from different sources. An estimate of the accuracy (i.e. the error associated with the production of the re-weighted tables) is given, which facilitates the interpretation of the disseminated output to users. In the Israeli approach, one of the main purposes of the ad-hoc survey is to evaluate the quality of the register data. In this sense, the survey could be considered as a sort of PES for the administrative data.

Timeliness and Accessibility

48. The timely dissemination of census data depends among other factors on the synchronization of the data collection processes of the different surveys used. Once the

⁹Repeated weighting is an imputation procedure, but differs from conventional imputation in that there is not a mass filling of the missing data through the plugging in of attributes of appropriate donors found from the data or other sources.

mechanisms are in place to produce tables by counting from the available register information or weighting up sample information to population totals, the resulting census tables can be made accessible to the general public.

Interpretability

49. Micro-integration¹⁰ could be viewed with suspicion if the methodology adopted is not transparent and no one from outside the national statistical institute will be able to easily reproduce the census results. This may be countervailed by including clear and complete metadata on the characteristics of the different registers and surveys, and the operational processes used to combine and integrate the data.

50. Metadata should also specify which census data are produced from what so that users may be aware of any possible implications to their analyses. For example, data derived from sample surveys may not meet the level of statistical significance or geographical detail required by some census users.

D. Census based on registers combined with full enumeration - quality assessment issues

51. Some countries for their census combine the use of register data with a complete enumeration of the population. As for the previous case, there are two main objectives of this type of census. Firstly, to improve accuracy of the population counts. Second, to obtain census variables that are not available from the administrative sources, or cannot be easily collected through a register. The obvious advantage of an intensive field enumeration of the population - instead of a survey as in the previous case - is that there is less need to worry about estimation, modelling, weighting and other sampling errors. It also becomes possible to check the coverage of the population register.

52. Many of the considerations made for the previous methodology (registers combined with sample surveys) are valid also for this case. However, there are some additional issues that are discussed below.

Accuracy

53. By expectation, the population counts in this approach should be more precise than in a traditional census or a fully register-based census. Unlike in the sample survey-based census where there are questions surrounding small area estimation, this type of census permits maximum geographical and conceptual detail. Further, the register-data is probably better served as a benchmark for the data collected through field enumeration, whilst the fieldwork can be used to cross-check register records.

¹⁰In micro-integration the data from the different data sources (surveys and registers) are integrated at the individual level with the aim of producing a single set of reliable and consistent results.

Timeliness

54. The timeliness of the release of the census data can be affected. This is because a full enumeration of the population, although with a shortened questionnaire, will be a pretty huge and time-consuming operation. It must be remembered that the normal traditional censuses operations (preparatory work, testing, enumeration, processing) will have to be carried out. In addition, these data will have to be integrated and made consistent with the data from the registers.

Interpretability

55. Metadata should provide information the different administrative sources used and on the field enumeration procedures, including how the questions that appeared in the questionnaire were chosen. In addition, a glossary of terms, definitions and concepts should be prepared. Documentation should also cover the micro-integration processes, to help the users to understand how the final data were produced.

Coherence

56. Internal coherency is probably facilitated in this type of census as the field enumeration is used to cross-check the register information and vice versa. Albeit any edit and imputation strategy will be using donors that are expected to be closely linked to the reality because the field enumeration will hopefully yield more donors, this harmonization of the field enumeration to registers is not a simple undertaking.

E. Rolling census - Quality assessment issues

57. The so called "rolling census" methodology consists in a continuous survey covering the whole country over a period of time. In France, where this approach has been implemented since 2005 based on a 5-year cycle, data collection is different for large municipalities, where sample surveys are conducted each year, and small municipalities, where an exhaustive data collection is conducted every five years on a rotation basis. Some issues that arise in the assessment of quality, based on the French approach, are discussed below.

Relevance

58. One of the advantages of the rolling census is that, since data collection is conducted continuously, with annual waves, it is possible to modify the questionnaire in relatively short time in order to provide information on emerging topics. This should contribute to improve the relevance of the census, even though a price may have to be paid in terms of comparability of the results across time.

59. When assessing relevance, it should also be considered that this approach allows

producing annual updates of the results. This is particularly important for phenomena that may evolve relatively quickly in the society, and that would be difficult to monitor through a traditional census that would produce data every ten or five years.

Accuracy

60. There are a number of issues on the accuracy of the rolling census which have been raised. Firstly, in large municipalities the census relies on sample data. In this case, the coverage assessment should cover also the sampling errors associated with the design. Secondly, although care is taken to ensure that the dwellings register used as a sampling frame is kept as up-to-date as possible, some properties will unavoidably be missed, so there needs to be a regular assessment of the frame coverage. In small municipalities, where an exhaustive data collection is conducted, the same issues discussed with regard to traditional censuses should apply.

Timeliness

61. One of the main advantages of this approach is that data collection and processing are distributed over time. This, in combination with the adoption of sampling for large municipalities, should allow producing results in a timely manner compared to other approaches.

Interpretability

62. The concept of a rolling census is complicated - even to statisticians. Therefore, it is particularly important that clear and complete documentation be provided at different levels of detail, for experienced users and the general public. The documentation should explain how population figures that are universal and refer to the same time frame are produced on the basis of the data collected annually.

Coherence

63. External coherence with other censuses could be an issue in a rolling census, in particular in terms of how it meets the different census criteria set in the CES Recommendations of individual enumeration, simultaneity, universality, small area data and defined periodicity. For some of these criteria, like individual enumeration and simultaneity, an assessment of the compliance with the criteria could contribute to a comprehensive evaluation of the external coherence of the census results.

F. Census based on traditional enumeration and yearly updates - Quality assessment issues

64. This method, developed for the first time in the USA, is a variation of the traditional census method with sampling (long form/short form). Here a very large annual household survey (the American Community Survey) provides the detailed characteristics of the population, replacing the census long-form. However, the basic demographic characteristics are still collected every decade through an exhaustive traditional field collection, with the dual purpose of benchmarking and general coverage improvement.

65. The quality assessment issues that affect a census of this kind are pretty similar to those of a rolling census. However, since once every decade there is benchmarked information collected on every individual, the issues of individual enumeration and simultaneity that surround the undertaking of a rolling census are somewhat avoided, at least for the basic short-form information collected.

Relevance

66. As for other methods based on sampling, the recourse to a sample survey (although a very large one) to provide information on the detailed characteristics of the population can affect the relevance of the results, which would not be available for small areas. On the other hand, the annual survey gives the possibility to include in the census new emerging topic, and follow annually the evolution of phenomena that may change rapidly.

Accuracy

67. An issue that could potentially affect accuracy is response rate for the annual survey. In fact, given its very large size (250,000 households are sampled every month), there is the risk that in the long term the response rate could fall. Consideration should be given to what would happen to the accuracy of the continuous estimates if the response falls below the projected levels. Similarly, the risk that households will be sampled more frequently could lead in future to apathy and scarce cooperation by the respondents. Moreover, the estimates of the population produced by the American Community Survey are liable to significantly larger margins of error as compared with the long-form sample in the decennial census. The main reason for this is that the sample used in the continuous survey is much smaller than the decennial census, leading to lower precision of the small area estimates.

Timeliness

68. The distribution over time of data collection and processing, in addition to the adoption of sampling, should allow this method to produce timelier results compared to most other methods. In particular, for detailed characteristics the American Community Survey should represent an improvement over the traditional decennial census in terms of timeliness and frequency.

Interpretability

69. Besides the metadata associated with a traditional census there needs to be information on the weighting scheme used to produce the population estimates, including the sampling mechanism and statistical model assumption. The move from long-form sample data to the continuous survey will have to be supervised properly; particularly the user expectation of what type of data is produced by the American Community Survey will have to be managed. Users will have to be made aware, especially in the initial stages, of the challenges and the impact of producing continuous estimates instead of decennial estimates will have. Clearly, there is an associated learning curve and connected resources required by users to make the transition from

the once in a decade long form sample to the continuous sample of the American Continuous Survey.

Coherence

70. External coherence should be assessed with results from previous censuses. This would allow assessing the possible effect of the methodology on the census results.

V. CENSUS QUALITY EVALUATION ACTIVITIES CONDUCTED IN ECE COUNTRIES IN THE 2000 ROUND

71. As mentioned in section 1, the most common approaches adopted for census quality evaluation are PES, demographic analysis and comparison with data from other sources. Given that the validity of all these approaches depend on the quality of the data used for the comparison (and on the modality with which the PES is conducted), countries usually select more than one method in order to have a more complete and reliable assessment of census quality. In the 2000 census round, more than 60% of the countries in the ECE region conducted two or more evaluation activities (see table 1). The data collected by ECE show regional differences: most countries in the European Union and some in South East Europe conducted coverage PES. In Eastern Europe, Caucasus and Central Asia (EECCA), instead, census evaluation is conducted mainly through field re-interviews.

Table 1. Number of evaluation methods used in ECE countries in the 2000 census round

Number of evaluation methods	Number of countries
Only one method	9
Two methods	13
Three methods	6
Four methods	6
Five methods	3
No evaluation activities	7
Total	44

Source: UNECE survey, 2004.

72. Demographic analysis and comparison with other sources were the most common evaluation approaches in the 2000 round, adopted by about half of the countries (23 out of the 44 that reported this information to ECE). PES was adopted by 20 countries to evaluate coverage, and by 12 countries to evaluate quality (see table 2)¹¹.

¹¹Source: UNECE survey on national practices in the 2000 census round (conducted in 2004). More information is available in "Measuring population and housing Practices on UNECE countries in the 2000 round of censuses" (forthcoming publication, United Nations), also available at: http://www.unece.org/stats/publications/Publication_on_2000_censuses.pdf

Table 2. Evaluation methods used in ECE countries in the 2000 census round

Evaluation method	Number of countries (out of 44)
Quality PES	12
Coverage PES	20
Demographic analysis	23
Field re-interviews	14
Comparison with external data	23
Other method	2

Source: UNECE survey, 2004.

73. The countries that took in 2000 a pure register-based census did not conduct any evaluation, or conducted a quality PES or comparison with external data. Among the countries that took in 2000 a census based on registers combined with full enumeration, in general several evaluation methods were adopted, including coverage PES, demographic analysis and comparison with external sources.

VI. CENSUS QUALITY EVALUATION: CONSIDERATIONS FROM AN INTERNATIONAL PERSPECTIVE

74. As the results presented in the previous section show, there is a wide variety of approaches to census evaluation across the various countries. Several countries in Western and Central Europe and North America have a long tradition of census evaluation, which is often conducted using a number of different methods including a PES aimed at evaluating coverage and quality. This group includes mostly countries with traditional census, with an increasing number of countries that are moving to alternative approaches based on the use of register and other sources. The countries with register-based censuses, in general, have limited evaluation programs, often restricted at evaluating the quality, while evaluating coverage seems to be more complex. The EECCA countries, with traditional censuses, have limited evaluation programs based mainly on field re-interviews, a method that does not provide accurate information on census coverage and quality.

75. International organisations have been increasingly promoting among member countries the importance of census evaluation and the adoption of adequate evaluation programs. The new CES Recommendations for the 2010 round of censuses cover census evaluation in detail for the first time (see paras. 83-88 and Appendix V).

76. In the EU programme for the 2011 censuses, census evaluation is given an important role. The EU Framework Regulation on Population and Housing Censuses (in the version currently being discussed by the European Parliament and Council) includes an article explicitly dedicated to census quality. The Eurostat Task Force on Census Legislation, among other tasks, is working to identify criteria to assess the quality of the next round of censuses.

77. The work on the quality reports being conducted at EU level in view of the 2010 round of

censuses is particularly important because it is probably the first time that there is an attempt to assess the quality of census data at the international level. On the other hand, this initiative is challenging from the methodological point of view, considering that a large number of countries is involved in the exercise, including a very broad range of census methodologies, including traditional census, register-based census, rolling census etc. The methodological work that is being conducted at the EU level could be beneficial also to other countries, because it could provide a useful standard for census quality assessment.

78. There is another role potentially very important - that could be played by international organisations in the field of census evaluation: produce and disseminate guidelines and methodological material on evaluation methods, and possibly collect information from countries on how evaluation was conducted (methodology, results, etc.). As shown in this paper, in many countries where the census is conducted in a traditional way there is limited experience with census evaluation, and clear demand to increase knowledge and build internal capacity. Manuals, guidelines and possibly other tools could be developed at the international level to share knowledge on census evaluation methods, in particular Post-Enumeration Surveys. The United Nations Statistical Division (UNSD) has plans to prepare a handbook on evaluation and PES. This is an important initiative to be supported, but other initiatives could also be promoted to develop methodological material on census evaluation methods applicable to alternative census methodologies, including those discussed in the present paper.

VII. CONCLUSIONS

79. No census is perfect and, regardless of the methodology adopted, the results will always contain some errors, caused by a number of factors. These errors may affect in different ways the coverage or the quality of the census data. For this reason, a comprehensive evaluation program should be planned as an integral part of the census, aimed at assessing the quality of the census process as well as the results. In this way, users will be provided with some measures of the quality of the census data, which will help them in interpreting the results. The results of the evaluation could also be used to adjust the census results, as it is done in some countries, in order to provide the best estimates on the size and characteristics of the population.

80. Measuring census quality, however, is not an easy task. There are a number of methodological issues and challenges in the measurement of the different dimensions of quality. Moreover, many of these measurement issues depend on the census methodology adopted, and in the ECE region there is a wide and growing variety of methodologies.

81. This paper tried to review and discuss some of the main issues in the measurement of census quality, considering the specificities of different census methodologies. The discussion, clearly limited in scope, showed how complex evaluating the census can be, especially for countries that adopted census methodologies for which traditional evaluation methods do not easily apply.

82. There is clearly need to develop and disseminate methodological material on census

quality evaluation. On one side, for some established evaluation methods - like PES - guidelines should be developed to facilitate the implementation in countries that have no or limited experience. On the other side, work should be promoted to develop evaluation methods applicable to the new census methodological approaches. This could be done by adapting or improving existing evaluation methods, or by developing new ones if necessary. In this context, the international organisations may play a coordination role, to promote methodological developments and facilitate the transfer of knowledge among countries.
